

Article

Relevance of Skills in Total Quality Management in Engineering Studies as a Tool for Performing Their Jobs

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Abstract: The Spanish higher education system needs to adapt to the requirements of the European Higher Education Area and to this end, it is necessary for higher education institutions to improve the quality of university education, leading to an increase in competency-based learning activities aimed at developing the skills of graduates. Since university graduates face a large number of requirements when entering the labour market, they need to develop and constantly update the appropriate skills to carry out their work properly. This paper aims to address two fundamental questions. First, do engineering graduates need acquired skills in Total Quality Management (TQM) to perform their jobs successfully? Secondly, which job profile requires the highest level of Total Quality Management training and knowledge? We carried out different multivariate statistical analyses using a sample of engineering graduates who had been in the labour market for two years. The results show that knowledge of this type of management philosophy is necessary for adequate job performance. The job profile requiring the highest level of skills in TQM is described.

Keywords: total quality management; training and skills; competence; graduates; higher education; labour market

1. Introduction

The idea of competence-based training (CBT) has been widely researched in recent years, mainly relating it to business excellence models (BEMs) [1–8]. Nowadays, supervisors or employers of graduates must be able to decide when a graduate may be trusted to bear the responsibilities of performing a professional activity, given the level of competence they have attained. They must also be able to identify the competencies or skills required of university graduates by the labour market and, moreover, the impact they might have on a company's success. Hartog (1992) defines competencies as the talents, skills, and capabilities of higher education graduates contributing to multi-factor productivity gains [9]. Graduates, especially those who have studied a branch of engineering, face many different demands during their transition to the labour market, and there are often mismatches between the skill levels obtained by graduates and those required in the workplace. Universities are increasingly required to produce highly skilled graduates who are able to respond to the ever changing and complex needs of the contemporary workplace [10–13]. This problem is rooted in the continuing changes linked to the new knowledge-based society, characterised by intensive use of information and communications. Nowadays, graduates are not only required to have developed the right skills to perform a job, but also to periodically update their skills to meet the constantly changing requirements and needs of organisation. A gap has appeared between the

skills and capabilities of graduates and the requirements of the work environment in an increasingly mobile and competitive society [14,15].

Currently, one of the keys to a successful company is business excellence models (BEMs) based on quality. Moreover, with rapid globalisation, quality has become a key factor in determining the success or failure of a company in the global market. However, it is not easy to define quality, since it implies the acquisition of different skills and capacities. There is an extensive bibliography with reference to this concept. The American Society for Quality Control (ASQ) (1974) defines quality as “the totality of characteristics of a product or service performed or made according to specifications to satisfy customers at the time of purchase and during use”. Many companies worldwide have emphasised quality as an important strategic dimension. However, adopting a quality assurance system may not be sufficient if there are no continuous improvement projects [16]. In this context, Dean and Bowen [17] defined Quality Management (QM) as a philosophy consisting of principles, practices, and tools that include, according to Hellsten and Klefsjö [18], principles or values such as customer focus, continuous improvement, and fact-based decisions. In this sense, sustainability considerations can be seen as a customer requirement [19]. Siva [19] stated “that existing QM practices such as collecting information concerning customer needs should be applicable in identifying the environmental requirements of products, in addition to other customer requirements”.

Changing customers’ needs have largely led to increasingly changing markets. In this regard, most organisations that have been successful in their efforts to improve quality have adopted an integrated approach commonly known as Total Quality Management (TQM). Total Quality Management (TQM) is a philosophy and a methodology that is widely used in business, and increasingly in education, to manage change or other processes [20], and contributes to the sustainable development of businesses, as evidenced in the literature review developed by Siva [19] about the connection between QM and sustainable development. Berry [21] defined the TQM process as a total corporate focus on meeting and exceeding customers’ expectations and significantly reducing costs resulting from poor quality by adopting a new management system and corporate culture, and Curry [22] argued that sustainability becomes a key factor for it to be successful. TQM was developed as a critical determinant in the success and survival of both manufacturing and service organisation [23] and as a source of competitive advantage [24–26] and innovation [27].

The adoption of TQM culture might be a determining factor in the success of companies, whereas Curry [22] argued that “without sustainability there is little benefit to be gained from TQM”.

However, there is no a clear definition of sustainability and the relationship of the term of sustainability and the triple bottom-line (TBL): economy, society, and the environment. The Association for the Advancement of Sustainability in Higher Education (AASHE) defines sustainability in a multidisciplinary way, covering different aspects related to social, environmental, and economic performance. In 2008, AASHE released a transparent, self-reporting framework for colleges and universities to measure their sustainability performance called Sustainability Tracking, Assessment, and Rating System (STARS) which attempts to extend this broad and multidisciplinary perspective of sustainability to the campus level.

The awareness that human development may not be sustainable by the Earth is directly linked with other terms: environmental protection and societal development, political implications, and human rights.

Nowadays, different studies are appearing to explore the suitability for business excellence models (BEMs) to address corporate sustainability [28–32], to contribute to the development of sustainable quality management as an integrated management of quality and sustainability, that supports lifestyle based on sustainability and sustainable development (SD). In this sense, Lagronse and Lagronse [32] stated that a crucial challenge that organisations face today is to create a strong culture based on quality. This is necessary, since the organisational culture influences the degree to which creativity, sustainability, and innovation are stimulated in an organisation.

Nevertheless, there is a lack of information about the level of TQM required for graduates, and even more so when applied to companies of different sizes (large and small or medium) (SMEs) [3,33–

42]. Furthermore, no attempt has been made nor measures suggested related to the need for organisational quality management for different areas or job profiles, such as top management leadership, training, or employers.

The aim of this study is to determine the level of TQM training and knowledge needed by engineering graduates to perform their jobs properly after joining a company, as well as to define the main aspects to be taken into consideration. This paper's primary focus is to answer two fundamental questions. Firstly, do engineering graduates need to acquire skills competences in TQM to carry out their future jobs? Secondly, which profile requires the most TQM training and knowledge? To answer both these questions, the following five specific questions are formulated: (1) When a university graduate is hired, what level of TQM knowledge is required? (2) What type of business sector requires the highest level of TQM knowledge? (3) Which jobs require the highest level of TQM training and knowledge? (4) Is the demand for TQM knowledge influenced by management responsibilities and the financial rewards of the job? (5) What relationships exist between TQM knowledge and other knowledge areas related to business management?

The rest of the paper is structured as follows. Section 2 gives the theoretical background of our research. Section 3 introduces the sample, database, and statistical analysis, Section 4 describes the main results and findings. Finally, Section 5 gives the main conclusions of the paper.

2. Theoretical Background

Total quality management originated in the U.S. in the 1980s, when Hewlett-Packard criticised U.S. chipmakers for producing products of a lower quality than those made by their Japanese competitors. It is ironic that when W. Edward Deming first introduced TQM, the Japanese adopted his philosophy, while the U.S. rejected its principles. During the following years, the Japanese successfully improved quality and production by adopting the TQM principles of Deming, Joseph M. Juran, and Genichi Taguchi, among others.

TQM refers to the wide range of management and control processes designed to lead the entire organisation and its employees to do the best job possible so as to supply products and/or services that satisfy the customer. According to [30], TQM means that the culture of the organisation is defined by and supports the constant attainment of customer satisfaction through an integrated system of statistical tools, techniques, and training. This involves the continuous improvement of organisational processes, resulting in high quality products and services. Thus, the TQM management philosophy is customer-focused. All members of an organisation implementing TQM strive to find a way to systematise the improvement of the organisation through the ongoing participation of all its employees. TQM incorporates the concepts of product quality, process control, quality assurance, and quality improvement.

Total Quality Management (TQM) is a management philosophy that encourages cost reduction, the creation of high-quality goods and services, customer satisfaction, employee empowerment, and the measurement of results. It is an all-encompassing dynamic process in an organisation that promotes never-ending improvement in the effectiveness and efficiency of all elements of a business [40].

Profitability, productivity, customer satisfaction, and product quality are the natural outcomes of TQM. It is an enhancement of the traditional way of doing business. It became a strategic priority for business around the world because it could demonstrate its significance in achieving and maintaining a competitive advantage in the manufacturing and service sectors. Bersterfield [41] analysed the following three elements of TQM: (1) Total—comprising the whole. Total implies that everyone in the organisation should get involved in Quality Management (QM) and every aspect of the organisation's business or activities should be subject to QM; (2) Quality—degree of excellence a product or service provides; (3) Management—actions, the art or manner of handling, controlling, directing, etc.

3. Research Methodology

3.1. Sample

This research was carried out using a graduate employability survey conducted at the Universitat Politècnica de València (UPV) on graduates two years after they completed their university studies. Therefore, these graduates have been in the labour market for approximately two or more years and know the requirements for their job in detail [42].

The total sample was comprised of 1340 graduates of different nationalities thanks to the high number of international programmes that the UPV carries out with universities from other countries. The employability survey conducted by the Polytechnic University of Valencia is used by the National Agency of Assessment, Quality, and Certification (ANECA) to evaluate employability, which is one of the main objectives of universities. Since such surveys are one of the tools used to identify possible improvements in the education delivered by the UPV, the survey is a longitudinal survey, where a structured questionnaire is distributed to students via email at three different times: at the end of their studies, a year after the completion of their studies, and five years later (survey A, survey B, and survey C), in an attempt to collect information about all aspects included in employability. The instrument is a single-item questionnaire, (Do you need to have TQM training and knowledge in your current job?), measured on a seven-point Likert scale. Technical details of the survey are shown in Table 1. The present study was developed with employability survey C, with employees who began their university studies in 2006 and 2007.

Table 1. Technical details of fieldwork.

Name of the Survey	Employability Survey C Conducted by the Polytechnic University of Valencia.
Objectives	To determine the employment status of graduates and learn the skills and knowledge they needed to perform their jobs. To determine if TQM training and knowledge was required to perform these jobs.
Population	Company employees who began their university studies in 2006 and 2007, meaning that they had been in the labour market for more than two or three years.
Study size. Sampling error	1340 graduates. The maximum error with 95% confidence was 2.6%. Location of the company: 1. Province of Valencia (639) 2. Rest of the Valencian region (243) 3. Madrid (128) 4. Barcelona (93) 5. Rest of Spain (134) 6. Rest of Europe (83) 7. Rest of the World (20)
Variable	Do you need to have TQM training and knowledge in your current job?

For this research, the variables and their categories as shown in Table 2 were considered. The complete details of the survey are available on request to the lead author.

Table 2. Variables selected in the study.

Variable	Category (Number of Surveys)
Company activity	1. Education (60)
	2. Consultancy and Engineering (197)
	3. Services (127)
	4. Telecommunications (103)
	5. Computers (158)
	6. Industrial (170)
	7. Architecture (115)

	8. Construction (133)
	9. Agrifood (86)
	10. Other (161)
Title or Position	1. Director (89)
	2. Middle management (243)
	3. Technical (706)
	4. Administrative (52)
	5. Operator (109)
	6. Others (141)
Annual Salary	1. Less than €12,000 (274)
	2. Between €12,000 and €18,000 (406)
	3. Between €18,000 and €24,000 (315)
	4. Between €24,000 and €30,000 (213)
	5. More than €30,000 (132)
People Management	1. Did not manage any people (817)
	2. Managed fewer than 10 people (355)
	3. Managed more than 10 people (168)

3.2. Method

In order to identify job profiles in terms of the demand for TQM training, the following statistical tools were used: analysis of variance (ANOVA) and Chi-squared Automatic Interaction detection (CHAID). ANOVA is a test of hypothesis that is appropriate for comparing means of a continuous variable in two or more independent comparison groups [43]. CHAID analysis is a tree classification method originally proposed by Kass [44]. CHAID analysis is an explanatory statistical technique, which is based on the definition of a dependent variable (the dependent variable is categorical in nature) and relies on the Chi-squared test to determine the best next division in each step [44,45]. CHAID develops classification trees, in which each node represents a division condition that results in an optimal classification. The split predictor variable is the one with the lowest Bonferroni adjusted p -value. This enabled us to segment the dataset according to the most significant predictor variables, as well as to establish the groups of graduates that belonged to each category.

In order to study the relationship between TQM training and other disciplines, factor analysis was used based on the principal component method. Factor analysis identifies the underlying variables, or factors, that explain the pattern of correlations within a set of variables studied (each of the knowledge areas). This technique involves summarising the information in a data matrix with V variables that seek to identify a small number of factors that explain most of the variance observed in a greater number of manifest variables. Factors represent the original variables, with minimal loss of information. Using the method of principal components, factorial analysis seeks to find linear combinations of the original variables that explain most of the total variation. The varimax rotation method [46] was used.

4. Results and Discussion

The single item used to evaluate the importance that graduates give to the necessity of TQM in their jobs (TQM variable) was a seven-point Likert scale in which higher levels signified a greater need. The answers are shown in Table 3. The average need for TQM knowledge that the surveyed graduates considered necessary for job performance was 5.49. A total of 10.6% of them considered that TQM training is practically not necessary for job performance, while 45.10% considered it quite necessary. Only 19.5% considered this training to be “quite” or “very necessary” for their work.

Table 3. Answers to the question: Is Total Quality Management (TQM) training necessary to perform the job?

Training and Knowledge in:	Mean Value	Standard Deviation
TQM	5.50	1.44
ICT	5.70	1.41
Languages	4.53	1.86
Project Management	5.53	1.59
Scientific Knowledge	4.88	1.55
Corporate Culture	4.95	1.49
Economic Knowledge	4.33	1.68

In accordance with the high variability of the responses, a major line of research was developed regarding the effect of different job profiles mismatches on TQM training and knowledge.

4.1. Importance of Training, Learning, and Knowledge for Total Quality Management (TQM)

To assess the level of TQM training and knowledge required by graduates at Universitat Politècnica de València (UPV) to successfully perform their jobs after joining a company, we tested the following variables: organisational activity, function or position, salary, and people management.

Analyses of Variance (ANOVA) was performed to analyse the influence of these variables on the need for TQM. These analyses allowed us to identify the job profile demanding the most TQM training. The results are shown in the following sections.

4.1.1. Importance of Training and Knowledge of TQM Per Business Sector

First, we examined whether there were any differences between the TQM training required by graduates employed in companies in the different business sectors studied by means of an analysis of variance. A significance level (< 0.05) was obtained, and it was therefore concluded that there were differences. Once the differences between the averages had been found, the categories amongst which these differences appeared were identified using Least Significant Differences LSD Intervals. In Figure 1, it can be appreciated that graduates were required to have the most TQM training in the industrial (4.68) and construction (4.68) sectors. On the other hand, the least demand might be related to the education (3.99) and ICT (4.00) sectors.

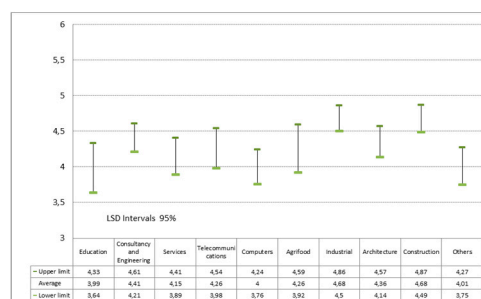


Figure 1. Least Significant Differences (LSD) intervals for quality and TQM training according to the business sector of the company on a seven-point Likert scale.

4.1.2. Training Actions and TQM Knowledge Regarding Employment

We studied the differences between the different job positions in a company occupied by university graduates and the requirements of proper dynamic training actions on TQM. The significance level obtained (<0.05) indicated that there were significant differences between them. The results are shown in Figure 2. It was observed that the graduates who held senior management positions were those who most needed quality and TQM knowledge to perform their jobs, with an average rating of 5.38, followed by those who hold a middle management position (4.77) and technicians (4.25). The university graduates who needed the least training were operators (3.95) and administrative employees (3.83).

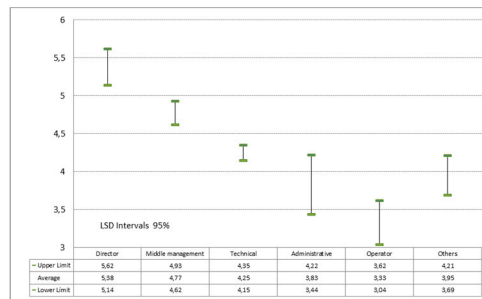


Figure 2. LSD intervals for quality and TQM training according to job functions or position on a seven-point Likert scale.

4.1.3. Importance of Training and Knowledge of TQM Based on Salary

We carried out an analysis to see if a relationship existed between salaries and the requirements of training actions in TQM. Figure 3 shows the LSD intervals with 95% confidence. The jobs with a salary higher than €24,000 required the highest level of quality and TQM training. This demand for training clearly decreased as the salaries were reduced.

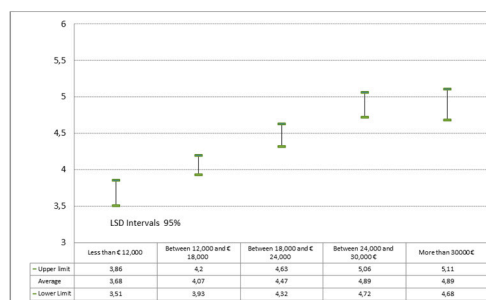


Figure 3. LSD intervals for training and TQM according to annual salary on a seven-point Likert scale.

4.1.4. TQM Knowledge Required According to the Number of Supervised Workers

Finally, we looked into the existence of any differences in the level of TQM training actions between employment in which management of people was required and those in which there were no management responsibilities. Figure 4 shows that the demand for training in TQM was clearly related to the size of the group managed. It can be observed that the graduates who required the most training in TQM were those who managed groups of more than 10 people (5.12), followed by those who supervised groups of fewer than 10 people (4.75), and finally, those who did not manage any people (3.93).

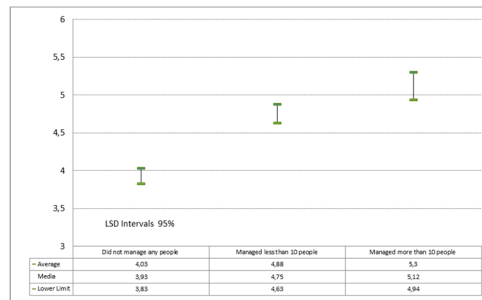


Figure 4. LSD intervals for training and TQM according to the number of people managed on a seven-point Likert scale.

4.1.5. Predominant Professional Profile as Regards TQM Training and Knowledge

The next step in the study was to perform a CHAID analysis. We used the single item of the questionnaire (Do you need to have TQM training and knowledge in your current job?) as the dependent variable, and business sector, job function or position, salary, and people management as explanatory variables for identifying the variable with most influence on the TQM training and knowledge profile.

Three nodes resulted in the first split (Figure 5), obtaining a χ^2 value of 1.5922 and a standard error on the estimated risk of 0.07027, which is statistically significant, with a significance level of 0.05. CHAID produced a tree with three nodes in the first split based on the management of groups of people and job function in a second split. Both variables were found to be the most relevant. The tree begins with a single group of respondents, node 0, consisting of 1088 individuals with an average demand of 4.31. The analysis found statistically significant differences between those who do not manage any people (node 1) those managing fewer than 10 people (node 2), and those managing more than 10 people, (node 3). Finally, the last variable, which split the third level, was salary.

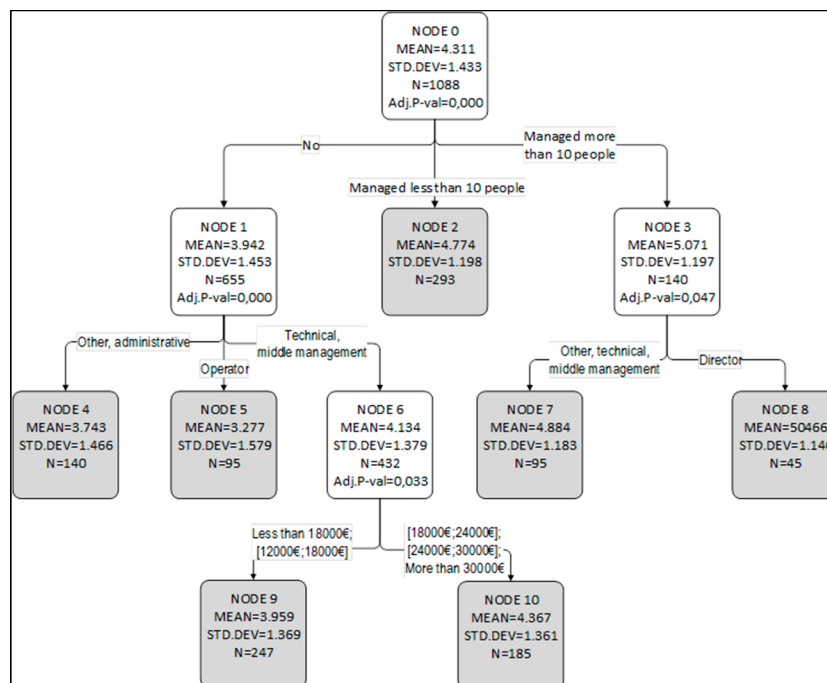


Figure 5. Chi-squared Automatic Interaction detection (CHAID) analysis results (dendrogram).

Considering that there were no additional predictors, seven different profiles could be distinguished in this study, as shown in Figure 6. These profiles show an image of the different levels of responsibility that graduates have in the current Spanish labour market, focusing on the relationship with TQM. For companies, a higher level of responsibility of the employees implies that

a higher level of TQM knowledge is required. This should be considered when designing training programs, and can also serve as a criterion to be considered in the recruitment process. For universities, this fact can also serve to guide the offer of postgraduate training, adapted to the different labour profiles.

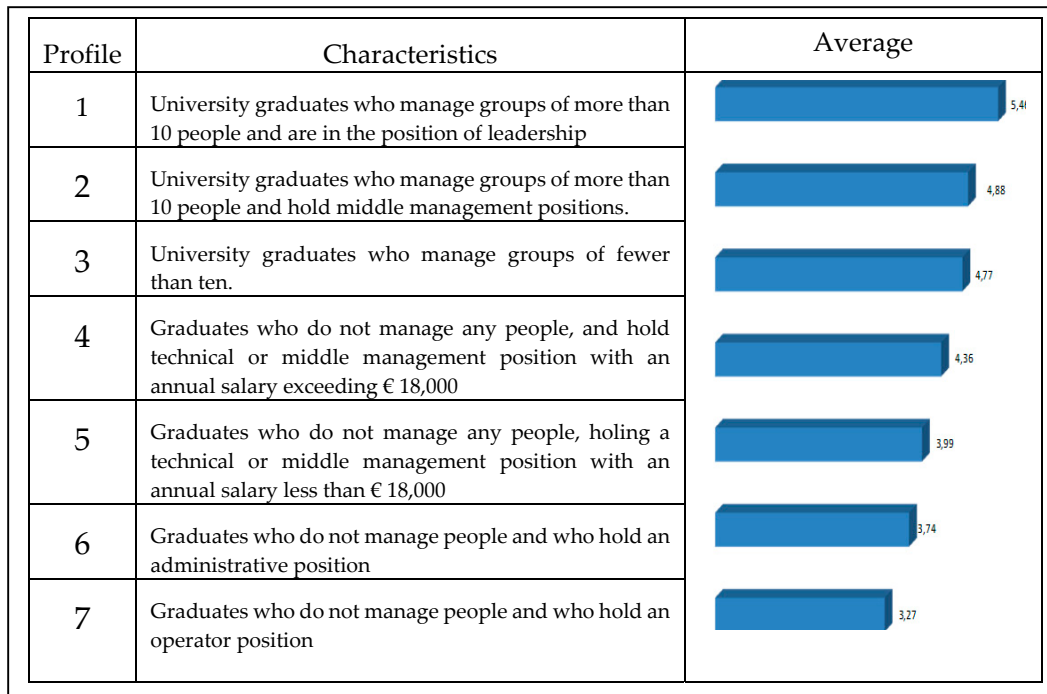


Figure 6. Professional profile on TQM training.

The job profile which requires university graduates to have the most TQM training and knowledge is characterised by the management of groups of more than 10 people and the holding of a management position. The job profile which demands the least TQM training is characterised by the performance of operator functions and the absence of people management responsibilities.

In today's university programmes, especially in the field of engineering, quality issues are considered a transversal subject, in other words, subjects or courses optional or compulsory, in almost all engineering specialties (mechanical, chemical, industrial, aerospace, civil, systems, etc.). In most cases, these courses can only be considered as an introduction to the body of knowledge of quality. At postgraduate level, there are master and specialisation programs which are more focused on quality and TQM. At the UPV, there is at least one specialisation programme in Six Sigma Black Belt, and a Master's degree in Data Analysis and Process Improvement Engineering. In addition, the other public university in Valencia offers a Master's degree in quality management.

4.1.6. Relationship Between TQM Training Actions and Different Areas of Knowledge

In the next step, we carried out an analysis to see if there are some areas of knowledge which have more effect on income, given that competencies mismatches in different areas are assumed to be closely related. The study focused on six general knowledge areas: information technology and communication (ICT), languages, project management, scientific knowledge, business culture, and economic knowledge. Table 4 shows the average of TQM training demand in the different areas studied on a ten-point scale. The area where graduates were required to have the most training to perform their job successfully was ICT, with an average score of 5.70, followed by project management (5.539) and TQM training (5.50mm). The area where least training was required was economic knowledge (4.33).

Table 4. Necessity of training and knowledge for successful job performance on a ten-point scale.

Training and Knowledge in:	Mean Value	Typical Deviation
TQM	5.50	1.44
ICT	5.70	1.41
Languages	4.53	1.86
Project Management	5.53	1.59
Scientific Knowledge	4.88	1.55
Corporate Culture	4.95	1.49
Economic Knowledge	4.33	1.68

Finally, to study the relationship between area of knowledge and the need to have TQM training and knowledge in the current job, a factorial analysis was carried out using principal component analysis. The first step in factorial analysis is to calculate the matrix of correlations between all the variables involved in the analysis. Table 5 shows the correlation matrix, in which it can be observed that all the correlations were significant.

Table 5. Correlation matrix.

	TQM	ICT	Languages	Projects	Scientific Knowledge	Corporate Culture	Economic
Pearson Correlation	1.000	0.376 **	0.296**	0.568 **	0.404**	0.519**	0.413 **
<i>p</i> -value		0.000	0.000	0.000	0.000	0.000	0.000

The next step was to extract the factors necessary to represent data and perform a rotation to facilitate interpretation. The results obtained are shown in Figure 7. The two factors explaining 64.67% of the total variance were identified). The goodness of fit was confirmed by the results of the Kaiser-Meyer-Olkin index (KMO) and Bartlett's test of sphericity, with values of KMO = 0.8674 and $\chi^2 = 3052.366$ ($p = 0.000$) [46].

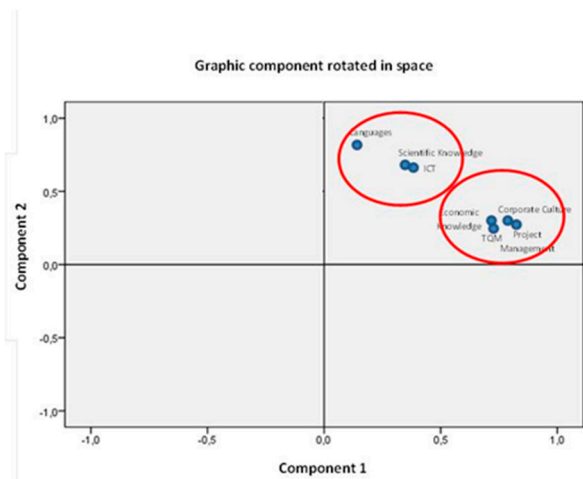


Figure 7. Principal component analysis. Relationship between different areas of knowledge and TQM required for successful job performance.

The first component or factor reflects the demand for corporate culture training, project management, TQM, and economic knowledge. The second factor reflects the demand for language training, ICT, and scientific knowledge. Component 1 can be referred to as management training, and component 2 as training on tools.

We can therefore conclude that the need for university graduates to have TQM training for job performance is closely related to training in project management, corporate culture, and technical knowledge, and less related to language, ICT, and scientific knowledge.

Using the factor scores of both components, an ANOVA was performed to evaluate the relationship between the two components identified, management training and training on tools, and the variables of business sector, job function, salary, and people management to find any significant differences among the categories of each variable. Figures 8–10 show the LSD interval, with 95% confidence, of each component and the distinct categories of the variable studied. Figure 8 shows the results relating to job function. There were significant differences among the different job functions (significance level <0.05). It can be seen that the job positions which require the most training in management (corporate culture, project management, TQM, and economic knowledge) are director positions, followed by middle management, and technician positions. Additionally, it was shown that operators and administrative positions require very little training in these subjects. The job positions which demand the most training on tools (languages, ICT, and scientific knowledge) are, again, director positions, middle management, and technicians. Administrative assistants and operators require little training in these disciplines.

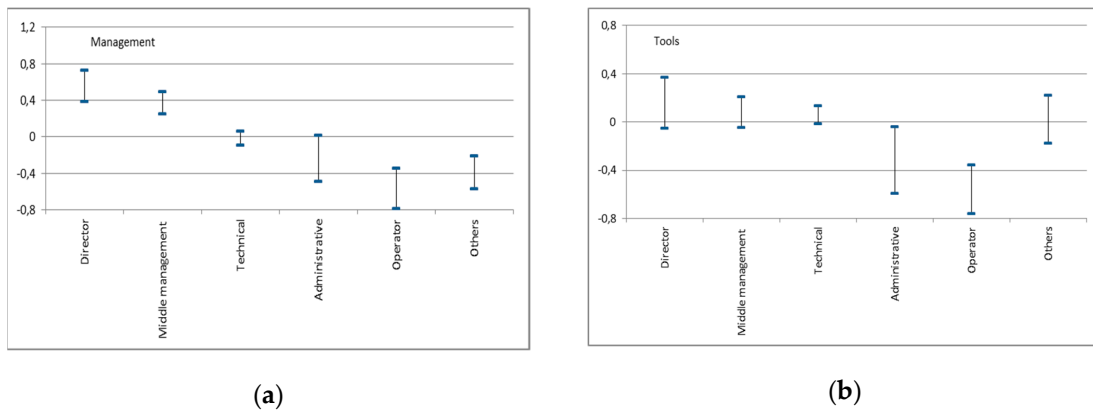


Figure 8. LSD intervals for each category of job and management training and training on tools. (a) The results relating to the job positions which require the most training in management; (b) the jobs positions which demand the most training on tools.

Figure 9 shows the results regarding salary, from which the main conclusion which can be drawn is clear: the higher salaries show most need for training in both management and tools.

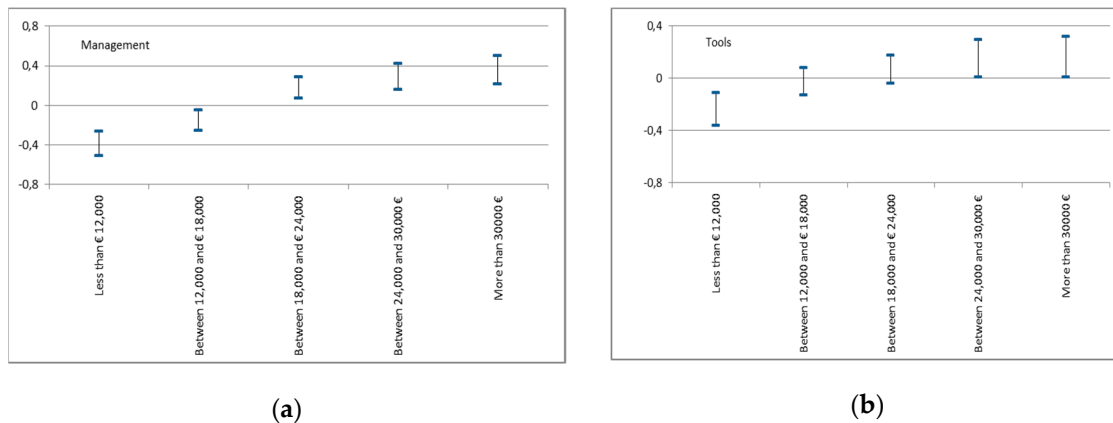


Figure 9. LSD intervals for each category of salary and management training and training on tools. (a) The results relating to the level of salary which requires the most training in management; (b) the level of salary which demands the most training on tools.

Figure 10 shows the results relating to people management. The main conclusion is that jobs that involve the management of people require extensive management training (corporate culture, project management, TQM, and economic knowledge) and less training on tools (languages, ICT, and scientific knowledge).

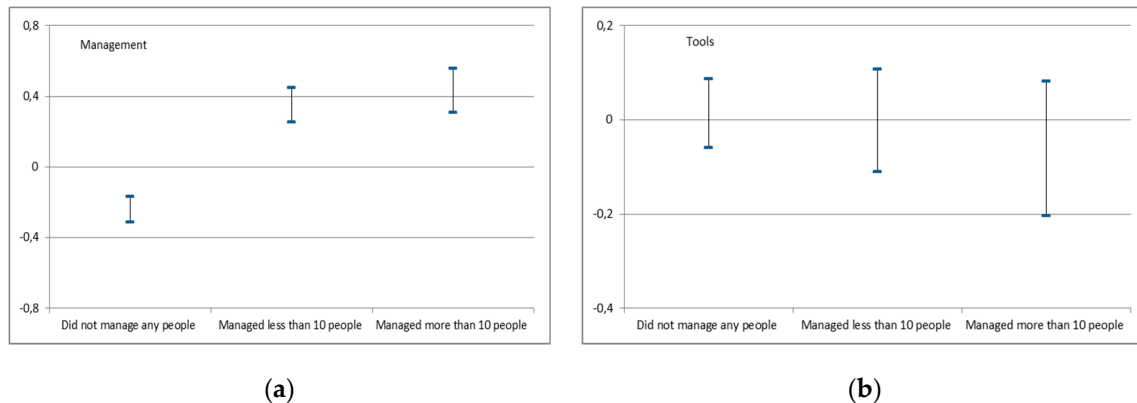


Figure 10. LSD intervals for each category of people management and management training and training on tools. (a) The results relating to the level of salary which requires the most training in management; (b) the level of salary which demands the most training on tools.

However, in the jobs where no people are managed, less management training and more training on tools are required.

Equivalent results were obtained for the business sector. The sectors that require most training in management (corporate culture, project management TQM, and economic knowledge) are construction, architecture, industrial, and the advisory and consulting sectors. The sectors which require the least training are education and ICT sectors. The sectors that require the most training in tools (languages, ICT, and scientific knowledge) are the telecommunications and ICT sectors, whereas the construction and service sectors demand the least training.

5. Conclusions

The application of the TQM philosophy, with all its complex tools and methods, will not be effective if it is not supported by proper training actions. If TQM implementation is to be successful, training actions are key.

In order to remain competitive and to achieve sustainability, TQM has been revealed as a key to success, which implies integrating Total Quality Management and sustainability. Nevertheless, there are few studies where the level of competence in TQM acquired by engineering graduates is related to the requirements of their employment.

This paper contributes by analysing whether graduates need to have acquired competence in Total Quality Management to perform their future jobs, identifying skills which require the most knowledge in this area.

Regarding the first question addressed by this study, “Do engineering graduates need to have acquired competence in Total Quality Management (TQM) to perform their jobs successfully”, the job profile for which the most TQM training is required is a university graduate who manages groups of more than 10 people and holds a director’s position. Conversely, the job profile for which the least TQM training is required is a university graduate who does not manage people and holds an operator’s position.

As regards the second research question, “What is the profile of the jobs which require the most Total Quality”, we should stress that Total Quality Management knowledge and training are indispensable in the highest paid jobs for successful job performance. Directors and middle management positions are those for which university graduates need the most TQM training and knowledge, while administrative assistants and operators require the least.

Our findings suggest that those jobs with a high requirement of TQM training are certain business sectors, such as construction and industry, and that the education and ICT sectors require the least. Jobs that have a high requirement are director and middle management posts, jobs requiring management of groups and highly-paid jobs. Monetary rewards depend most on competencies related to TQM knowledge.

To sum up, the results of our study suggest that most TQM training and knowledge are required in jobs where people must be managed. TQM training needed for job performance is closely related to the need for training in project management, economic concepts, and corporate culture and less related to the need for training in ICT, scientific knowledge, and languages.

These measures could be used by decision-makers in an organisation to assess the status of quality management in order to direct improvements in the quality area. Researchers can use such measures to better understand quality management practice.

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