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**COMPARISON OF TQM AND ISO 9000 EFFECTS IN COMPANY**

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**PERFORMANCE: AN EMPIRICAL STUDY IN SPANISH COMPANIES**

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**ABSTRACT**

*The effect of Total Quality Management (TQM) and ISO 9000 on performance has been extensively analysed by researchers, but this sort of research has usually been developed in separated cells. However, there are few articles analysing the effect of both systems within the same sample of companies. Our paper analyses both the effect of a TQM system and the ISO 9000 implementation in company performance. A structured questionnaire using the Flynn et al. (1994) scale for measuring TQM has been used to get the data. A postal survey to nearly 3000 industrial Spanish companies with more than 100 employees was sent. This questionnaire was answered by 713 quality managers. The results show a positive relationship between TQM application and hard and soft results while only an improvement in hard results after the ISO 9000 implementation has been found.*

**1. INTRODUCTION**

Over the last two decades quality management has been an important research topic as it can be seen by the important number of publications in scientific journals (Martínez *et al.*, 1998). This interest has mainly been motivated by the success' stories of companies that, after applying some sort of quality management, have increased their productivity and results.

In this way, many researchers have analysed the impact of TQM implementation on business performance inquiring into the mechanisms that could make possible the improvement in management (Elmuti and AlDiab, 1995; Mohrman *et al.*, 1995; Powell, 1995; Hendricks and Singhal, 1996; Forker *et al.*, 1997; Choi and Eboch, 1998; Easton and Jarrell, 1998; Adams *et al.*, 1999; Dow *et al.*, 1999; Terziovski and Samson, 1999 and 2000; Hua *et al.*, 2000; Zhang, 2000; Hendricks and Singhal, 2001a and 2001b).

Since 1987, when the ISO 9000 series of standards appeared, a big amount of papers about motivation for registration, costs and benefits of certification and its effects upon company performance have been published. (Rayner and Porter, 1991; Askey and Dale, 1994; Brecka, 1994; Vloeberghs and Bellens, 1996; Ebrahimpour *et al.*, 1997; Meegan and Taylor, 1997; Brown et al, 1998, Anderson *et al.*, 1999; Huarng *et al.*, 1999; Hughes *et al.*, 2000; Sun, 2000; Withers and Ebrahimpour, 2000; Gotzamani and Tsiotras, 2002) Most of these papers were descriptive.

In many occasions, these studies regarding ISO 9000 have confused the standards prescriptions with a total quality management system although, at the beginning, it was just as a quality assurance system. In fact, many papers have studied the ISO 9000 impact in performance referencing the TQM system.

Even though TQM and ISO 9000 have several differences in their principles that put the certification far underneath (Martinez and Martinez, 2004), they also have some aspects in common that could justify their joint analysis. However, this sort of research has usually been developed in separated cells. Just a few researchers have compared the joint effect of TQM and ISO 9000 within the same sample (Terziovski et al., 1997; Ismail and Hashmi, 1999; Sun, 1999; Rahman, 2001).

This paper attempts to analyse the ISO 9000 and TQM impact in company performance. Our objective is to clarify the effect of each system according to their different nature. Moreover, we will also analyse the way in which ISO 9000 contribute to TQM implementation and the joint effect of both systems when they are implemented at the same time in a company in order to point out any possible synergy between them.

## 2. LITERATURE REVIEW

Along the revised literature it was generally found a positive effect of TQM on company results. There are papers analysing the relationship of TQM with product quality and other non financial results (Shetty, 1993; Elmuti and AlDiab, 1995; Mohrman *et al.*, 1995; Powell, 1995; Forker *et al.*, 1997; Choi and Eboch, 1998; Dow *et al.*, 1999; Terziovski and Samson, 1999 and 2000; Zhang, 2000). Others have analysed the effect on financial results (Easton and Jarrell, 1998; Hua *et al.*, 2000; Hendricks and Singhal, 2001a) and there are also papers analysing the effect of TQM on the stock market value (Hendricks and Singhal, 1996; Easton and Jarrell, 1998; Adams *et al.*, 1999; Hendricks and Singhal, 2001b).

TQM has been considered mostly as one variable formed by many dimensions. Previous papers have analysed the effect of the TQM variable over all kinds of results. However, it has been found another group of research that relate each TQM dimension with results (Mohrman *et al.*, 1995; Powell, 1995; Forza and Filippini, 1998; Anderson and Sohal, 1999; Dow *et al.*, 1999; Samson and Terziovski, 1999; Curkovic *et al.*, 2000; Martínez-Lorente *et al.*, 2000). The purpose of this kind of research is to obtain evidence about the most influential TQM dimensions for improving performance. In this sense, the general agreement is that the most influential dimensions are those that Powell (1995) considers as intangible, behavioural factors like leadership, organisational skill and culture, executive commitment, open organisation and empowerment. For example, Dow *et al.* (1999) found that only 3 TQM dimensions -employee commitment, shared vision and customer focus- had a positive relationship with product quality. Anderson and Sohal (1999) found that the most important TQM dimensions were leadership and customer focus. Samson and Terziovski (1999) identified the variables of leadership, workforce management and customer focus as the most

important. Therefore, TQM dimensions of top management support, workforce management, employee attitudes and behaviour and customer relationship are the most important according to the literature.

There are many papers on ISO 9000, but most of them are merely based on case studies or are descriptive or prescriptive (Ebrahimpour *et al.*, 1997; Withers and Ebrahimpour, 2000). Moreover, only a small number analyse the relationship between ISO 9000 and company results. This relationship is not clear according to the literature. Some papers show a positive relationship between certification and results (Romano, 2000; Withers and Ebrahimpour, 2000; Santos and Escanciano, 2002). The positive results shown by many of them are often mainly based on improvements in the rate of defects (Sun, 2000; Withers and Ebrahimpour, 2000) Other papers present a less optimistic vision of its benefits (Terziovski *et al.*, 1997; Simmons, 1999; Lima *et al.*, 2000; Sun, 2000; Hua *et al.*, 2000; Aarts and Vos, 2001; Singels *et al.*, 2001; Wayhan *et al.* 2002). Heras *et al.* (2002b) found a positive relationship between company results and ISO 9000 certification. However, they later showed that the causal relationship could be in the contrary way, that is, more profitable companies implemented the ISO 9000 certification more (Heras *et al.*, 2002a). Häversjö (2000) had reached the same conclusion for Danish industry.

The most important reasons for obtaining ISO 9000 certification have been reported as of external type, that is, they try to get it either because of pressure from customers and suppliers or as a marketing tool (Rayner and Porter, 1991; Askey and Dale, 1994; Vloeberghs, 1996; Ebrahimpour *et al.*, 1997; Brown *et al.*, 1998, Anderson *et al.*, 1999; Hughes *et al.* , 2000; Withers and Ebrahimpour, 2000). However, several papers show that the results from certification depend on the type of company motivation for deciding to get it (Brecka, 1994; Meegan and Taylor, 1997; Huarng *et al.*, 1999; Hughes *et al.*, 2000; Sun, 2000; Gotzamani and Tsiotras, 2002, Terziovski *et al.*, 2003). These authors state that companies that obtain

ISO 9000 certification motivated by external reasons but who do not believe that it can really help them to improve quality and efficiency get worse results than those that believe that ISO 9000 can be a good way to reduce quality costs. In this sense, Sun (2000) suggests that in order to get benefits from ISO 9000 certification, this norm must be seen as a way towards TQM.

A minor group of researchers has compared the joint effects of TQM and ISO 9000 and they agree in pointing out that TQM implementation leads to better results in more aspects than ISO 9000 certification (Terziovski *et al.*, 1997). However, one of the benefits attributable to the standard is that it constitutes a good first step towards a TQM system, raising awareness on quality amongst workers and creating a good climate to implement it (Taylor, 1995; Tummala and Tang, 1996; Baena López, 1998; Skrabec, 1999; Sun, 2000; Escanciano *et al.* , 2001).

There is even another group of researchers that affirm that the ISO 9000 certification has more impact on company performance when it is implemented with the objective of continuing and finally implementing a TQM system (Brecka, 1994; Meegan and Taylor, 1997; Huarng *et al.*, 1999; Hughes *et al.*, 2000; Sun, 2000; Gotzamani and Tsiotras, 2002).

It is important to point out that the literature shows that the TQM dimensions that best influence companies' results (the soft variables) are those that have a lesser weight in ISO 9000. Moreover, the points of TQM with more importance for ISO 9000 (basically process control) do not have a significant positive effect on company results.

After having classified and revised the literature regarding TQM/ISO 9000 in company performance the following hypotheses regarding the effect of TQM and ISO 9000 have been tested.

### **Hypotheses related with TQM:**

***H1: There is a positive relationship between TQM and company results***

This hypothesis has been extensively tested in the literature. Our work only try to add a new confirmation to the knowledge on this topic.

***H2: The “soft” variables of TQM are the most influential in obtaining benefits from TQM***

When TQM is divided into its core principles for the analysis, the majority of authors report that these variables are the most important for getting better results. It contrasts with the traditional view of quality management as quality control.

### **Hypotheses related with ISO 9000:**

***H3: There is no positive relationship between ISO 9000:1994 and company results***

There are no clear conclusions regarding its benefits. On the contrary, it has been pointed out that the most influential aspects of quality management are those not comprised in the standard requisites.

***H4: Internal motivation to get the certification is positively related to the benefits obtained from certification***

As it is stated in Huarng (1998), Van der Wiele et al. (2000), Withers and Ebrahimpour (2001) and Singels et al. (2001), the ISO 9000 standards are so generic that only the spirit in which the company want to apply them will change management and improve performance.

### **Hypotheses related with the joint effect ISO 9000-TQM**

***H5: Companies registered by ISO 9000 after being applying TQM obtain fewer benefits from ISO than companies that implement ISO firstly***

This hypothesis is based on the previous ones. If performance is only improved by TQM implementation then, a company that had implemented TQM previously to ISO 9000 will not improve its results when it decide to implement the norm since these will have been improved before. For the same reason the following hypothesis will be tested,

***H6: Companies applying TQM and ISO 9000 have no better results than companies only applying TQM***

### **3. POPULATION, SAMPLE AND METHODOLOGY**

This research focus in industrial companies since ISO 9000 was originally created for this kind of companies. In fact, the new version of the standard in 2000 had even to adapt the vocabulary to service companies. Moreover, ISO 9000-service companies show different characteristics than industrial, as it is related in the specialized literature regarding this issue (Beaumont et al., 1997; Brah et al., 2000; McAdam and Canning, 2001; Gustafsson et al., 2003).

Population was comprised by Spanish industrial companies with more than 100 employees and included in the “SABI” database. This database was employed because it offers financial as well as general information that later could be used.

The study was addressed to the whole population with the aim of obtaining generalizable results. In addition, this is the predominant focus in operations management (Rungtusanatham et al., 2003). Total population was comprised of 2986 companies.

Data was gathered by a postal questionnaire sent to the companies in the population. This methodology is widely recognised for confirmatory studies in operations management since publications in more rigorous scientific journals apply it, being quality management and specifically, ISO 9000, one of the five premium areas of interest (Rungtusanatham et al.,



2003). The questionnaire was pre-tested by some academics and companies in the Region of Murcia.

Questionnaires were sent to the attention of the “quality manager” without specifying the name of the manager, since the database did not contain this information. Inside each envelope we included a presentation letter, a questionnaire and a pre-paid addressed envelope to be returned with the fulfilled questionnaire. In the letter, quality managers were offered a future summary of final conclusions.

The first sending to 2986 companies was made in March 2003. In May 2003, with the objective of improving the response rate, as advised by Frohlich (2002), a second sending was done to 1500 randomly selected companies that had not responded the first time.

From the originally sent 2986 letters, 36 were returned due to unknown address (it was supposed that those companies had probably changed their address or were extinguished), and 12 that initially were supposed to be manufacturing were services, so, the population was finally composed of 2938 companies.

The number of valid received questionnaires was 713. It constitutes a response rate of 24,27%. Response rate is usually interpreted as evidence of the interest showed for the research by managers. In this sense, a nearly 25% response rate is a considerable success with Spanish companies and is higher than the suggested minimum in Malhotra and Grover (1998).

## **Variables**

### **TQM**

In order to measure TQM implementation the scale of Flynn et al. (1994) was chosen. It is appropriate for manufacturing companies and is validated and accepted as a good measurement of TQM in the literature. In fact, Malhotra and Grover (1998) advice to use previously tested scales in the literature and, as an example of a good scale to be used, they

propose in their conclusions to use the Flynn et al. scale for measuring total quality management practices in organizations.

In addition to that scale, in order to have another measurement of results directly obtained from the implementation of TQM, we asked directly to the manager if the company had implemented a TQM system. As we have also measured this issue with a perceptual scale, the information provided by the directive can be tested for veracity.

### **ISO 9000**

It is a categorical variable indicating if the company is or not certified.

### **Company Performance**

Although there is not a clear performance definition in the literature, there is a general agreement that it should not be limited just to the financial results (Quinn and Rohrbaugh, 1983; Venkatraman and Ramanujam, 1986) since it would be a partial vision of the business situation (Curkovic et al., 2000).

Another debate regarding performance is the use of primary or secondary sources. In this sense, it is recommended to use both in order to test if there is a convergence between them (Venkatraman and Ramanujam, 1986).

Two types of measures of company results were used for this research: a subjective one (respondents' opinions) and an objective one (financial data). Both types of measures have their problems. Reliability of subjective measures depends on the sincerity and good information of managers. Financial data are influenced by the sector situation and this is difficult to isolate from the analysis. Therefore, the use of both types may improve the validity of results.

The subjective measure tried to assess the operational results of the company. Managers were asked on how their companies compared with their competitors on:

- ? Production costs.
- ? Fast delivery.
- ? Flexibility to change production volume and adapt stocks.
- ? Cycle time.
- ? Internal quality
- ? External quality
- ? Customer satisfaction
- ? Market share
- ? Employees satisfaction

In addition to this, we asked managers about specific improvements in these measures from the date they implemented TQM and ISO 9000, so we have evidence about not only their results comparing with competitors but also compared with the situation in which they were before the implementation of any of the quality systems.

Financial measures were two:

- ? Productivity
- ? ROA

The 3 last years average was used in order to avoid possible external events that could affect these measurements if only the last year was used..

The questions had to be responded on a 1 to 7 scale: 1 far below competitors, 7 far over competitors. This scale was different from the rest of questions (5 point-scale). It was made in this way because according to some authors (Lissitz and Green, 1975), scales with more than 5 points are less reliable, and also because our pretest proved that 5 point scales were easier to answer and it could improve the response rate. However, regarding performance, as the last two questions asked the manager to position himself from strong worsening to strong

improvement in the company from the certification/TQM implementation, companies would probably only answer from the middle of the scale to the end. Consequently, with a 5-point scale we would only have had 3 points. With a 7-point scale information would be richer. In the pre-test this suspicion was confirmed so we decided to apply the 7-point scale just for performance measurement.

Summing up, this research collects hard results information from a primary source (the survey to the quality managers) and financial data from a secondary source (SABI database).

## 4. ANALYSIS AND RESULTS

### 4.1 Reliability and validity

The first step in our research is to evaluate if the scales of measurement are reliable and valid.

The Cronbach alpha has been calculated for each of them and is presented in table 1. In order to maximise the reliability some items have been deleted, with the condition of leaving at least three items in each scale (number of items in brackets).

**TABLE 1-RELIABILITY ANALYSIS**

<i>Scale</i>	<i>Cronbach alpha</i>
Leadership (4)	0,8202
Rewards system (3)	0,8157
Process control (3)	0,7925
Feedback (3)	0,8597
Process management (3)	0,8501
New product's design (4)	0,7699
Interfunctional design (3)	0,7134
Selection (3)	0,8539
Teamwork (3)	0,8781
Suppliers relationship (4)	0,7305
Customers orientation (3)	0,7363
Performance (9)	0,8295

As it can be seen, all the scales are reliable (values higher to 0.7)

Content validity in our research can be assumed, at least in the TQM scale, since it has been previously tested in the literature (Flynn *et al.*, 1994).

Construct validity can be tested by convergent and discriminant validity. The last is usually checked by applying factorial analysis to each scale and seeing if all its components score in an only factor with eigenvalue higher than 1. All the scales except performance scored in one factor. Performance scale's items weighted into two factors, as shown in table 2.

**TABLE 2-FACTORIAL ANALYSIS OF PERFORMANCE**

<b>Factor 1</b>	<b>Factor 2</b>
Unit production costs	Manufacturing quality
Fast delivery	Design quality
Flexibility	Customers satisfaction
Cycle time	Market share
	Employees satisfaction

According to these results, the performance scale should be divided into two scales. Factor 1 was called “hard results” since variables that correlated with this factor were more easily measured and mainly related with costs. Factor 2 was called “soft results” since its variables are more difficult to measure and mainly related with quality.

The Cronbach alpha was calculated again for the new scales. The result was 0,7290 for hard factor and 0,8134 for soft factor, so in later analysis we will introduce two scales of qualitative results instead of one.

Convergent validity is theoretically grounded on the basis that one scale used to measure one concept is correlated with another with the same purpose. In our questionnaire we introduced a direct question about the implementation of TQM. We are able to test if both measurements are correlated. As one of them is a categorical variable we did an analysis of variance (ANOVA) comparing the means of values for each scale, dividing the sample into companies that said to be applying TQM and companies that did not. Table 3 shows the results.

**TABLE 3: CONVERGENT VALIDITY**

		<b>N</b>	<b>Mean</b>	<b>F</b>	<b>Sig.</b>
<b>Leadership</b>	<i>Do not apply GCT</i>	486	3,4729	17,869	<b>0,000</b>

	<i>Apply GCT</i>	216	3,7473		
<b>Rewards system</b>	<i>Do not apply GCT</i>	486	2,1317	39,058	<b>0,000</b>
	<i>Apply GCT</i>	216	2,6358		
<b>Process control</b>	<i>Do not apply GCT</i>	485	2,5165	56,464	<b>0,000</b>
	<i>Apply GCT</i>	216	3,0756		
<b>Feedback</b>	<i>Do not apply GCT</i>	484	2,3216	75,669	<b>0,000</b>
	<i>Apply GCT</i>	216	3,1451		
<b>Process management</b>	<i>Do not apply GCT</i>	484	3,6257	12,452	<b>0,000</b>
	<i>Apply GCT</i>	216	3,8796		
<b>New products design</b>	<i>Do not apply GCT</i>	479	3,4706	13,850	<b>0,000</b>
	<i>Apply GCT</i>	213	3,6925		
<b>Interfunctional design</b>	<i>Do not apply GCT</i>	478	3,1555	25,710	<b>0,000</b>
	<i>Apply GCT</i>	212	3,5079		
<b>Selection</b>	<i>Do not apply GCT</i>	483	3,2008	23,487	<b>0,000</b>
	<i>Apply GCT</i>	215	3,5558		
<b>Teamwork</b>	<i>Do not apply GCT</i>	484	3,1818	37,597	<b>0,000</b>
	<i>Apply GCT</i>	216	3,6543		
<b>Suppliers</b>	<i>Do not apply GCT</i>	486	3,5869	9,584	<b>0,002</b>
	<i>Apply GCT</i>	216	3,7689		
<b>Customers</b>	<i>Do not apply GCT</i>	484	3,6402	22,945	<b>0,000</b>
	<i>Apply GCT</i>	216	3,9568		

This output leads us to think that the scale has convergent validity because, despite not having used two scales to corroborate it, the scale converges towards a measure that it is supposed to converge. Moreover, these results allow us to use the direct question later in the test of hypotheses.

#### 4.2 Possible sample bias

As the companies surveyed were obtained from a database in which there is information about size (number of employees), sector and financial results, we can examine if there are important differences between sample and population.

The first difference analysed was the sector distribution. Table 4 shows the number of companies in each industry (percentage in brackets).

**TABLE 4: INDUSTRY DISTRIBUTION**

<b>SECTOR</b>	<b>POPULATION</b>	<b>SAMPLE</b>
Food and beverages	417 (14,8%)	97 (14 %)
Tobacco	7 (0,2%)	0 (0%)
Textiles	137 (4,8%)	16 (2,3%)
Confectionery	68 (2,4%)	6 (1%)
Leather	36 (1,3%)	67(0,9%)
Wood	59 (2,1%)	24 (3,5%)

Paper	96 (3,4%)	25 (3,6%)
Printing	164 (5,8%)	20 (2,9%)
Petrol	6 (0,2%)	3 (0,4%)
Chemical	270 (9,6%)	64 (9,3%)
Plastics	165 (5,8%)	49 (7,1%)
Non metallic minerals	245 (8,7)	65 (9,4%)
Iron	110 (3,9%)	31 (4,5%)
Metals	235 (8,3%)	60 (8,7%)
Machinery and mechanical equipment	185 (6,6%)	57 (8,2%)
Office and computer systems	9 (0,3%)	3 (0,4%)
Machinery and electric equipment	122 (4,3%)	38 (5,5%)
Electronic equipment. Radio, TV and communication equipment	47 (1,7%)	13 (1,9%)
Medical, surgery and optician equipment	28 (1%)	9 (1,3%)
Automobile industry	177 (6,3%)	45 (6,5%)
Other transportation industry	62 (2,2%)	17 (2,5%)
Furniture	89 (3,2%)	25 (3,6%)
Recycling	6 (0,2%)	2 (0,3)
Production and distribution of electric energy, gas and hot water	23 (0,8%)	8 (1,2%)
Water distribution	46 (1,6%)	4 (0,6%)
Building	14 (0,5%)	3 (0,4%)

To analyse if there is a difference between the sample and the population we correlated the number of companies existing in each sector with the number of companies of each sector in the sample. The Pearson correlation was 0,957 and significant at the 1% level. It means that the sample is a good representation of the population regarding to the industry distribution.

An analysis of variance (ANOVA) comparing the average of employees in the population and the sample was done in order to test if there was any difference in relation to company size. The ANOVA did not reject the null hypothesis of equal means ( $F=0,034$ ,  $p=0,854$ ) so it is not possible to affirm that means are different.

The averaged ROA was also compared, and the results of the ANOVA did not prove that means of population and sample were different ( $F=0,724$ ,  $p=0,395$ ).

Once collected the information, there are possible bias that can be tested. First of all, it could be thought that respondents are more interested in quality than non-respondents and this could mean that respondents have higher levels of quality management than non respondents. This problem was faced assuming in first place that quality levels of non respondents are similar to the levels of the latest respondents. The total quality management averages of both

the first ten days respondents and the latter 10 days was then compared. No important differences ( $F=2,821$ ;  $p=0,094$ ) were detected. On the other side, we compared the quality means of respondents in the first and second survey. We again did not find any difference ( $F=3,596$ ;  $p=0,058$ ).

Another possible bias is the person who answers the questionnaire. We compared the quality means between all the possible respondents and did not find any difference ( $F=0,830$ ;  $p=0,563$ ).

Explained all that, it cannot be affirmed that our sample is biased in those aspects. However, we can not defend that the sample is not biased by another fact that could not been checked.

### 4.3 Test of hypotheses

#### TQM hypotheses

In order to test the effect of TQM over company results we count on two continuous variables: TQM (the mean of points in each dimension) and results (as concluded from the factorial analysis we have hard, soft, ROA and productivity, these last two as the average during the last three years). The way to find any relationship between two continuous variables is using the Pearson correlation. Results are shown in table 5.

**TABLE 5: EFFECT OF TQM ON COMPANY RESULTS**

Variables	Hard results	Soft results	ROA	Productivity
TQM	0,381***	0,510***	0,001	0,050

\*\*\*  $p < 0,01$ ; \*\*  $p < 0,05$

It can be pointed out a positive and significant relationship between TQM and hard and soft results, but not with financial results.

However, we have considered TQM as a whole. In order to test the influence of each of its dimensions we have correlated all of them with the results, as shown in table 6.



**TABLE 6: EFFECT OF TQM DIMENSIONS ON COMPANY RESULTS**

Variables	Hard results	Soft results	ROA	Productivity
<b>LEADERSHIP</b>	<b>0,300***</b>	<b>0,413***</b>	0,006	0,044
<b>INFORMATION</b>	<b>0,221***</b>	<b>0,265***</b>	-0,053	-0,001
<b>PROCESS MANAGEMENT</b>	<b>0,269***</b>	<b>0,336***</b>	0,70	<b>0,106***</b>
<b>DESIGN</b>	<b>0,321***</b>	<b>0,461***</b>	-0,004	0,005
<b>HUMAN RESOURCE</b>	<b>0,296***</b>	<b>0,419***</b>	0,013	<b>0,100***</b>
<b>SUPPLIERS</b>	<b>0,265***</b>	<b>0,412***</b>	0,037	0,045
<b>CUSTOMERS</b>	<b>0,281***</b>	<b>0,287***</b>	0,009	-0,033

\*\*\* p<0,01; \*\*p<0,05

All dimensions are affecting hard and soft results. None affects ROA and just Process Management and Human Resource Management affect the productivity results. It is important to note that the process management dimension according to Flynn includes the items related to the tidiness and cleanliness of the plant, so it could be considered that the only two variables affecting productivity are “soft”, although the evidence is still low.

### ISO 9000 hypotheses

The first hypothesis stated the effect between ISO 9000 certification and company's results. As the ISO variable is categorical, we have made an analysis of variance to find any difference between the results means in the groups of certified and non-certified companies.

Table 7 shows the results.

**TABLE 7: ISO 9000:1994 AND COMPANY RESULTS**

		N	Mean	F	Sig.
Hard results	<i>Non certified</i>	227	4,8051	4,828	<b>0,028</b>
	<i>Certified</i>	467	4,9602		
Soft results	<i>Non certified</i>	227	4,9778	0,707	0,401
	<i>Certified</i>	467	5,0352		
ROA	<i>Non certified</i>	231	4,3088	1,306	0,254
	<i>Certified</i>	475	4,8642		
Productivity	<i>Non certified</i>	229	1,7591	0,320	0,572
	<i>Certified</i>	475	1,7992		

As it can be seen, the only affected results may be the hard results. The hard results variable is composed by the items related to the process management, and it is in this point where the ISO 9000:1994 focuses its attention. However, soft results are mainly related with quality, the element that justifies ISO 9000. These results confirms partially our hypothesis 3,

ISO 9000 does not have an important effect on results. The only perceived effect is on the results more related with cost and the production department and this could be related with the importance that in the application of ISO 9000:1994 have received the control and measurement issues.

The results above could be influenced by the fact that companies that have adopted ISO 9000 certification are those that have implemented TQM previously. In order to avoid this bias, the TQM variable was introduced like a covariate in the ANCOVA, as shown in table 8.

**TABLE 8: ANCOVA ISO 9000.COMPANY RESULTS WITH TQM AS A COVARIATE.**

		Average	N	Sig.
Hard results	<i>Non certified</i>	4,8000	225	<b>0,026</b>
	<i>Certified</i>	4,9601	466	
Soft results	<i>Non certified</i>	4,9767	225	0,504
	<i>Certified</i>	5,0344	466	
ROA	<i>Non certified</i>	4,3077	225	0,254
	<i>Certified</i>	4,8736	466	
Productivity	<i>Non certified</i>	1,7562	225	0,509
	<i>Certified</i>	1,8057	466	

Again, certified companies have significantly higher results than non certified firms only in hard results, once eliminated the effect of TQM.

Motivation has been traditionally considered as a moderating factor at attaining results from the registration. In order to test hypothesis 4, an analysis of variance between all the levels in the question of motivation for certification (5 very motivated internally, 1 very motivated externally) was done. Table 9 shows the results.

**TABLE 9: MOTIVATION AS A MODERATING VARIABLE IN THE ISO -RESULTS RELATIONSHIP**

	Motivation level	N	Average	F	Sig.
<b>Operative results from certification</b>	1	43	4,4651	7,645	<b>0,000</b>
	2	109	4,4694		
	3	132	4,7424		
	4	140	4,8000		
	5	97	4,9897		
<b>External results from certification</b>	1	45	4,7544	10,118	<b>0,000</b>
	2	109	4,8683		
	3	132	4,9830		
	4	140	5,1782		
	5	97	5,3918		

The results support the literature. The average results in the different groups are higher when the motivation is more internal and lower when it is mostly external.

### **ISO 9000-TQM hypotheses**

The first statement advocated that companies that implemented the TQM system in first place and later the ISO 9000 would get fewer benefits from certification than companies that had implemented ISO 9000 firstly.

To test this hypothesis we created a new variable as the difference of the years since the company started to apply TQM and ISO 9000. This new variable was correlated with the results from certification. Table 10 shows the results.

**TABLE 10: CORRELATION BETWEEN DIFFERENCE OF YEARS SINCE TQM AND ISO 9000 WERE IMPLEMENTED AND RESULTS FROM CERTIFICATION**

Variables	Hard results from certification	Soft results from certification
<b>Difference of the number of years since the implementation of TQM and ISO 9000</b>	-0,036	-0,149

The results do not confirm our hypothesis. This hypothesis was tested again with an analysis of variance examining differences in means of companies having applied TQM or ISO 9000 in first place, as it is showed in table 11.

**TABLE 11: ANOVA OF RESULTS FROM CERTIFICATION BETWEEN COMPANIES IMPLEMENTING TQM OR ISO 9000 FIRST**

		N	Media	F	Sig.
Hard results from certification	<i>First TQM later ISO 9000</i>	32	4,9609	0,51	0,821
	<i>First ISO 9000 later TQM</i>	86	4,9215		
Soft results from certification	<i>First TQM later ISO 9000</i>	32	5,1703	0,132	0,717
	<i>First ISO 9000 later TQM</i>	86	5,2291		

The previous results are confirmed now. There is no evidence enough to sustain any difference in results varying with the order in which TQM was implemented. However, it is important to note that the year of implementation of TQM was asked directly and consequently this date could be incorrect, maybe just the date in which the company is starting to plan a TQM implementation.

The second question was if companies applying TQM and ISO 9000 obtained higher results than companies applying just TQM. We made an analysis of variance between both groups of companies. Results appear in table 12.

**TABLE 12: ANOVA FOR DIFFERENCES IN RESULTS OF COMPANIES APPLYING TQM AND ISO 9000 JOINTLY AND JUST TQM.**

		N	Average	F	Sig.
Hard results	<i>TQM</i>	55	5,0015	0,332	0,565
	<i>TQM and ISO</i>	158	5,0754		
Soft results	<i>TQM</i>	55	5,1127	0,239	0,626
	<i>TQM and ISO</i>	158	5,1707		
ROA	<i>TQM</i>	57	4,2623	0,276	0,600
	<i>TQM and ISO</i>	160	4,7330		
Productivity	<i>TQM</i>	56	1,7279	0,164	0,686
	<i>TQM and ISO</i>	160	1,7952		

There is no difference between those groups. Hypothesis 6 is then confirmed.

## CONCLUSIONS

This research is a new contribution to the knowledge on the relationships of both TQM and ISO 9000 with company results. The data has been obtained from a sample of Spanish industrial companies. Firstly, using a previously tested scale to measure TQM

implementation, the effect of different dimensions of TQM on different measures of company results was evaluated. Results were measured according two objective financial data (ROA and productivity) and subjective internal data. These subjective data were divided after a factorial analysis in two measures, hard results and soft results. Hard results were results more related with costs and soft results were more related with quality.

Our analysis does not let us to affirm that all kinds of results considered are significantly better for TQM companies since the financial results were not affected according to our findings. However, financial results can be measured following different criteria and are affected by multiple factors that we were not able to isolate in this research. Moreover, all TQM dimensions were positively correlated with the two measures of qualitative results considered. Two of these dimensions were also slightly correlated with an objective result, productivity: the human resource management dimension and the tidiness and cleanliness of the workplace dimension. In summary, it can be concluded that our research is a new support to the advantages of adopting a TQM policy.

The ISO 9000 standard affects mostly to hard results. It seems logical since ISO 9000 is basically a process management-oriented quality assurance system. The moderating effect of motivation is supported by this research since it has been found that internally motivated companies get more benefits from certification than externally motivated ones.

We did not find any evidence to support that companies that had implemented a TQM system obtained less benefits from registration than the ones having applied ISO 9000 first. However, we have the problem of the date of TQM implementation. What we found is that the ISO 9000 does not add any value to companies that have previously implemented a TQM system. Therefore, companies with a TQM system had no incentives to get an ISO 9000 certification unless their clients or other organisations do it compulsory for them.

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## APPENDIX: QUESTIONNAIRE

### SECTION A

1. Please, mark your position in the company at the moment.

<input type="checkbox"/> General Manager	<input type="checkbox"/> Quality manager	<input type="checkbox"/> Member of the production department
<input type="checkbox"/> General manager for Spain	<input type="checkbox"/> Production manager	<input type="checkbox"/> Member of the quality department
<input type="checkbox"/> Plant manager		<input type="checkbox"/> Other:

2. Please, specify the product with higher production volume in your company

3. How many product lines are manufactured in your company?

4. Please, specify the average number of employees in 2002

5. What is the nationality of the main stakeholders in your company?

<input type="checkbox"/> Spanish	<input type="checkbox"/> USA	<input type="checkbox"/> Other. Please say
<input type="checkbox"/> Other EU	<input type="checkbox"/> Japanese	

6. What is the percentage of sales for each of the following markets?

Country	Percentage
1. Spain	
2. Other EU	
3. Rest of the world	
<b>TOTAL</b>	<b>100%</b>

7. Position of your company between the points below:

Workers have the higher importance in the production process	1	2	3	4	5	Machinery have the higher importance in the production process
It is workforce intensive	1	2	3	4	5	It is capital intensive
Our competence is strong	1	2	3	4	5	Our competence is weak
Our customers are loyal. They never change of supplier	1	2	3	4	5	Our customers change often of supplier
Competence in our sector is based mainly on prices, not in differentiation	1	2	3	4	5	Competence in our sector is based mainly on differentiation, not in prices
Our sector is saturated. There are a lot of companies	1	2	3	4	5	Our sector is growing. There is still room for more companies

### SECTION B: If your company is not registered please go directly to section C

8. Mark the certificate/s of quality assurance that your company has got and the year of certification:

<input type="checkbox"/> ISO 9001:1994 Year:	<input type="checkbox"/> ISO TS 16949 Year:
<input type="checkbox"/> ISO 9002:1994 Year:	<input type="checkbox"/> ISO 9001:2000 Year:

9. The decision of being registered by ISO 9000 may basically be caused by external pressures (customers or the fact that being certified is a previous condition to be able to sell in some markets), internal reasons (belief that the company will increase its performance) or both reasons. Indicate the importance of these reasons in your company at the time of obtaining the registration. ("1" would be external reasons and "5" main reason is internal)

External pressures	1	2	3	4	5	Internal causes
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10. What registration body did your company chose?

- AENOR
- Bureau Veritas
- Lloyds Register
- DNV
- TÜV
- Other:

11. Please mark the main reason for choosing the registration body:

- It was the most known in Spain
- It was the most known in the market in which we act
- It was "permissive"

- ☛ It was recommended by our customers
- ☛ It w as the cheapest
- ☛ Other:

**SECTION C**

12. Mark your level of agreement/disagreement in these statements (1: completely agree; 5: completely disagree)

	Completely disagree			Completely agree	
All major department heads within our plant accept their responsibility for quality	1	2	3	4	5
Plant management provides personal leadership for quality products and quality improvement	1	2	3	4	5
The top priority is evaluating plant management in quality performance	1	2	3	4	5
Our top management strongly encourages employee involvement in the production process	1	2	3	4	5
Workers are rewarded for quality improvements	1	2	3	4	5
We pay a group incentive for quality improvement ideas	1	2	3	4	5
Our plant has a annual bonus system based on plant productivity	1	2	3	4	5
Non financial incentives are used to reward quality improvement	1	2	3	4	5
Processes in our plant are designed to be "fool proof"	1	2	3	4	5
A large percent of the equipment or processes on the shop floor are currently under statistical quality control	1	2	3	4	5
We make extensive use of statistical techniques to reduce variance in processes	1	2	3	4	5
Charts showing defect rates are posted on the shop floor	1	2	3	4	5
Charts showing schedule compliance are posted on the shop floor	1	2	3	4	5
Charts plotting the frequency of machine breakdowns are posted on the shop floor	1	2	3	4	5
Workers are always told when they do a good job	1	2	3	4	5
Information on productivity is readily available to employees	1	2	3	4	5
My manager always comments about the quality of my work	1	2	3	4	5
Our plant emphasizes putting all tools and fixtures in their place	1	2	3	4	5
We take pride in keeping our plant neat and clean	1	2	3	4	5
Our plant is kept clean at all times	1	2	3	4	5
I never have trouble finding the tools I need	1	2	3	4	5
Our plant is disorganized and dirty	1	2	3	4	5
New product designs are thoroughly reviewed before the product is produced and sold	1	2	3	4	5
Customer requirements are thoroughly analyzed in the new product design process	1	2	3	4	5
La calidad de los nuevos productos nos preocupa más que su coste	1	2	3	4	5
New product quality is a more important priority than new product quality	1	2	3	4	5
Quality is more important than schedule concerns in the new product development process	1	2	3	4	5
Direct labor employees are involved to a great extent before introducing new products or making product changes	1	2	3	4	5
There is little involvement of manufacturing and quality people in the early design of products, before they reach the plant	1	2	3	4	5
We work in teams, with members from a variety of areas to introduce new products	1	2	3	4	5
We use ability to work in a team as a criterion in employee selection	1	2	3	4	5
We use problem solving ability as a criterion in selecting employees	1	2	3	4	5
We use work values and ethics as a criterion in employee selection	1	2	3	4	5
Our plant is organized into permanent production teams	1	2	3	4	5
During problem solving sessions, we make an effort to get all team members' opinions and ideas before making a decision	1	2	3	4	5
Our plant form teams to solve problems	1	2	3	4	5
In the past three years, many problems have been solved through small group sessions	1	2	3	4	5
We strive to establish long-term relationships with suppliers	1	2	3	4	5
Our suppliers are actively involved in our new product development process	1	2	3	4	5
Quality is our number one criterion in selecting suppliers	1	2	3	4	5
We rely on a small number of high quality suppliers	1	2	3	4	5
We frequently are in close contact with our customers	1	2	3	4	5
Our customers often visit our plant	1	2	3	4	5
Our customers give us feedback on quality and delivery performance	1	2	3	4	5

**SECTION D**

13. Please, select in which competitive position is your company in comparison with its competitors relating to these performance measurements (1: Much worse, 7: Much better)

	Much worse			Much better			
Unit production costs	1	2	3	4	5	6	7
Fast deliveries	1	2	3	4	5	6	7

Flexibility to change production volume and inventories	1	2	3	4	5	6	7
Cycle time	1	2	3	4	5	6	7
Design quality	1	2	3	4	5	6	7
Manufacturing quality	1	2	3	4	5	6	7
Customers satisfaction	1	2	3	4	5	6	7
Employees satisfaction	1	2	3	4	5	6	7
Market share	1	2	3	4	5	6	7

14. **ONLY FOR COMPANIES APPLYING ISO 9000** Since your company obtained the ISO 9000 certification How these performance measures have evolved (in average)? (1: Strong decrease; 7: Strong increase)

	Strong decrease			Strong increase			
Unit production costs	1	2	3	4	5	6	7
Fast deliveries	1	2	3	4	5	6	7
Flexibility to change production volume and inventories	1	2	3	4	5	6	7
Cycle time	1	2	3	4	5	6	7
Design quality	1	2	3	4	5	6	7
Manufacturing quality	1	2	3	4	5	6	7
Customers satisfaction	1	2	3	4	5	6	7
Employees satisfaction	1	2	3	4	5	6	7
Market share	1	2	3	4	5	6	7

15. IS YOUR COMPANY APPLYING THE PHILOSOPHY OF A TQM SYSTEM?

<input type="checkbox"/> NO	<input type="checkbox"/> YES. (tell us the approximate date in which it started)
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16. **ONLY FOR COMPANIES APPLYING TQM** Since your company implemented a TQM system How these performance measures have evolved (in average)? (1: Strong decrease; 7: Strong increase)

	Strong decrease			Strong decrease			
Unit production costs	1	2	3	4	5	6	7
Fast deliveries	1	2	3	4	5	6	7
Flexibility to change production volume and inventories	1	2	3	4	5	6	7
Cycle time	1	2	3	4	5	6	7
Design quality	1	2	3	4	5	6	7
Manufacturing quality	1	2	3	4	5	6	7
Customers satisfaction	1	2	3	4	5	6	7
Employees satisfaction	1	2	3	4	5	6	7
Market share	1	2	3	4	5	6	7