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Exploring the binom innovation – quality and environmental management systems

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1. Introduction

Deming already stated in his day (Deming, 1986) that the true implication of an organization in the, then, original quality "philosophy" would imply a cultural change of huge dimensions. This statement, undoubtedly contrasted by the ensuing events, seems that it should carry implicitly with it a set of organizational innovations to bear it out, especially in organizations from the production sector; while it is true that this has possibly not always been like this, especially in cases in which the implementation of quality management systems has just been visible.

There are several scientific studies in which the relation between quality management and the innovative capacity of the organization has been analysed. In particular, they analyse if those organizations with a higher "level" of quality are more innovative. Innovative with respect to what, we may ask? Well, generally in the creation of new products and services. However, these studies, generally of a theoretical nature, are not lacking in limitations. Thus, for example, most of them are based on the analysis of organizations which have implemented Total Quality Management (TQM), such as, for example, Llorens et al. (2003), Singh and Smith (2004) or Hoang et al. (2006), heedless of the implementation of quality assurance systems by means of management standards, like the ISO standard ISO 9001:2000. Despite this, Prajogo and Sohal (2003) already highlighted that the contribution of TQM to innovation has not been explored sufficiently in previous research; in particular, empirical studies are rare.

Moreover, these few empirical studies are not free from debate either. Thus, in the case of TQM in particular, there are some which detect a positive relation between it and the innovating capacity of the organization, such as, for example, Flynn et al. (1994), who confirms its relation in terms of speed to market, while Terziovski and Samson (1999) confirm it in relation to the number of new products offered to the market. Subsequently, Prajogo and Sohal (2003) have confirmed how TQM has a positive relation both with the quality of the product offered and with product innovation performance. In any event, it is also true that studies are found, such as the one by Singh and Smith (2004), in which exactly the opposite is declared; that TQM implementation reduces the company's innovating capacity. These statements are born out by theoretical contributions by authors such as Slater

and Narver (1998) and Kim and Marbougne (1999), who believed that TQM can hinder innovation and the level of innovation in organizations (Baldwin and Johnson, 1996).

Nonetheless, for this innovating capacity to be carried out, there are many intervening factors. As Mitra (2000) and Szeto (2000) state, innovation is the result of the combination of different activities, such as research and development, process development, design, marketing, organizational restructuring, resource management, and employee development and thus it is likely to be supported by TQM practices (based on Hoang, et al., 2006). It is for this reason that authors like Karagozoglu and Brown (1998), Johannessen et al. (2001) or Prajogo and Sohal (2003), measure an organization's innovating capacity by using variables, such as: new products offered, number of patents created, new markets, new product variants, and even new production methods. Focusing precisely on this last aspect, we raise the question in this article: to what extent are these organizational innovations related to the implementation of quality systems in the organization? Or, are they only related in the case of implementing TQM practices, as would appear to be inferred in the detected studies? Do other possible "levels" of quality management not imply any kind of organizational innovation?

In this respect, some contributions have been detected in book form, which have analysed, in recent years, to what extent involvement in quality management is related to organizational innovations. Thus, for example, Peris et al. (2001), Oackland (2003), Oackland (2004), and Camisón et al. (2007) tackle this matter, although, once again, they only focus on organizational innovations derived from TQM implementation, which does not give an answer to the question raised about the different levels of quality in which an organization can be immersed. All this without forgetting that real TQM is implemented in a small number of organizations in comparison with companies which opt for only quality assurance by means of establishing the ISO standard 9001:2000 (Heras et al., 2006).

Therefore, we ask ourselves: does a relation exist between the different quality "levels" and the organizational innovations implemented in organizations? In particular, this article will focus on companies in the production sector because they are undoubtedly the least analysed and are the ones which implement a priori more relevant organizational innovations.

To do so, in the first place, the levels of quality and the types of organizational innovations seen fit to be analysed will be defined in the following section. Based on this, and using empirical methods with the participation of more than 150 companies, the involvement of these organizations in the most usual quality management systems, as well as the organizational innovations implemented by them, will be assessed. The possible existing relation between both aspects is analysed in depth in the final sections of this article.

2. Theoretical framework

With the aim of carrying out the proposed study, what is understood by organizational innovation must be defined first. Existing literature is undoubtedly quite extensive and scattered. In this respect, Lam (2005) has already pointed out that there is no consensus on a definition of the term "organizational innovation", which remains ambiguous. However, the most accepted definition is possibly the one provided by Damanpour and Evan (1984) and Damanpour (1987), according to whom organizational innovation is defined as the use of new managerial and working concepts and practices.

Subsequently, there have been several authors who have carried out classifications of the organizational innovations according to categories. To sum up, Pardo del Val (2004) managed

to bring together the most important classifications in four main dimensions: scope, origin, necessity and speed (see table 1).

Dimension or variable	Types of change	Authors
According to their scope	Changes of growth Strategic changes	Greiner, 1972; Levy, 1986; Barczak et al., 1987; Nadler and Tushman, 1989, 1990; Goodstein and Burke, 1991; Marshak, 1993; Mezias and Glynn, 1993; Blumenthal and Haspeslagh, 1994; Hutt et al., 1995; Van de Ven and Poole, 1995; Ghoshal and Barlett, 1996; Krüger, 1996; Ruiz and Lorenzo, 1999
According to their origin	Reactive changes Forward-looking changes	Nadler and Tushman, 1989; Strebel, 1994; Appelbaum et al., 1998
According to their necessity	Essential changes Timely changes	Levy, 1986; Goodstein and Burke, 1991; Beer and Eisenstat, 1996; Appelbaum et al., 1998
According to their speed	Quick changes Gradual changes	Marshak, 1993; Blumenthal and Haspeslagh, 1994

Source: Pardo del Val (2004)
Table 1. Types of organizational innovations

This paper, based on the previous classification according to its origin, focuses attention on the reactive changes, in other words, on those which arise in response to a phenomenon (Nadler and Tushman, 1989). In this way, management identifies the need for change and prepares the necessary steps so that the organization can overcome pressures from the environment (Applebaum et al., 1998), in this case, establishing quality management systems.

In order to so, it has been seen fit to analyse the type of innovation according to its scope. Thus, from among all the classifications, and based on papers by Whittington et al. (1999), Wengel et al. (2000) and Coriat (2001); Armbruster et al. (2007) have proposed that organizational innovations be classified as structural and procedural. According to these authors, structural organizational innovations are those which "influence, change and improve responsibilities, accountability, command lines and information flows as well as the number of hierarchical levels, the divisional structure of functions, or the separation between line and support functions. Such structural organizational innovations are, for instance, the implementation of teams, or the change from an organizational structure of functions into one of product or customer- oriented lines, segments, divisions or business units". At the same time, Armbruster et al. (2007) have defined procedural organizational innovations as those which "affect the routines, processes and operations of the company. Thus, these innovations change or implement new procedures and processes within the company, such as simultaneous engineering or zero-buffer-rules. They may influence the speed and flexibility of production or the quality of production". This is the classification which will be used in this paper.

On the other hand, Armbruster et al. (2007) have also classified these innovations into intra-organizational and inter-organizational. While intra-organisational innovations occur within an organisation or company, inter-organisational innovations include new organisational structures or procedures with the organisation's environment, such as customer quality audits or outsourcing.

For the scope of this paper, it has been deemed appropriate to focus only on intra-organizational innovations, because they are probably the most relevant. In this respect, the latter have been classified in sub-unit level and organisational level, depending on whether they are located in a specific department, or whether they affect the overall structure of the company as a whole. Based on the previous authors, in table 2 some examples of organizational innovations in the production sector are presented, according to the classification used. It is evident that this table does not include all possibilities and some of them can be classified differently depending on the scope of each case. However, this table provides a clear framework in the design of the research to be carried out.

	Sub Unit Level	**Organisational level**
Structural innovations	Team work in production (manufacturing and assembly) Integration of tasks (planning, operating or controlling functions) Quality circles	Decentralisation of planning, operating and controlling functions Time bank for flexible labour capacity Manufacturing cells Cross-functional teams Reduction of hierarchical levels Virtual enterprise
Procedural innovations	Simultaneous/concurrent engineering Continuous improvement process (CIP) Preventive maintenance Job enrichment / job enlargement	Internal zero-buffer-principle (Kanban) Just-in-time delivery to the costumer (JIT) Supply chain management Outsourcing

Source: in-house compilation based on Armbruster et al. (2007)
Table 2. An item-oriented typology or organizational innovations in the production sector

On the other hand, and with reference to the different quality "levels" in which an organization may find itself, undoubtedly the most accepted classification is Dale's (2003), according to which 4 stages are identified: inspection, quality control, quality assurance and total quality management. It should be noted that, following Dale (2003), the terms are used to indicate levels in a hierarchical progression of quality management (see figure 1).

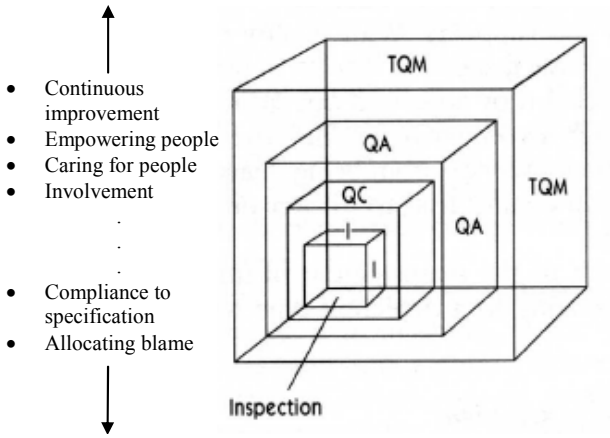

Figure 1. The four levels in the evolution of TQM (Source: Dale (2003)

The four previous levels correspond specifically to the following aspects in the field of quality management:

- Inspection (I): Conformity evaluation by observation and judgement accompanied as appropriate by measurement, testing or gauging (ISO, 2005). This level would correspond to management through inspection, as only end results are known, while nothing is known about the process.
- Quality control (QC): Part of quality management focused on fulfilling quality requirements (ISO, 2005), where quality management is defined as coordinated activities to direct and control an organization with regard to quality (ISO, 2005). The second level would correspond to manufacturing process QC, i.e. the application of Statistical Process Control (SPC). Those organizations whose approach to the management of quality is based on inspection and Quality control are operating in a detection-type mode (i.e. finding and fixing mistakes).
- Quality assurance (QA): Part of quality management focused on providing confidence that quality requirements will be fulfilled (ISO, 2005). The third level would be a counterpart of QA relating to definition of all processes, in particular of non-manufacturing processes, especially in the case of the development of new products. QA is a prevention-based system which improves product and service quality, and increases productivity by placing emphasis on product, service and process design. This is the level which is considered to be obtained by an organization after implementing a quality management standard, such as ISO 9001:2000, known precisely as "quality assurance management system" in its previous systems.
- Total Quality Management (TQM): TQM involves the application of quality management principles to all aspects of the organization, including customers and suppliers, and their integration with the key business processes (Dale, 2003). Reed et al. (2000) reviewed the ideas proposed by the "quality gurus": Deming, Juran, Crosby, Feigenbaum and Ishikawa and found five TQM practices on which all of them had agreed. These are: customer focus, leadership and top management commitment, training and education, team, and culture. These could define the concept of TQM.

3. Objective and hypothesis

With the aim of finding out if greater achievement of a level of quality in the production sector entails greater implementation of organizational innovations the following working hypothesis has been posed:

H1: A greater level of quality established in a company entails greater use of organizational innovations.

In order to assess this hypothesis, and using the organizational concepts provided by the classification mentioned by Armsbruster et al. (2007), four sub-hypotheses have been posed, one for each of the typologies of the organizational innovations proposed by these authors. These are:

H1a: A greater level of quality established in the company entails greater use of structural innovations in the Sub Unit level.

H1b: A greater level of quality established in the company entails greater use of procedural innovations in the Sub Unit level.

H1c: A greater level of quality established in the company entails a greater use of structural innovations in the Organisational level.

H1d: A greater level of quality established in the company entails greater use of procedural innovations in the Organisational level.

In this way, each of the sub-hypotheses analyses whether, for any level of the organization, sub-unit and organizational level, and for any category of the classification of organizational innovations proposed by Armsbruster et al. (2007), structural and procedural organizational innovations, there is greater use of organizational innovations the greater the established level of quality is.

4. Methodology and sample

In order to analyse each of the proposed sub-hypotheses, empirical data from the Spanish sub-sample of the international questionnaire, European Manufacturing Survey (EMS). EMS was created by the Fraunhofer Institute for Systems and Innovation Research (ISI) in 1993 and is biannual (Lay and Maloca, 2004).

Among its main objectives is the detailed study of the use of organizational and technological innovations, both at an intra-organizational and an inter-organizational level in manufacturing companies. EMS is not intended to be a "new" or "better" monitoring system; instead, it proposes a complex methodology as a first step towards a common way for collecting information on technological and organizational concepts among others. In the last edition, in 2006, EMS was carried out in 12 countries (Austria, Croatia, France, Germany, Greece, Netherlands, Slovenia, Spain, Switzerland, Turkey, United Kingdom and Italy) resulting in approximately 3.500 responses.

In order to determine the implementation of organizational innovations, EMS has listed a set of organizational innovations, among which the ones used in this paper are found, and are shown as an example in Table 2. In this study, it has been seen fit to use the ones which affect the analysed unit in a more cross-cutting way.

Thus, in this way and for the case of the first sub-hypothesis, which aims to analyse the use of structural innovations in the Sub Unit level, the use of teamwork in production and the integration of tasks have been studied. In the second hypothesis, the use of procedural innovations in the Sub Unit level is analysed by means of the study of the degree of use of simultaneous/concurrent engineering and the continuous improvement process (CIP). In the third hypothesis, the organizational innovations used to analyse the use of structural innovations in the Organisational level are decentralisation of planning, operating and controlling functions and time bank for flexible labour capacity. Finally, in the fourth sub-hypothesis, the use of structural innovations in the Organisational level by means of the degree of use of internal zero-buffer-principles (Kanban) and Just-in-time delivery to the costumer (JIT).

Regarding the levels of quality analysed in this paper, although four possible levels of quality management in an organization have been defined, as Dale (2003) proposes, after a first analysis of the sample, it was deemed appropriate to work with only 3 levels: inspection and quality control, quality assurance and total quality management. This enabled associations to be obtained with a number of relatively similar companies, without jeopardizing the research objective, as will be seen in the following section. It should be taken into account that this classification, which groups the first two levels defined by Dale (2003), quality inspection and quality control in a single group, has been used previously by other authors (e.g. Casadesús et al., 2005). This is due to the fact that both levels are closely related, so that, in practice, they may even be mistaken. Those organizations which have not yet established any quality assurance system, such as the ISO standard 9001:2000, are commonly found in this group.

In order to determine which companies form part of each group, specific questions are included in the EMS questionnaire in which the quality management practices which exist in

the company are asked about directly: quality control systems, implementation of quality management standards, implementation of total quality management models etc. In this way, each organization can be classified in relation to the highest level found. Thus, an ISO 9001:2000 certified organization, implementing the EFQM model for TQM, will qualify for the level of greater involvement: TQM implementation, since, according to Dale's classification (2003), a greater level includes the former.

The Spanish sub-sample consists of manufacturing establishments (NACE code 15-37) which have at least 20 employees. The Spanish National Statistic Institute facilitated the distribution of all manufacturing establishments with these characteristics. Approximately, 10% of the population received the EMS questionnaire, corresponding to 4.450 surveys. The questionnaire was sent out by postal mail to the selected firms in two rounds. The first round was sent out in April 2006 while the second one was in June 2006.

Our final dataset consists of 151 entries. With the 4.450 questionnaires sent out this represents a response rate of approximately 3.5%. In our view, such a low response rate is due to two reasons: it is the survey's first run, and to the non-obligatory character of participation compared to other mandatory surveys. At any rate, the results obtained have a confidence level of 83%, taking into account a margin of error of 5% (p=q=0.5).

5. Results

5.1. Descriptive analysis

Grouping the organizations analysed according to their level of quality, the results obtained are shown in Table 3. As can be seen, on average, the companies situated in the highest quality level of Dale's classification (2003) are the ones with a greater number of employees and a larger turnover. As expected, the greatest number of companies are concentrated in the second quality level, in other words, that of those organizations which have implemented a quality assurance standard, mainly ISO 9001:2000, but, by contrast, have not become involved in TQM models.

Group	N	Employees	Turnover (M€)
1. Quality inspection & Quality control (QI&QC)	34	70	11,67
2. Quality Assurance (QA)	72	124	22,18
3. Total Quality Management (TQM)	45	156	29,57

Table 3. Summary of basic descriptive statistics by quality level group

If a descriptive analysis is carried out according to the technological classification by OECD sectors (see Table 4), it can be seen how companies are equally distributed in three of the four categories, except the High-technology industries, where there are only four companies.

	NACE	N	Groups		
			1 (QI&QC)	2 (QA)	3 (TQM)
Low-technology industries	36-37, 20-22, 15-16, 17-19	49	21 (42.9%)	15 (30.6%)	13 (26.5%)
Medium-low-technology industries	23, 25, 26, 351, 27, 28	49	5 (10.2%)	27 (55.1%)	17 (34.7%)
Medium-high-technology industries	31, 34, 24 excl. 2423, 352 + 359, 29	49	8 (16.3%)	28 (57.1%)	13 (26.5%)
High-technology industries	353, 2423, 30, 32, 33	4	0 (0.00%)	2 (50.00%)	2 (50.00%)
Total		151	34 (22.5%)	72 (47.7%)	45 (29.8%)

Table 4. Classification of manufacturing industries based on technology intensity

A first tendency can be detected based on Table 4: the technology intensity of the sector to which the company belongs must be one of the causes of greater use of organizational innovations within the company. This statement is based on the fact that, if, on the one hand, it is in less intensive sectors where there is a larger proportion of companies in the lowest level of quality (group 1, 42.9%), this gradually decreases at the same time as the technology intensity increases. Thus, in sectors with more technology intensity, there is no company belonging to this group.

Regarding the two sectors of medium technology intensity, these are very similar since, in both cases, the greater percentage of companies, 57.1% in the case of medium-high and 55.1% in medium-low, are found in the second level of quality. Only in sectors with greater technology intensity does the number of companies with the highest levels of quality (group 3) represent the greatest percentage. However, these considerations should be regarded with great caution due to the sample size and the heterogeneous distribution among sectors.

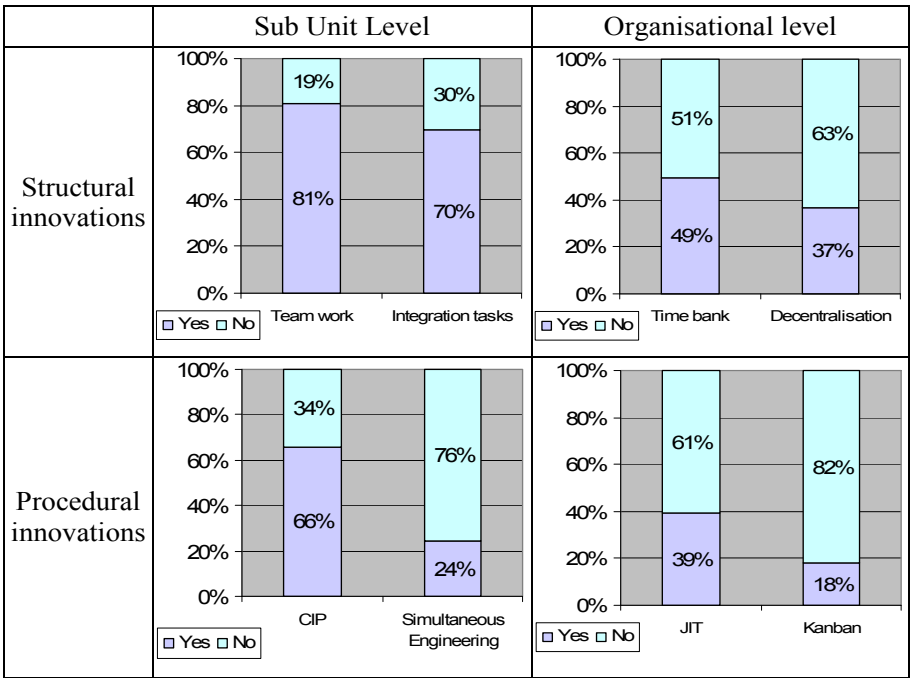

Figure 2. Use of the different organisational concepts

On the other hand, in Figure 2 the use of the different organizational concepts analysed in the entire sample is shown. First, it can be observed how the results in each quadrant of studied concepts are relatively similar, except the procedural innovations in the sub-unit level. This would confirm that the variables used could be quite representative of each quadrant, or hypothesis, to be studied.

On the basis of the data obtained, it can be seen that team work in production is the most usual concept in the sample, due to the fact that more than 80% of the companies claim to use it in production. In the next place comes integration of tasks with 70%. It must be highlighted how the two most used organizational concepts are those which, according to the classification of Armbruster et al. (2007) are found within the structural innovations – subunit level quadrant. On the other hand, among the least used concepts is the Kanban system (18%) and simultaneous engineering (24%).

If, instead of analysing which the most implemented organizational concepts are, we analyse in greater depth which of these concepts has a greater degree of use within the organizations that use it, a different classification is found which can provide us with a different viewpoint (Figure 3). Even though the leader of the classification continues to be teamwork in production, now it can be seen how the second most widespread organizational innovation is the Kanban system, which was previously in last place. This leads us to conclude that, although the Kanban system is not widely established, it has a high degree of use within the companies which have implemented it. Similar analyses can be carried out with the rest of the organisational innovations studied.

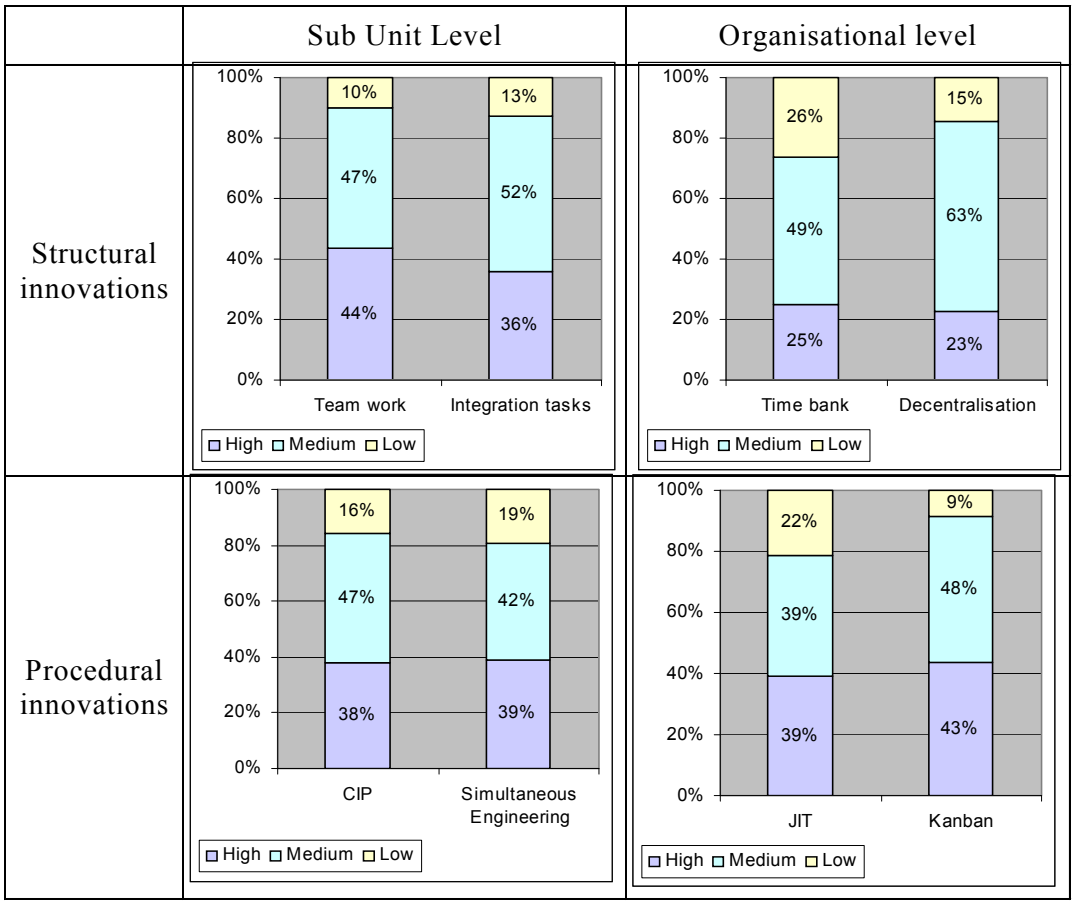

Figure 3. Degree of use of the different organisational concepts

In Table 5, the means of use of each of the analysed organisational innovations, according to the level of quality implemented, are found. In this way, each mean represents the number of organizations which have adapted that innovation. Thus, for example, 5% of the companies in the first level of quality use the "Kanban" system, while the ones in the second and third level use it in a 13 and 21% respectively. Therefore, "0" denotes unused organizational innovation, while "1" implies an established organizational innovation.

mean	Group 1 (QI + QC)	Group 2 (QA)	Group 3 (TQM)
Structural innovations at sub unit level			
Team work in production (manufacturing and assembly)	0.65	0.65	0.64
Integration of tasks (planning, operating or controlling functions)	0.44	0.53	0.53
Procedural innovations at sub unit level			
Simultaneous/concurrent engineering	0.07	0.21	0.16
Continuous improvement process	0.18	0.51	0.66
Structural innovations at organisational level			
Decentralisation of planning, operating and controlling functions	0.20	0.26	0.27
Time bank for flexible working hours	0.31	0.29	0.41
Procedural innovations at organisational level			
Internal zero-buffer-principle (Kanban)	0.05	0.13	0.21
Just-in-time delivery to the costumer	0.20	0.28	0.39

Table 5. Means of use of organisational concepts per group

According to the results in Table 5, it becomes clear, in a first, purely descriptive analysis of the detected tendencies, that, generally speaking, in the great majority of the organizational innovations, a positive correlation exists between the degree of use of the innovation and the level of quality: the more implemented organizational innovations are, the greater the organization's quality control. Exceptions to this general rule are the organizational innovations "Time bank for flexible working hours", where group 2 has less use than group 1, "Simultaneous engineering" where it is in group 2 where its use is more widespread, and "Team work in production" where it appears that its use is independent of the level of quality of the company. All this would suggest, in a first approximation to the main hypothesis that consequences exist in a greater use of organizational innovations, due to a greater implementation of quality systems in the companies.

In order to analyse if there are significant differences in the use of organizational concepts among the three groups, created on the basis of Dale's levels of quality (2003), a comparison of means among groups has been carried out using the Wilcoxon-Mann-Whitney test, assuming that the variables do not follow a normal distribution. The Mann-Whitney U test was decided upon, due to the fact that it is the most powerful among the different non-parametric tests (Martín et al., 2008).

This was done in such a way that for each of the eight organizational innovations, contrasts have been carried out among the three groups assuming that the null hypothesis denotes there is no difference of means between groups. For a degree of significance of 95%, the results obtained are shown in table 6.

p-value among groups	Groups 1-2	Groups 1-3	Groups 2-3
Structural innovations at sub unit level			
Team work in production	0.699	0.766	0.496
Integration of tasks (planning, operating or controlling functions)	0.267	0.330	0.921
Procedural innovations at sub unit level			
Simultaneous/concurrent engineering	0.355	0.175	0.024*
Continuous improvement process	0.000*	0.000*	0.064
Structural innovations at organisational level			
Decentralisation of planning, operating and controlling functions	0.468	0.397	0.821
Time bank for flexible working hours	0.638	0.292	0.102
Procedural innovations at organisational level			
Internal zero-buffer-principle (Kanban)	0.166	0.012*	0.114
Just-In-Time delivery to the customer	0.220	0.023*	0.141

* indicates that the Mann-Whitney test is significant ($p < 0.05$).

Table 6. Wilcoxon–Mann–Whitney test to compare means among quality level groups

The detected p-values clarify that, although the previous results in Table 5 suggested that a positive correlation between quality level and the use of organizational innovations in the great majority of cases, there are only significant differences among groups in half of these cases: "Simultaneous Engineering", "Continuous Improvement Process", "Internal zero-buffer-principle (Kanban)" and "Just-in-time delivery to the customer"; all these referring to procedural innovations. In the rest of the cases, there are no clearly significant differences.

5.2. Solution of the hypothesis

Based on the results obtained, and with a view to providing an answer to the main hypothesis, the results will now be analysed in greater depth, relating them to each of the four posed sub-hypotheses.

Regarding the first sub-hypothesis, H1a, according to which a greater quality level established in a company entails greater use of structural innovations in the Sub Unit level, the data related to the establishing of "Teamwork in production" and "Integration of tasks" should be analysed. It can be observed how these are two of the most common innovations among companies, independent of their quality levels. This reasoning is due to the high means value, around 50-60%, and to the little difference between these. Consequently, analysing the difference between means using the Mann-Whitney U test, the null hypothesis that there are no differences among groups is accepted. The first sub-hypothesis must be rejected.

Sub-hypothesis H1b proposed that a greater level of quality established in a company entails greater use of procedural innovations in the Sub Unit level. In this case, significant differences have been detected between the two organizational innovations studied: "Simultaneous/concurrent engineering" and "Continuous improvement process". Regarding CIP, there are significant differences between the first group (QI and QC) and the rest of the groups (QA and TQM). These results suggest that use of this significant innovation takes place when the company achieves the second quality level (QA), since there are no significant differences between the second and third group. By contrast, in the case of "Simultaneous/concurrent engineering", it is between the second and third group when the majority of companies decide to put this innovation into practice. In conclusion, the null

hypothesis must be rejected and the difference between means accepted. For this reason, H1b must be accepted.

Thirdly, sub-hypothesis H1c stated that the greater level of quality established in the company entails greater use of structural innovations in the Organisational level. Regarding the two variables analysed: "Decentralisation of planning, operating and controlling functions" and time bank for flexible labour capacity, as occurs in the first sub-hypothesis, significant differences are not detected among the three groups. Consequently, the proposed null hypothesis must be accepted, thus rejecting this sub-hypothesis.

Finally, the last sub-hypothesis, H1d, stated that greater quality control established in the company entails greater use of procedural innovations in the Organisational level. This has been analysed on the basis of establishing the "internal zero-buffer-principle (Kanban)" and "Just-In-Time delivery to the customer". As can be seen in both innovations, differences are found between the first and third group. A possible explanation might be that neither innovation is used until the highest quality levels have been reached by the company. As a result of this, the null hypothesis of equality of means must be rejected, and the alternative is accepted; therefore, sub-hypothesis H1d is accepted.

Consequently, and once the four sub-hypotheses have been analysed, it can be deduced that the main hypothesis may be accepted or rejected according to the scope of the innovations which are studied. In other words, it should be rejected when referring to structural innovations, while it will be accepted if we only refer to procedural innovations.

Therefore, and to sum up, it can be asserted that in the case of production companies, a greater level of implementation of quality systems has an impact on a greater implementation of procedural innovations, that is, in those innovations which "affect the routines, processes and operations of the company" (Armsbruster et al., 2007). By contrast, they do not exert an influence on structural innovations or those which "influence, change and improve responsibilities, accountability, command lines and information flows as well as the number of hierarchical levels, the divisional structure of functions, or the separation between line and support functions" (Armsbruster et al., 2007).

6. Conclusions

Firstly, and before focusing on the work carried out, it is interesting to notice how no empirical paper, analysing the impact of the different quality levels which can be achieved by organizations in organizational innovations, has been detected. The literature only offers research related to the establishing of TQM, when these models or philosophy are clearly far less implemented than quality assurance systems, such as, for example, ISO standard 9001:2000.

In this article, based on one of the many classifications of organizational innovations, the one compiled by Armsbruster et al. (2007), and the different levels of quality defined by Dale (2003), the impact of the implementation of quality management systems on organizational innovations has been analysed. The aim of this paper has been to ascertain if greater achievement of quality levels in production organizations implies greater use of organizational innovations.

Descriptively speaking, and based on the empirical study carried out, a greater implementation of organizational innovations has been clearly detected, especially the use of "Team work in production", and a greater level of quality in companies with a greater number of employees and a larger turnover. However, on the other hand, it is also true that the

majority of companies can be found in the quality level defined as "Quality assurance", without having opted yet for TQM.

Nevertheless, from the results obtained it must be especially highlighted how the implementation of quality management systems does indeed entail organizational innovations of a procedural type, at every level of the organization, while no significant differences are detected regarding innovations of a structural type. This, which could be obvious in the case of the group of organizations that have only implemented Quality Inspection and Quality Control (QI and QC), is also surprisingly fulfilled in the companies involved in TQM. It would appear that implementing this philosophy does not entail implementing more organizational innovations of a structural kind than that of any other level of quality, as could have been believed a priori.

The use of only two variables for the analysis of each type of organizational innovation is a limitation of design of the empirical work carried out. It is for this reason that now, once the tendency of these innovations in relation to the implemented quality management systems is known, we should take advantage to study each aspect in greater depth, by means of a field study which focuses more on each kind of organizational innovation.

7. References

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