How integrated are environmental, quality and other standardized management systems? An empirical study☆

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ABSTRACT

The aim of this article is to analyze the extent to which environmental management systems are really integrated with the quality and other standardized management systems implemented in organizations. To this end, an empirical study was carried out on 435 companies that were registered to multiple management system standards, including ISO 14001: 2004 and ISO 9001: 2000 at the minimum. Overall, 362 of those organizations indicated that they had integrated all or at least some of their standardized management systems. Results from the cluster analysis show three types of organizations in function of their level of integration of management system goals, documentation and human resources, as well as procedures. The results also illustrate which particular management system components are integrated and to what degree.

1. Introduction

In recent years, many organizations have implemented Environmental Management Systems (EMSs) in order to improve their environmental management. However, this has not been the only standardized Management System (MS) applied by these organizations. In fact, multiple Management System Standards (MSSs) are often implemented to improve organizational performance in quality, safety, security and a number of other aspects or functions.

The standardized EMS with the greatest impact at the global level, with more than 129,000 certifications [2], has undoubtedly been that developed by the Technical Committee (TC) 207 of the International Organization for Standardization (ISO), namely ISO 14001: 2004. This standard proposes an EMS based on the "*Plan-Do-Check-Act*" (PDCA) model, with MS requirements classified under six chapters: *general requirements*, *environmental policy*, *planning*, *implementation and operation*, *checking and corrective action* and *management review* [3].

This EMS has very often been implemented, in parallel or consecutively, in organizations which had already used some other standardized MS. This is usually (see, for e.g., Ref. [4]) a Quality Management System (QMS) based on ISO 9001: 2000, the MSS generated by the same organization (ISO), but a different TC, namely ISO/TC176. ISO 9001: 2000 is based on the "*Process Approach*" and eight *Quality Management Principles*: *customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making and mutually beneficial supplier relationships* [5]. ISO 9001: 2000 classifies MS requirements under five chapters: *quality management systems, management responsibility, resource management, product realization, and measurement, analysis and improvement* [6].

These two standards together undoubtedly make up the set of standards that has had the most impact globally, with more than one million certifications to ISO 9001 and ISO 14001 all over the world and a 16% increase in 2006, the last year for which such data is available [2]. However, other MSs being implemented in organizations which already use a standardized EMS do not stop at the ISO 9001-based QMS. Therefore, for instance, MSSs have been developed for occupational health and safety (e.g., OHSAS 18001 and CSA Z1000), corporate social responsibility and accountability

(e.g., SA 8000 and AA 1000), and security of information systems (ISO 27001) and supply chains (ISO 28000). Naturally, one of the questions for the companies implementing two or more MSSs is whether the related MSs should be implemented and managed individually, or whether they could benefit in some way from the possible synergies when integrating these MSs.

A theoretical answer can be found in literature, since all these MSs, certifiable or not, can be integrated into a single MS: an Integrated Management System (IMS). However, the definitions of the "*integration*" process and the resulting "*IMS*" vary, not only depending on the situation of each organization, but also on the particular study defining these terms. For example, in Garvin [7], integration is defined as the "*degree of alignment or harmony in an organization - whether different departments and levels speak the same language and are tuned to the same wavelength*". Beck-merhagen et al. [8] discuss integration as "*a process of putting together different function-specific management systems into a single and more effective IMS*". According to Karapetrovic and Willborn [9] and Karapetrovic [10], an IMS is characterized by a complete loss of the unique identities of these subsystems and can be defined as a "*set of interconnected processes that share a pool of human, information, material, infrastructure, and financial resources in order to achieve a composite of goals related to the satisfaction of a variety of stakeholders*". For Pojasek [11], "*a genuinely integrated system is one that combines management systems using an employee focus, a process view, and a systems approach, that makes it possible to put all relevant management standard practices into a single system*". Combining these definitions, we can summarize integration as a process of linking different standardized MSs into a unique MS with common resources aiming to improve stakeholders' satisfaction.

In fact, although integration and IMSs have been studied in detail from a theoretical point of view (see, for instance, Refs. [7,9,10,12–14]), there has been very little related empirical research. We found only six relevant studies of this type, namely Douglas and Glen [15]; Fresner and Engelhardt [16]; Zutshi and Sohal [17]; Karapetrovic et al. [18]; Zeng et al. [19] and Salomone [20]. However, these studies do not explicitly address the question we are about to pose here. Namely, it seems quite clear that organizations which implement an EMS should integrate it with other standardized MSs. But, do all organizations integrate in the same way? In other words, are all organizations fully integrating their MS goals, resources and processes? Or, for example, are they integrating only some of these system components, or even partially integrating them?

The main aim of this paper is to provide an empirical response to these questions. Given that the majority of the organizations involved in the implementation of an EMS find themselves also involved, at one time or another, with implementing another standardized MS before, in parallel with, or after the EMS, addressing such questions from an empirical perspective carries a particular relevance.

In the next section we provide a literature review on the topic of IMSs, followed by a presentation of the methodology used in the study. Subsequently, empirical results are discussed, and the final section sets out the related conclusions.

2. Literature review

The integration of standardized MSs has been theoretically analyzed from a number of perspectives. The findings of these studies can provide an input for those organizations wishing to implement an EMS jointly with another standardized MS. The main points related to three such perspectives, namely the integration strategies, methodologies and degrees, are discussed below.

2.1. Integration strategies

The first aspect that can be analyzed is the integration strategy, namely the particular MSs the organization intends to integrate, as well as the implementation sequence. For example, Karapetrovic and Willborn [9] discuss a two-step integration strategy based on the QMS and the EMS. In the first step, they suggest three options for integrating those two MSs, and in the second step, they address the integration of MSs other than QMS and EMS. The three options in the first step are to establish:

1. The QMS first and the EMS second,
2. the EMS first and the QMS second, and
3. the QMS and the EMS simultaneously.

Karapetrovic and Jonker [21] subsequently discuss an integration strategy for when companies have more than the QMS and EMS implemented. Based on the first option from above, namely establishing the QMS first and the EMS second, the sequence could be:

1. Integrate the QMS and other MSs that are based on the "Process Approach",
2. Integrate the EMS and other MSs that are based on the "PDCA Model", and
3. Link, align and integrate these function-specific MSs.

The empirical study of Douglas and Glen [15], which analyzed IMSs in small and medium-size enterprises, found that all organizations in the sample (28) had implemented first the QMS and then the EMS. Salomone [20], based on the research in Italian companies, shows how in practice a small majority of organizations implemented first the QMS and then the EMS (52% of the sample companies). These results are similar to the findings of Karapetrovic et al. [18] from a study of organizations in the Spanish region of Catalonia, although in this case the percentage of companies that implemented a QMS followed by an EMS was as high as 86%.

2.2. Integration methodologies

The methodology used in the integration process is another important aspect of IMSs, which naturally depends on each organization's own decision. Currently, an international standard covering integration methodologies does not exist. However, at the international level, ISO has just published a book called "The Integrated Use of Management System Standards" [22], which provides a reference on such methodologies. At the national level, different countries have developed guidelines for integration, for example in Australia and New Zealand: *AS/NZS 4581: 1999* [23], in Denmark: *DS 8001: 2005* [24], in Spain: *UNE 66177: 2005* [25], and in the United Kingdom: *PAS 99: 2006* [26].

In addition, many authors have suggested various integration methodologies. For example, Puri [27] proposed a "*ten phase road map for developing and implementing an integrated EMS/Total Quality Management system*", Karapetrovic and Willborn [9] discussed a system-based approach with seven integration steps, Wright [28] presents "*the key elements*" to integrate MSs based on ISO 14001 (five steps) and OHSAS 18001 (four steps) with ISO 9001, and Zeng et al. [19], in an empirical research project in China, proposed a three-level "*synergetic model for implementing an IMS*".

2.3. Integration degrees

The final aspect to be highlighted here is the degree of integration. Just like the other two integration aspects, namely the strategy and the methodology, the decision as to what degree of

integration an organization is going to achieve depends on the organization itself. According to the literature, there is no unique model for all organizations, although academics have defined different degrees of integration.

Fig. 1 summarizes some of the models found in the existing literature. Although the differences in the definitions of each level or degree of integration that exist among the models make a completely accurate, yet effective, classification impossible, four such levels that indicate approximately the same degree of integration, from separation or no integration ("level 0") to complete integration ("level 3"), are identified in the figure.

Seghezzi [29] describes three "*different ways for the integration of systems: addition, merger and integration*". In "addition", "*partial systems for quality, environment, etc., are kept separate*" and "*described in separate documents*", but their "*contents are made comparable*". In "merger", work instructions are completely integrated, but not the procedures and the manual; "*total system is created but the partial system is still visible.*" In "integration", "*companies can choose or develop a generic MS as their general system and include all partial systems in it*".

Wilkinson and Dale [13] describe a four-level model. The first level "*applies to individual MSs, where the system is integrated into every function and activity*" of the organization. The second level is a combination of "*systems based on the identified linkages between MSs*". Documentation is combined and "*integration into every function is still required*". The third level "*involves integrating selected parts*" of MSs "*with other certified systems, but without using identified linkages*". The fourth level "*is to integrate both certified and uncertificated systems with the overall MS*", with the policies and objectives "*aligned to and supporting the overall strategy, policy and objectives of the business.*"

Kirkby's [30] approach has "*three possible models of MSs: separate, aligned and integrated management systems.*" The first level is

"*separate*", where MSs "*cover their own distinct areas for each set of requirements*". At the second level ("aligned"), MSs "*make use of the common areas of the standards*" and "*all common elements such as management review (and) internal audit (…) are routed through the same system.*" The last level ("integrated") combines all "*standards into one common MS*".

In Karapetrovic [14], three types of organizations can be found: those which have integrated only the documentation, those which have aligned the processes, objectives and resources, and finally those which have all parts of the MS integrated in a single MS. The process is summed up in Karapetrovic [10] where two levels are defined: "partial integration" which can range from a simple collaboration to alignment and harmonization of objectives, processes and resources of separate MSs and "full integration" in which constituting MSs lose their unique identities, resulting in complete integration to a single multipurpose IMS. A very similar idea is presented in Beckmerhagen et al. [8] who also discuss three degrees of integration. In "harmonization", organizations have integrated the documentation at a partial level. "Cooperation" denotes the "*enhancement of the combined system using integrated audits and resources*". Finally, in "amalgamation", full integration of MSs into a "*new and comprehensive IMS*" is achieved.

In the same way, Pojasek [11] labels each of the levels, in accordance with the British Standards Institution (BSI) classification: "Combined" signifies "*separate MS are being used at the same time in the same organization*", "integratable" refers to the identification of common elements, "integrating" denotes the integration of these common elements and finally "integrated" means "*one system incorporating all common elements*".

Jørgensen et al. [31] and Jørgensen [32], define three different levels of integration: "correspondence" – "*cross references and internal coordination*", "generic" – "*understanding of generic processes and tasks in the management cycle*", and "integration" – creation of "*a*

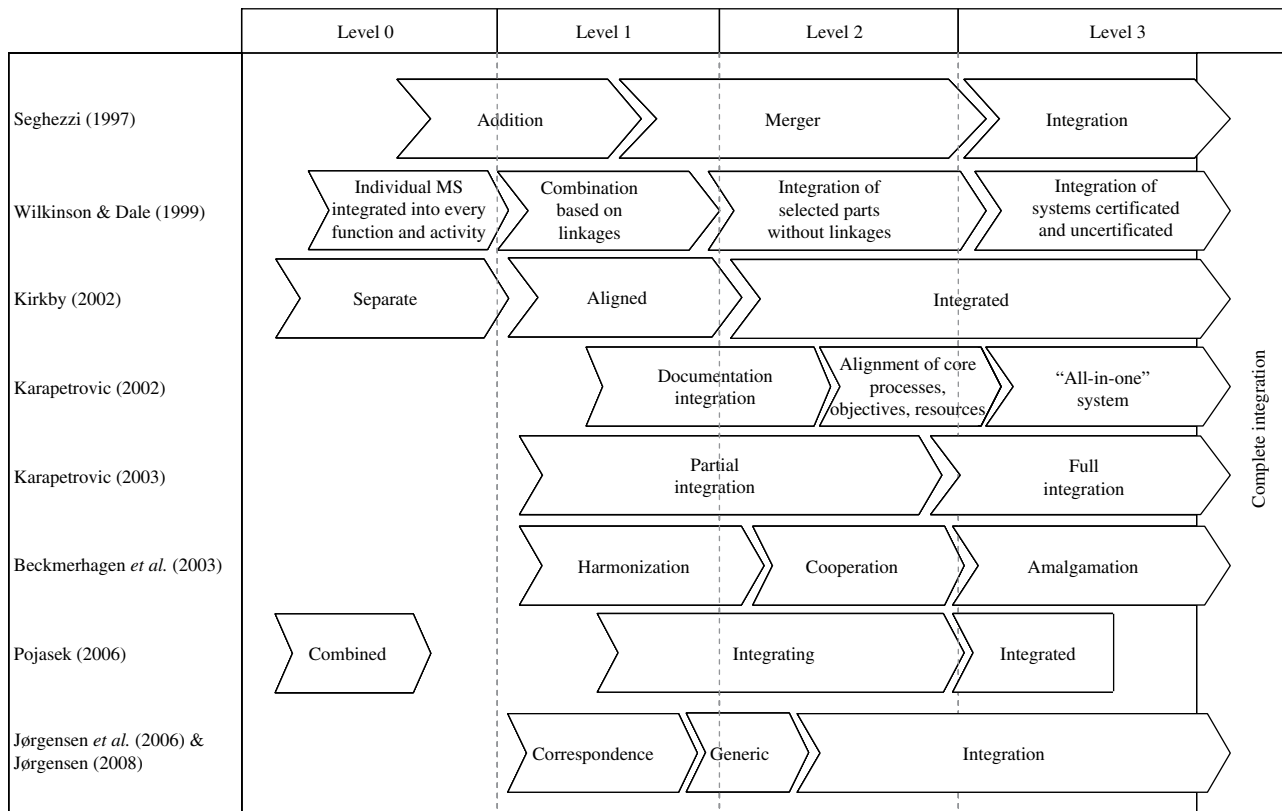|	Level 0	Level 1	Level 2	Level 3	
Seghezzi (1997)		Addition	Merger	Integration	
Wilkinson & Dale (1999)	Individual MS integrated into every function and activity	Combination based on linkages	Integration of selected parts without linkages	Integration of systems certificated and uncertificated	
Kirkby (2002)	Separate	Aligned	Integrated		
Karapetrovic (2002)		Documentation integration	Alignment of core processes, objectives, resources	"All-in-one" system	
Karapetrovic (2003)		Partial integration		Full integration	
Beckmerhagen et al. (2003)		Harmonization	Cooperation	Amalgamation	
Pojasek (2006)	Combined	Integrating		Integrated	
Jørgensen et al. (2006) & Jørgensen (2008)		Correspondence	Generic	Integration	Complete integration

Fig. 1. Degrees of integration according to some authors. Source: Own elaboration from the literature.

culture of learning, stakeholder participation and continuous improvement of the performance".

Apart from the theoretical discussions of the degrees of integration illustrated above, we have not detected other related empirical research, except Douglas and Glen [15], who present an exploratory study of small and medium-size enterprises that had implemented ISO 9000 and ISO 14001. While studying the degrees of integration, Douglas and Glen [15] found that 71% of the 28 companies in the sample had integrated some aspects of their QMS and EMS. Of these organizations, 45% had developed a single manual and procedures incorporating both systems.

Consequently, the work presented next is among the first empirical contributions in the field analyzing the extent to which the various proposed levels of integration make sense in reality and what these levels really include.

3. Methodology

The objective of this paper is to study the extent to which companies integrate their EMS with other MSs they have implemented. In order to do so, we carried out an empirical study in Spain, a country with one of the highest number of ISO 14001 : 2004 and ISO 9001 : 2000 certificates in the world [2]. Specifically, in the case of ISO 14001 : 2004, Spain is in third position, after Japan and China, while in terms of the number of ISO 9001 : 2000 certificates, it is in fourth place after China, Italy and Japan [2].

A questionnaire was sent to 1615 companies that, at the minimum, had both the ISO 14001 : 2004 and ISO 9001 : 2000 certificates. These companies were located in three Spanish autonomous communities with the highest intensity of certifications, namely Catalonia, the Basque Country and Madrid see, Ref. [33]. The envelope containing the questionnaire was addressed to the MS managers of the organization. Details of the fieldwork are set out in Table 1.

Valid responses were received from 435 organizations, representing 27% of the sample. 75 of the responding organizations implemented other standardized MSs, for example the ones for corporate social responsibility (CSR) and occupational health and safety (OHS), in addition to the EMS and the QMS. However, those additional MSs were not the same for all such companies. For instance, 75 organizations implemented OHSAS 18001-based OHSMSs, while 47 implemented CSRMSs. The survey had 16 different sections, based on the various aspects of integration studied, for instance the reasons for not integrating the MSs, the particular MSs and MSSs were already implemented in the organization, tools used in the integration process, the main difficulties faced in this process, integration of internal and external audits, and the future use of standardized MSs. Most of these aspects go beyond the specific aims of this article, but a descriptive analysis of the results can be found in Karapetrovic et al. [18].

In one question in the survey, organizations were asked about what particular MSs were integrated in a single MS, with three

options for the answer, namely none, only the specific ones or all of them. The answers are shown in Fig. 2, where 14% of organizations did not integrate their MSs ("no integration"), 7% integrated only some of them ("partial integration"), and 79% integrated all their MSs ("full integration").

In order to further study the actual degrees of integration, an in-depth analysis of the remaining survey data was performed. Therefore, the survey included questions related to the degrees of integration specific to each MSs element which, according to Karapetrovic and Willborn [9], needs to be integrated, namely the MS resources, goals and processes. According to the definitions of ISO 9000 [5], goals or objectives are "*something sought or aimed for*", a process is a "*set of interrelated or interacting activities which transforms inputs into outputs*", and resources, although not defined by ISO 9000: 2005, are described in ISO 14001 to "*include human resources and specialized skills, internal infrastructure, technology and financial resources*" [3]. In an IMS, the goals are common for all MSs and are the first aspect that needs to be integrated [9,10,21]. Processes are interconnected and use the same pool of resources [10]. These three main elements included in the integration process are the basis for the questions studied here.

The first group of questions was related to the integration of human resources, given that it is important to know to which point the human resources involved are integrated or not, namely whether or not the responsibility for managing one MS falls to the same person that manages other MSs. This aspect was analyzed taking into account three different levels of responsibility: top management, asking about the executive management, functional level, asking for the organization's MS representative, and the "shop-floor", asking for the inspector of the various MSs.

The second group of questions, related to the goals and documentation resources, were focused on the degree of integration of these MS components. Specifically, we wished to learn whether or not the organizations integrated the goals (policy and objectives) and the documents (manual, procedures, instructions and records) which are indispensable to an MS.

Finally, with reference to processes, we analyzed the extent to which procedures were integrated, since a procedure is defined by ISO 9000: 2005 as "*a specified way to carry out an activity or a process*" [5]. We asked, for example, about the degree of procedural integration for document and record control, product realization, and internal auditing.

Following a descriptive analysis of the data obtained, further multivariate analyses were carried out, namely the multiple correspondence analyses (MCA) and a cluster classification. The MCA was carried out in order to minimize the qualitative information into a few quantitative axes to help in the interpretation of the data [34,35]. The cluster analysis was done to group the

Table 1
Survey information.

Study factor	Factor value
Location	Spain
Time	2006–2007
Population (approximate) [organizations with both ISO 9001 and ISO 14001 certificates]	2706
Sample size	1615
Number of responses	435
Response rate	27%
Confidence level ($p = q = 0.5$)	96%

Source: Own elaboration.
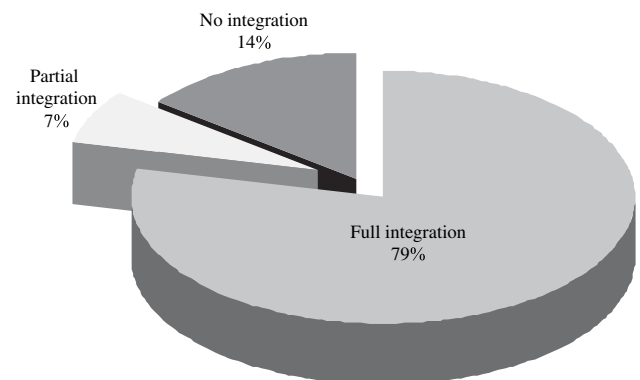
Fig. 2. Integrated standardized management systems. Source: Own elaboration.

organizations, with the aim of discovering the different types according to their degree of integration. The results are presented in the following section.

4. Results

The sample analyzed was made up of 362 companies which claimed to have some level of integration, specifically 86% of companies in the sample whose MSs were partially or fully integrated (see Ref. [1] for an earlier version of this paper). Thus, those companies that did not integrate their MSs, and hence exhibit the "Level 0" characteristics discussed before, were not considered further in this study.

4.1. Descriptive analysis

The question studied in this paper, as previously mentioned, is divided into three parts: human resources, goals and documentation resources, and procedures. A preliminary descriptive analysis considers each of these aspects separately.

Fig. 3 illustrates the extent of integration with respect to the personnel involved in the MS. At all three hierarchical levels (manager, representative and inspector), it is most common to have different people responsible for different function-specific MSs. If we bear in mind that the great majority of companies consider their systems to be fully integrated, the results obtained do not agree with those of Karapetrovic [10,14] and Beckmerhagen et al. [8], according to whom a certain level of integration was expected for all hierarchy levels. Clearly, there are a large percentage of the responding organizations, more than half of them in fact, which may have the various MSs integrated in many respects, but not in terms of the human resources.

Regarding the integration of MS goals and documentation (Fig. 4), the majority of companies have all the items measured fully integrated, although this proportion is considerably higher for the organization's policy (78%), objectives (73%) and the manual (82%), than for the procedures, instructions and records. Specifically, records and instructions are fully integrated in a smaller number of companies (54% and 56%, respectively), albeit a majority. This finding shows that the first documentation resources to be integrated are likely the ones relating to the most strategic areas of the MS, moving on later to the documentation related more to operations. These results are aligned with the findings of Karapetrovic and Willborn [9], Winder [36], Karapetrovic [14] and Jørgensen et al. [31], according to whom integrating policy and objectives is the first step for the implementation of an IMS. However, these results do not seem to be in line with the theoretical proposal by Seghezzi [29], according to whom organizations would integrate the working procedures first and the manual later on, or the findings of Douglas and Glen [15], who detected that 78% of the

organizations integrated their systems and only 45% the manual, indicating that they probably started the process of integration with the working instructions and procedures.

Finally, Fig. 5 illustrates to what extent the MS procedures are integrated. It can be observed that a large majority of companies have five of the procedures under study fully integrated: internal audits, management review, document control, record control and internal communication.

These procedures can be classified under the different requirements of ISO 9001: 2000 [6], following the specific chapters of the standard, namely Chapter 4: "Quality Management System" (control of documentation, record control), Chapter 5: "Management Responsibility" (planning, management review, internal communication), Chapter 6: "Resource Management" (resource management), Chapter 7: "Product Realization" (product realization, determination of requirements) and Chapter 8: "Measurement, Analysis and Improvement" (internal audits, control of nonconformities, preventive and corrective action, improvements). Taking this classification into account, Fig. 5 indicates that procedures related to product realization are the least integrated, while procedures related to measurement, analysis and improvement have the highest degree of integration. Again, we reach a similar result to that obtained in the case of human resources involved, namely that the procedures relating to the more operational processes, such as product realization (Chapter 7 of ISO 9001: 2000), are probably the last to be integrated. Those which could be considered more strategic are integrated first, possibly because of the greater difficulty in standardizing each organization's operational working procedures.

4.2. Multiple Correspondence Analyses

In order to facilitate the understanding of the results with a smaller number of variables, a Multiple Correspondence Analysis (MCA) was carried out. For the MCA, the 21 original variables were ordered into a matrix: 3 variables ask about the people, 6 about goals and documentation, and 12 about procedures. The data processing produces two quantitative axes (extracted factors), explaining 80% of the total variance. Each axis is explained by a number of variables which make the greatest contribution to or have the greatest weight in that axis. The contribution or weight of a variable in an axis depends on the number of variables and the percentage values. The minimum percentage of contribution in order to take a variable into account is 3% in this study. Table 2 sets out the contribution of each variable to each axis, with those with the higher weight in each axis showed in bold.

The first axis represents a partial degree of integration, because all the main contributors or variables with a higher weight in the axis belong to the partial integration category. The second axis, summing up the information of the original data, represents a full degree of integration because the variables that most contribute to
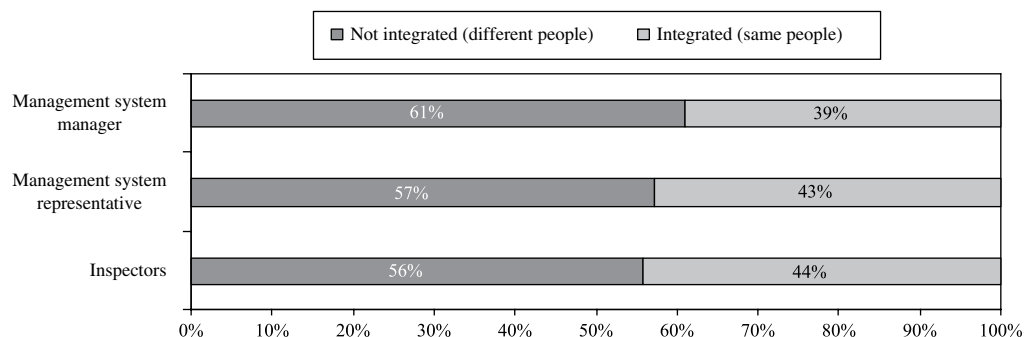

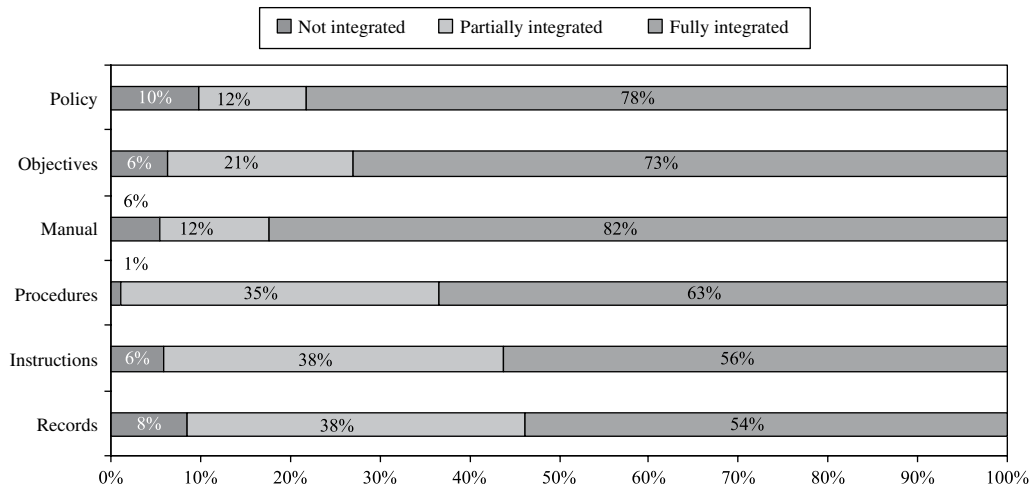**Fig. 3.** Integration of human resources. Source: Own elaboration.

Fig. 4. Integration of goals and documentation resources. Source: Own elaboration.

its creation or that have a higher weight belong to the full integration category. These degrees of integration coincide fully with the classification in Karapetrovic [10]: partial and full.

Axis 1 can provide us with an idea of which aspects are important in organizations that only partially integrate their MSs, given that this axis, explained by a total of 10 variables (those with higher weights), is formed only by variables which represent a partial level of integration. Apart from the integration of the organization's policy, the variables that most contribute to the axis definition or creation are related to procedures, specifically those for documentation control, preventive and corrective action, control of nonconformities, record control and improvements. Under careful analysis, it can be seen that the majority are related to Chapters 4 ("Quality Management System") and 8 ("Measurement, Analysis and Improvement") of ISO 9001: 2000. Namely, once again we see that those organizations which partially integrate do so mainly in the more strategic aspects of the organization, leaving the more operational areas such as "product realization" for either later, lesser integration or no integration.

The second axis defines organizations which fully integrate the various MSs they had implemented. This axis is defined by 16 variables, the majority in full degree of integration. The greatest contributors are those variables related to procedures, as in the first axis and are, in a descending order: document control, preventive and corrective action, control of nonconformities, record control, improvements and management review. Four variables related to documentation belong to the full integration category: procedures, policy, manual and records. As in the other axis, the human resource variables do not contribute to the creation of the second axis. It should be noted that there are some variables in this axis that are not integrated or are integrated at a partial level. Although they are taken into account, the greater contributions are related to full integration and we use these as the variables to define this axis.

One of the most important aspects of this analysis, which can be seen in the Table 2 above, is that in neither of the two axes do we see any variable related to human resources forming a part of the main axis. This indicates that the integration of these resources does not affect the level of integration of the systems that have
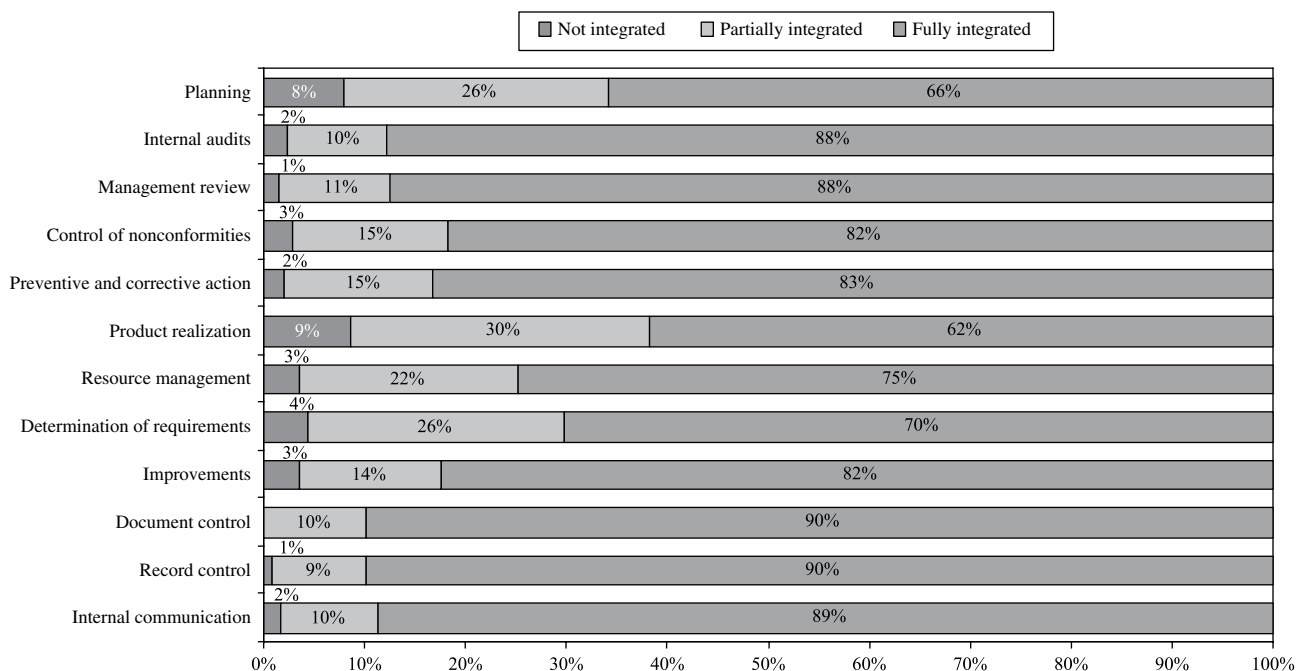

Fig. 5. Integration of procedures. Source: Own elaboration.

Table 2
Variables contributing to the creation of each axis.

		Axis 1			Axis 2		
		Not integrated	Partial integrated	Fully integrated	Not integrated	Partial integrated	Fully integrated
Human Resources	Management system manager	0.04%	–	0.09%	0.39%	–	0.08%
	Management systemrepresentative	0.05%	–	0.07%	0.16%	–	0.09%
	Inspectors	0.14%	–	0.24%	0.14%	–	0.27%
Goals and Documentation Resources	Policy	0.23%	**3.30%**	0.76%	0.45%	0.43%	**6.23%**
	Objectives	1.13%	1.44%	0.90%	1.44%	2.14%	2.72%
	Manual	1.86%	2.91%	1.02%	1.70%	**3.52%**	**5.50%**
	Procedures	0.05%	**3.42%**	2.03%	1.93%	0.10%	**6.47%**
	Instructions	0.05%	0.46%	0.18%	**3.85%**	0.09%	0.88%
	Records	1.32%	1.77%	2.51%	0.35%	2.50%	**3.35%**
Procedures	Planning	1.37%	1.91%	1.60%	**4.74%**	2.60%	**3.61%**
	Internal audits	1.52%	**3.18%**	0.63%	3.03%	2.88%	**6.02%**
	Management review	0.15%	**3.94%**	0.62%	1.20%	0.28%	**7.44%**
	Control of nonconformities	1.43%	**4.68%**	1.35%	1.18%	2.71%	**8.86%**
	Preventive and corrective action	1.74%	**5.06%**	1.32%	2.54%	**3.29%**	**9.57%**
	Product realization	1.95%	1.96%	2.12%	2.50%	**3.68%**	**3.71%**
	Resource management	0.32%	2.30%	0.90%	**4.01%**	0.60%	**4.35%**
	Determination of requirements	2.05%	**3.48%**	2.19%	1.70%	**3.88%**	**6.59%**
	Improvements	2.80%	**4.16%**	1.41%	**4.15%**	**5.29%**	**7.87%**
	Document control	0.00%	**6.45%**	0.72%	0.00%	2.66%	**12.19%**
	Record control	0.92%	**4.33%**	0.58%	1.37%	1.75%	**8.18%**
	Internal communication	1.48%	2.88%	0.52%	1.10%	2.80%	**5.46%**

Source: Own elaboration.

been implemented. To put it another way, regardless of whether the system is partially or fully integrated, the human resources which manage it may be the same or different for each of the systems concerned. No differences are detected with respect to these resources. This result does not correspond with the findings of the theoretical studies (e.g., Ref. [10,14]). Consequently, the possible integration of these resources will not be taken into account in the subsequent analysis.

4.3. Cluster classification

In order to classify the organizations into different groups for the purpose of discovering the integrating nature of the companies which participated in the survey, we used the two axes resulting from the MCA as the original variables for the cluster analysis. We measured the similarities or dissimilarities between individuals using distances, applying hierarchical methods [37], because our objective was to group all individuals into a small number of groups. To detect outliers that might condition the classification, we applied the single linkage method [38]. As a consequence, three respondents were eliminated from the analysis ($n = 359$). The method used to obtain the groups was the Ward method [39], because it is one of the most robust methods, creating homogeneous groups with minimum variance. The result was a three-group classification. To verify whether the relation between the classification and the axes is strong enough to consider the classification to be acceptable, the mean of the eta square (η^2) measure of relation must be high. In our case, the mean is $\eta^2 = 0.655$, which is acceptable.

Fig. 6 shows the three groups obtained. In order to make this grouping easier to understand and to be able to adjust it to the elements integrated by the companies, rather than defining and showing them as functions of the axes detected, we represented them by two different axes: (1) level of goals and documentation integration and (2) level of procedural integration. These are the aspects which contribute to the creation of the two axes. These new axes account for 79% of the variance, slightly less than in the previous section, but nevertheless, very significant. In order to find out the weights of the goals/documentation and procedures in each group, we used a percentage codification in which the organizations that claimed to have a partial integration of goals/

documentation or procedures were taken to be 50% integrated. This aspect of the work is not entirely rigorous, since the organization might have partially integrated at a level of 60% or 40%, for example. However, given that what we were aiming for a simple graphical representation of the relative importance of each of the groups detected, this simplification should not have too much of an effect on the results. In Fig. 6, the surface area of each cluster is represented as a function of the number of companies which make up each group. These three groups are described next.

4.3.1. Group 1

In this group there are only eight companies, representing 2% of the sample. Organizations belonging to this group have partially integrated their goals, documentation and procedures. This group is not homogeneous, in the sense that in some respects the eight organizations behave in a very different way from one another and cannot be jointly defined, as is the case for the other groups. This is a result of the relatively low level of significance of this group (i.e., the small number of companies which make it up). As a consequence, all the data here must be analyzed with caution.

Goals and documentation are integrated at the average level of 29%, while procedures are integrated at 56%. The difference between these two averages is considerable and it can therefore be
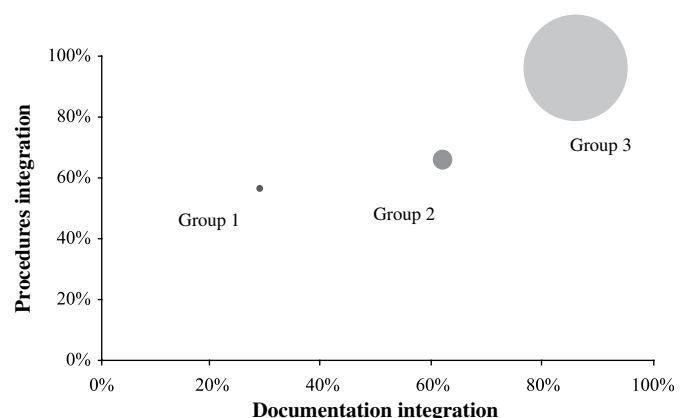
Fig. 6. Group classification. Source: Own elaboration.

claimed that these businesses pay more attention to the integration of procedures than to the integration of goals and documentation.

This finding also seems to be in line with the results obtained when specific goals and document levels were considered. Namely, the most highly integrated documents are procedures in general (50%). They are followed by the management system policy (37%) and the operating instructions (33%). Objectives are integrated at the average level of 25%, records at 13% and, finally, the least integrated item is the management systems manual.

As for the specific procedures, those with the highest level of integration are record control, which are fully integrated in all companies belonging to this group, management review (94%), resources management and internal communication (81%), internal audits (75%) and documentation control (69%). These are some of the so-called "common elements" of MSSs that, as Pojasek [11] states, "*can save money*" because it costs more when organizations implement and comply "*with multiple stand-alone standards*". The remaining procedures have a level of integration below 45%. In this case, we see similarity to the chapters of ISO 9001: 2000 [6], since the procedures that can be connected to the Chapters 4, 5, 6 and 8 are the most integrated. As noted in the descriptive results, procedures related to Chapter 7 are the least integrated ones.

4.3.2. Group 2

This group is made up of 41 companies representing 11% of the sample. Companies' procedures are integrated at a slightly higher-level than documentation and goals, with documentation at 62% and procedures at 66%. However, as these percentages are very similar to each other, one can conclude that on average, goals, documentation resources and procedures are integrated by more than 62%.

In terms of the goals and the documentation resources, the most integrated items are policy (78%), objectives (66%) and the manual (67%), while procedures are 58% integrated and instructions and records exhibit the 55% and 53% levels, respectively. This shows once again how organizations begin to integrate MSs, starting with the more strategic aspects and slowly moving towards operations.

For procedures, the most integrated ones are the procedures for internal communication (74%), internal audits (71%), management review, resources management and documentation control (70%) and improvements and records control (66%). As in Group 1, procedures corresponding to Chapters 4, 5, 6 and 8 of ISO 9001: 2000 are those with a higher percentage of integration, while those in Chapter 7 are the least integrated, considering that this chapter refers to the standard-specific requirements. This confirms the findings in the descriptive results shown earlier.

4.3.3. Group 3

This group is made up of 310 companies representing 87% of the sample, the largest by far of the groups identified. These organizations have, on average, their documentation integrated at a level of 86% and procedures at 96%.

The most integrated items from the goals and documentation category are policy and objectives (87%) and the management system manual (94%). Procedural documents are integrated at 86%, while instructions and records are at 78%. These results correspond with the ones in the previous group of companies, namely that higher-level documents like the manual and procedures also exhibit a higher prevalence of integration.

As for procedures, these are integrated at a level of 96%. The most integrated are document and record control (99%), internal audit, internal communication and preventive and corrective action (97%), management review and improvements (96%) and control of nonconformities (95%). It can be noted that the procedures corresponding to Chapters 4, 5 and 6 of ISO 9001: 2000 are those with the highest level of integration. As noted in the other groups, those

from Chapter 7, which are more difficult to integrate, have a lower level of integration, even though the actual percentage is still very high within this group.

5. Conclusions

Many organizations need to implement an EMS jointly, in parallel or sequentially, with other standardized MSs. When this happens, there is an option of integrating all the systems in a single IMS. Thus, the aim of this study is to discover the degree of integration of such systems within companies. In order to do so, an empirical study was carried out on more than 400 companies which had, at the minimum, implemented both the EMS standard ISO 14001: 2004 and the QMS standard ISO 9001: 2000.

From the results obtained we can conclude that there are a great number of companies (86% of the sample) which had already integrated their MSs at various levels. This result is similar to the findings obtained by Douglas and Glen [15], with 78%, and by Zeng et al. [19], with 57%, although their samples were considerably smaller, namely 28 and 104 organizations, respectively, compared to 435 in our study. With time, it can be expected that the number of companies which integrated their standardized MSs will increase.

It can also be concluded that the results are quite aligned with the theoretical classifications of the integration degrees, although an exact pairing of the empirically-identified groups of organizations with the theoretically-described levels of integration, especially for partial integration levels "1" and "2", was not feasible. We found four groups of organizations, from "Group 0" to "Group 3", each of them described below.

- Group 0
  14% of the 435 companies that responded to the survey are included in this group. These 73 companies did not integrate their MSs. Therefore, they be categorized into "Level 0" of the classification depicted by Fig. 1, as characterized by, for example, Wilkinson and Dale [13], Kirkby [30], Pojasek [11] and likely also Seghezzi [29], in their respective groupings corresponding to this level. Organizations belonging to Group 0 were not taken into account for the cluster analysis, which was performed on the remaining 86% of the respondents and identified three groups among the companies with an integrated system.
- Group 1
  This group is formed by 2% of the total of 362 organizations that integrated their MSs and is characterized by companies with very different integration behaviours. Therefore, due to their heterogeneous nature, the results from these companies cannot be generalized for the whole group and have to be interpreted with caution. However, this limitation is not significant, since there are only a few of these companies in the total sample. The companies from Group 1 seem to be at the initial level of integration and have integrated the documentation resources, record control, management review and resources management the most. Since this group is represented by a distinctly lower degree of integration relative to Groups 2 and 3, and exhibits characteristics similar to the "Level 1" – categorized groupings of, for example, Seghezzi [29], Wilkinson and Dale [13], Kirkby [30] and Beckmerhagen et al. [8], it can be connected with the "Level 1" classification. However, this group also shows some features of the higher levels of integration from Fig. 1, as described by, for instance, Karapetrovic [14] and Pojasek [11].
- Group 2
  11% of the 362 companies that integrated their MSs are classified in this group, which demonstrates a higher degree of integration compared to Group 1. Regarding goals and

documentation resources, these companies integrate policy, objectives and manual the most. With respect to the procedures, internal communication and audit are the most integrated ones. As with the preceding group, although a logical connection can be made with the "Level 2" classification and the corresponding groupings of, for example, Wilkinson and Dale [13], Kirkby [30], Karapetrovic [14], and Beckmerhagen et al. [8], Group 2 also has similarities, in some respects, with the highest level of integration, and the related groupings of, for instance, Seghezzi [29] and Pojasek [11].

- Group 3

   The final group is constituted by 87% of the 362 companies that integrated, in this case, a great part of their MSs, but have not all achieved full integration. On average, these organizations have integrated their MSs at 85%. The policy, objectives and manual are the most integrated goals and documentation resources, while document and record control, internal audit and communication are the most integrated procedures. This group can be categorized into "Level 3", as characterized by basically all the authors included in Fig. 1, for example, Seghezzi [29], Wilkinson and Dale [13], Kirkby [30], Karapetrovic [14], Karapetrovic [10], Beckmerhagen et al. [8] and Pojasek [11].

Another conclusion that can be highlighted from the findings is that organizations follow a pattern regarding the documentation and procedures they integrate the most. It seems clear that they begin with the most strategic goals, documentation and procedures (policy, objectives and manual in the case of the goals and documentation, and record control, internal audits and internal communication for procedures), integrating operations and tactics later on (e.g., Refs. [10,21]).

Finally, there is, however, an element confirmed in our research which differs from what is claimed in the theoretical literature, namely the role of the people involved in the integrated management systems. In our study, this variable is not significant for either partial or full integration. That is, there are no differences between the involvements of personnel in MSs as a function of the level of MS integration. Therefore, the responsibility for the environmental and the quality MSs often falls on the same person, even though the systems are not integrated, or conversely, two different people may manage an integrated system. Karapetrovic [10,14] and Beckmerhagen et al. [8] suggest that the hierarchy level is related to the degree of integration, but this could not be found in our study.

For future research, given the large number of companies with an implemented EMS integrated within an IMS, it would be interesting to discover what difficulties they face during the integration process, whether the implementation model followed or tools used condition the process of integration and differences in auditing between companies integrating and those that do not integrate.

Acknowledgements

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