

# Evolution of Integrated Management Systems in Spanish firms

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## ARTICLE INFO

### Article history:

Received 13 April 2011

Received in revised form

5 September 2011

Accepted 17 October 2011

Available online 25 October 2011

### Keywords:

ISO 9001

ISO 14001

Integrated Management System

Standards

Evolution

Spain

## ABSTRACT

The aim of this paper is to analyze the evolution of the implementation and integration of standardized Management Systems (MSs) such as ISO 9001 and ISO 14001. Specifically, we study the implementation of different standards during a four-year period (2006–2010) and we examine the level of integration of different MS elements such as the resources, documentation, goals and procedures during this period. Additionally, the paper aims to evaluate the impact of integration on companies over time, namely the difficulties experienced by firms during the integration of MSs in organizations with more than one MS. In order to accomplish these objectives, the first dynamic study on the integration of MSs has been undertaken.

In order to compare firms that integrate their MSs in two different moments in time, two empirical studies were conducted, one in 2006 and one in 2010. These studies used a survey directed to firms with more than one MS in Catalonia (Spain).

This paper contributes to the understanding of how firms that have an Integrated Management System (IMS) integrate their standardized MSs and how they perceive the challenges related to managing the IMS over time. It also demonstrates that firms integrate their MSs rather than keep them separated, therefore showing a tendency toward integration over time.

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## 1. Introduction

Management Systems Standards (MSSs) have developed in an unprecedented manner in the last few years. The impact generated by quality, environmental and other MSSs is demonstrated by the importance of such standards worldwide, ISO 9001 and ISO 14001 (ISO, 2010). In particular, at the end of 2009, ISO 9001 accounted for 1,064,785 registered companies in more than 170 countries and ISO 14001 for 223,149 in about 150 countries (ISO, 2010). From 2006 to the end of 2009, the number of certifications has increased with 167,856 ISO 9001 certificates and 94,938 ISO 14001 certificates (ISO, 2010). However, although the importance and the diffusion of these two MSs in different countries has been widely studied by several authors (e.g., Corbett and Kirsch, 1999, 2001; Saraiva and Duarte, 2003; Franceschini et al., 2004; Marimon et al., 2006, 2011; Lagodimos et al., 2007; Casadesus et al., 2008), their main findings suggest that the number of certificates worldwide presents a “saturation effect”, that is, when the number of certified organizations reaches a certain limit, certification loses its connotation

and becomes less attractive for the remaining companies (Franceschini et al., 2004).

Despite the “saturation effect”, these two standards act as frameworks for quality management and environmental management, respectively in a great number of organizations worldwide. Moreover, they “provide confidence for business-to-business transactions, for consumers when choosing products, for government departments when awarding procurement contracts, and for enterprises when qualifying suppliers in global supply chains” (ISO, 2009).

In a context where new standardized management systems (MSs) appear frequently, “more and more organizations are applying not only one, but a range of management system standards to satisfy their own needs as well as those of external stakeholders” (ISO, 2009). Apart from ISO 9001 and ISO 14001, companies can integrate standardized MSs such as the ones for occupational health and safety (e.g., OHSAS 18001 and CSA Z1000) or for corporate social responsibility and accountability (e.g., SA 8000 and AA 1000), among others.

As the aim of this article is to study the evolution of MS implementation and integration from 2006 to 2010, we look at some of the standards and other supporting elements published by the International Organization for Standardization (ISO) during this period. From 2006 on, ISO has published several new MSSs and has also revised some existing ones.

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One of the most relevant publications, in 2008, is ISO 9001:2008, the fourth edition of the standard, first published in 1987, “which has become the global benchmark for providing assurance about the ability to satisfy quality requirements and to enhance customer satisfaction in supplier–customer relationships” (ISO, 2009).

During this period, ISO has also published a series of standards related to quality management that are directed toward assessing and improving customer satisfaction. They all “provide guidance for planning, designing, developing, implementing, maintaining and improving processes to increase customer satisfaction” (ISO, 2009). Specifically, in 2007, ISO published ISO 10001:2007, which “address codes of conduct to organizations”. ISO 10003:2007 focuses on “improving an effective and efficient dispute-resolution process for complaints that have not been resolved by the organization”. Finally, ISO/TS 10004:2010 “defines processes to monitor and measure customer satisfaction” (ISO, 2009).

Another standard published in 2009, ISO 31000 for risk management, “is experiencing a rapid take-up by the global market”, although it is not a certification standard (ISO, 2009). ISO 31000:2009 sets out principles, a framework and a process for the management of risk (ISO, 2009). Recently, ISO has published ISO 26000:2010, the standard giving guidance on social responsibility (Castka and Balzarova, 2008a,b; ISO, 2009).

Moreover, “the tremendous impact of ISO 9001 and ISO 14001 on organizational practices and on trade has stimulated the development of other ISO standards and deliverables that adapt the generic management system approach to specific sectors or aspects” (ISO, 2009). From 2006 to 2010, these standards have appeared in the automotive (ISO/TS 16949:2009), petroleum and gas (ISO/TS 29001:2007), ship recycling (ISO 30000:2009), and supply chain security (ISO 28000:2007) sectors.

Other types of ISO documents, for application in specific industry sectors are the International Workshop Agreements, such as IWA 2 on education (IWA 2:2007) and IWA 4 regarding local government (IWA 4:2009).

Regarding the integration of MSs, in order to assist organizations, ISO published in 2008 a handbook, “The integrated use of management system standards”, which provides a methodology and real cases as examples to help an organization carry out the integration process (ISO, 2008).

During the last four years, both this proliferation and the increasing importance of MSSs have been demonstrated (Singh, 2008; ISO, 2010). Traditionally, organizations have focused on establishing MSs that comply with each MSS requirements individually, often in isolation from each other and sometimes even in conflict (Karapetrovic and Willborn, 1998; Zeng et al., 2007). However, Integrated Management Systems (IMS) that address organizations’ objectives jointly are becoming more and more popular as they aim to satisfy the needs of several MSs while running a business (Beckmerhagen et al., 2003). Achieving this can be beneficial to the organization’s efficiency and effectiveness, as well as reducing the cost of managing each system individually (Tari and Molina-Azorin, 2010).

The purpose of this paper is to understand how the integration of MSs changes within a period of time and to relate it to the difficulties perceived by companies of having an IMS. Moreover, it aims to analyze the implementation and integration of different MSs in Spanish firms. The overall aim is to analyze the impact of integration on companies.

With the aim to survey companies on the impact of MS implementation and integration, two empirical studies were undertaken, one in 2006 and one in 2010, surveying quality and environmental system managers. The analysis carried out in this paper is based on the answers of the same firms responding to the 2006 and the 2010 surveys. This method was used in order to be able to observe the

dynamics of the same sample of firms regarding the integration of their systems. This is, as far as we know, the first study reported in literature that analyses the evolution of MS integration over a period of time.

First, a review of the literature on the evolution of perceived benefits and challenges of MSS implementation is presented. As we have not been able to find any studies on the evolution of integration benefits and difficulties, we review existing research on the extent of integration and integration tools used by organizations. We follow with an analysis of the impact of integration, namely the benefits and difficulties of MSs integration in organizations. We subsequently develop the methodology used in this study, which involves a quantitative analysis of the implementation of MSs, the extent of their integration, as well as the difficulties of integration. The last part of the article includes empirical results of the investigation and a concluding section.

## 2. Literature review

As we have previously mentioned, only a few studies have been found on the evolution of the impact of MSSs implementation over time.

For example, there are studies proving that firms which have been working for a longer time with certified systems perceive higher benefits than those that have just been certified (Brecka, 1994; Ferguson, 1996; Tang and Kam, 1999; Singels et al., 2001; Terziovski et al., 2003; Dowlatshahi and Urias, 2004; McGuire and Diltz, 2008). Other studies prove that a high number of certified firms do not perceive benefiting significantly from the certification process, and this situation does not improve over time (Jones et al., 1997; Leung et al., 1999; Casadesus and Karapetrovic, 2005; Karapetrovic et al., 2006). Some of the benefits mentioned by the authors defending the positive impact of MSSs implementation over time include lower operating costs, reduced wastage, and improved efficiency and productivity compared to the companies that had just completed the certification (Brecka, 1994; Terziovski et al., 2003; Casadesus and Karapetrovic, 2005; Karapetrovic et al., 2010).

Thus, it is very difficult to determine which benefits MSSs implementation brings over time and it is even more difficult to assess the impact of the evolution of MSs integration, as there is no existing literature on that topic. Therefore, in order to understand the impact that IMS have on organizations, it is vital to review the existing studies on the integration of MSs, especially on the benefits and challenges firms encounter during the process.

As MSSs are increasingly being implemented by companies, the structure and content of these standards are becoming very similar in order to enhance their compatibility and facilitate their joint implementation (Karapetrovic, 2002; López-Fresno, 2010). Therefore, they often incorporate common elements such as the control of documents and records, internal audits, corrective and preventive action, management review and continuous improvement (Asif et al., 2010). In fact, the Plan, Do, Check, Act (PDCA) improvement cycle (Deming, 1982), has become the foundation for many of these standards (Labodova, 2004; López-Fresno, 2010).

Therefore, IMSs are becoming more and more popular as firms find it more reasonable to integrate their MSs rather than manage them individually (Karapetrovic and Willborn, 1998; Bernardo et al., 2009; Douglas and Glen, 2000; Karapetrovic et al., 2006; Zeng et al., 2007). Moreover, empirical studies regarding the scope of integration confirm the idea that firms prefer integration over disintegration (Douglas and Glen, 2000; Karapetrovic et al., 2006; Zeng et al., 2007; Salomone, 2008; Karapetrovic and Casadesus, 2009; Bernardo et al., 2009).

Regarding the order of implementation of the MSs in the organizations, Salomone (2008), shows how a majority of their sample

of Italian organizations implemented first the QMS and then the EMS. In this line, Karapetrovic and Casadesus (2009) found that most respondents implemented ISO 9001 before ISO 14001.

Jørgensen et al. (2006) and Jørgensen (2008), define three different levels of integration: “correspondence” refers to cross references and internal coordination, “generic” which is the understanding of generic processes and tasks in the management cycle, and “integration”, the creation of a culture of learning, stakeholder participation and continuous improvement of the performance. Regarding MS integration, Karapetrovic and Willborn (1998) define three main elements of a standardized MS which can be integrated at different levels, namely goals, processes, and resources. Karapetrovic et al. (2006) conducted an empirical study in order to study the extent of integration of these elements, obtaining responses from 176 Catalan organizations with multiple cross-functional certificates like ISO 9001 or ISO 14001. The authors found a high level of integration regarding the extent of the integration of the human resources, the company policy, objectives, the management system manual, and the processes of document control, record control, auditing, and management review. However, the authors found that aspects such as the use of integrated records, instructions or procedures, found at tactical organizational levels, or the planning, determination of requirements, product realization and other internal business processes, seemed to be integrated to a lesser extent. In the same direction, Bernardo et al. (2009) empirically studied the integration of environmental with other MSs in Spain. 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. In particular, 14% of organizations did not integrate their MSs, 7% integrated only some of them, and 79% integrated all their MSs.

However, the combination and effective integration of these systems is not always clear, often lacking a real structure on which to build an integrated system (Karapetrovic and Jonker, 2003; Griffith and Bhutto, 2008; Asif et al., 2010). Karapetrovic et al. (2006) examined the use of the models and tools to integrate MSs in companies, namely a framework already used in one or more of the standards being implemented, such as the PDCA cycle, a detailed analysis of the common elements, a process map or a company-specific model.

At the same time, there has been a growing recognition of the value that IMSs can bring to the business (Karapetrovic and Willborn, 1998; Wassenaar and Grocott, 1999; Wilkinson and Dale, 1999; Douglas and Glen, 2000; Renzi and Cappelli, 2000; Zutshi and Sohal, 2005; Salomone, 2008; Asif et al., 2009; Griffith and Bhutto, 2008; Khanna et al., 2010; Asif et al., 2010). Today, many organizations are implementing MSs not just to fulfill the requirements of individual standards, but to operate in a more combined, efficient and effective way (Asif et al., 2010). And in doing so, organizations can look to achieve significant internal benefits as well as meeting any external demands (Asif et al., 2010). For instance, according to Zeng et al. (2011), the main benefits of implementing Integrated Management Systems include decreased paperwork, decreased management cost, decreased complexity of internal management, simplified certification process and facilitates continuous improvement. Several authors also suggest the benefits of IMSs regarding the integration of their audits and find that the majority of organizations registered to multiple standards integrate their internal audits and are also externally audited in a similar manner, thus profiting from the existing synergies among standards (Karapetrovic et al., 2006; Bernardo et al., 2010).

In order to avoid the failure of MS integration, it is important that firms manage the difficulties associated with the implementation and maintenance of an IMS (López-Fresno, 2010). These challenges are numerous and involve aspects such as the lack of human resources, the lack of government support, departmentalization of functions and individual concerns of the people involved (Karapetrovic and Willborn, 1998; Wassenaar and Grocott, 1999; Matias and Coelho, 2002; Karapetrovic, 2003; Zutshi and Sohal, 2005; Karapetrovic et al., 2006; Zeng et al., 2007; Asif et al., 2009).

In the next sections of this paper, we present the first empirical study on evolution of the integration of MSs over time. In the following section, the methodology applied will be described. Finally, the empirical analysis and the conclusions are presented.

### 3. Methodology

The purpose of this study is to investigate the evolution of IMSs experienced by ISO 9001 and ISO 14001 registered companies in Catalonia over time. Additionally, the paper aims to evaluate the impact of integration, namely the extent of integration and the difficulties experienced by firms, during the integration of MSs in companies with more than one MS.

Two empirical studies, carried out in 2006 and 2010 respectively, were used in order to study the evolution of integration in companies. In 2006, the first study was conducted by sending questionnaires to 535 of the 1191 certified Catalan companies, addressed to the person responsible for quality and/or environmental management in the company. The companies were randomly selected using the Spanish Industrial Codes for stratification (Karapetrovic and Casadesus, 2009). A total of 176 valid answers were obtained. The survey therefore had a 33% response rate with a 93% level of confidence. The results of this study can be found in Karapetrovic et al. (2006).

In order to continue this study on the integration of MSs in Catalonia, a new empirical study was carried out from February to July 2010, using a questionnaire addressed to the 176 firms that answered the survey in 2006 (Karapetrovic and Casadesus, 2009). The questionnaire comprised a combination of semi-open and Likert-type questions with a 1 to 5 scale. The survey instrument was refined using a pre-test process.

In order to be able to compare the answers of the companies of both samples, the questionnaire used in 2010 was a new version of the one used in Karapetrovic et al. (2006). The surveys in 2006 and 2010 included questions regarding the implementation of MSs, the integration level, the use of integration guidelines, the integration difficulties and the integration of audits. However, in 2010, regarding the integration of MSs, an additional question about the benefits of integration was included, following the literature on the topic.

In 2010, the empirical study was conducted by means of a mail survey addressed to the person responsible for the QMS and/or EMS of the organization, and was subsequently followed up with a telephone call and an additional e-mail communication with the firms.

From the 176 companies that answered in 2006, with a subsequent follow-up by telephone, 76 valid answers were obtained. The survey therefore had a 43% response rate and a 93% reliability, with a 95% confidence.

For enhanced consistency, this work was carried out with the same methodology, using the same firms as in 2006 and in the same region of Spain, Catalonia. Catalonia has traditionally been of the regions of Spain with the highest rate of ISO 9001 registrations in the country and experiencing a growth in the number of certificates which is very similar to the average rate of growth in Spain (Heras and Casadesus, 2006). In 2010, Spain is a country with one of

**Table 1**  
Profile of the 2006 and 2010 surveys.

Study factor	Year 2006	Year 2010
Location	Catalonia (Spain)	Catalonia (Spain)
Time	2006	2010
Population	1191	535
Sample size	535	176
Received responses	176	76
Response rate	33%	43%
Level of confidence $p = q = 0.5$	93%	93%

Source: own elaboration.

the highest number of ISO 14001: 2004 and ISO 9001: 2000 certificates in the world (ISO, 2010). And more specifically, Catalonia is one of the leading regions in Spain regarding the number of certifications of ISO 9001 and ISO 14001 together with the regions of Madrid, the Basque Country and Andalucia (Forum Calidad, 2010).

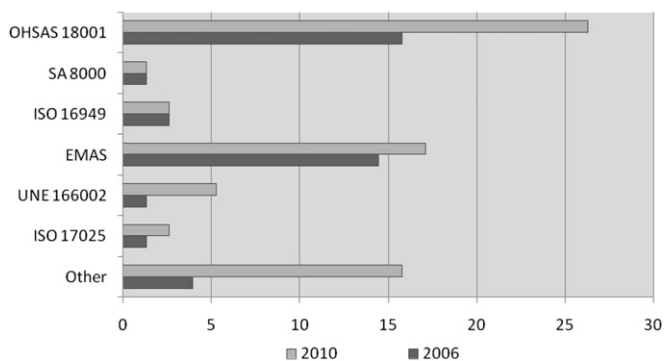
Table 1 compares the features of this empirical work to that of the previous study. The survey profiles are presented in Table 1.

An empirical analysis on the evolution of the implementation and integration of MSs is provided in the next section. The results are presented with the following structure. First, results regarding the implementation of standards among firms in the 2006 and 2010 samples, the integration level of firms and the tools used, are analyzed. Second, we illustrate the degree of integration of the human resources, documentation, goals and procedures of the IMS. Finally, we provide data regarding the difficulties of integration, as well as their evolution. For each of these aspects, we first provide a descriptive analysis comparing the 2006 and 2010 samples. Moreover, statistical tests, namely Wilcoxon and McNemar tests to compare the means of the variables and a logistic regression are used to analyze the significant differences of the integration variables over time.

## 4. Findings

### 4.1. Evolution of implemented standards 2006–2010

Due to the survey design, all of the respondents were registered to both ISO 9001 and ISO 14001. Apart from these two standards, the most implemented one among firms is OHSAS 18001 for occupational health and safety with a 10.52% increase from 2006 to 2010 (see Fig. 1). The proportions for the implementation of other function or stakeholder specific standards like SA 8000 for Corporate Social Responsibility or UNE 166002 for Research and Development are much lower. The implementation of sector-specific standards such as ISO 16949 for the automotive sector or ISO 17025



**Fig. 1.** Evolution of the implementation of standards 2006–2010. Source: own elaboration.

for calibrations in laboratories has experienced no increase or a moderate increase (1.31%) respectively. Enhanced-requirement standards focused on a single organizational area, such as EMAS for the environment reported a level of implementation of 14.47% and 17.10% in 2006 and 2010 respectively, representing a 2.63% increase. The other major increase is a group named “other standards” with a 11.84% change, which includes standards such as ISO 22000 for food safety, ISO 13485 for medical devices, ISO 3834-2 quality requirements for fusion welding of metallic materials or UNE 216301 certification for energy efficiency.

### 4.2. Level of integration

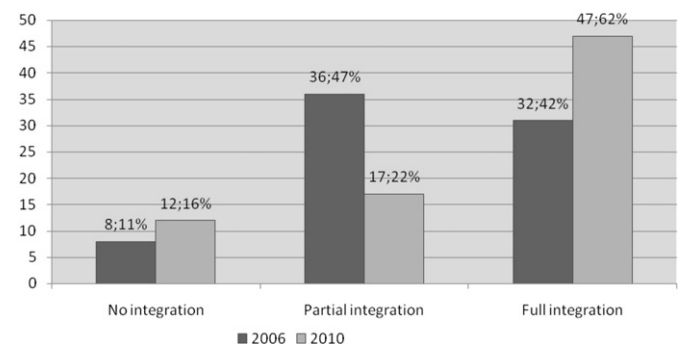
As discussed in the literature, from the 2006 survey, Bernardo et al. (2009) find three levels of integration: “no integration”, “partial integration” and “full integration”. Comparing the level of integration of 2006 and 2010, Fig. 2 indicates that the levels of “no integration” (11%–16%) and “full integration” have increased (42%–62%) while the level of “partial integration” has decreased (47%–22%).

One significant conclusion which can be drawn from these findings is that a great majority of organizations compliant with multiple standards have integrated the systems that these standards represent (Karapetrovic et al., 2006), and, as expected (e.g., Karapetrovic, 2002), the scope of integration includes the most popular standardized MSs, i.e. quality, environment and health and safety, as shown in the previous section.

Moreover, these findings are especially relevant because they seem to indicate that firms tend to polarize in one of the two extremes: either they integrate all their MSs or they chose not to integrate any of them. Thus, firms perceiving the benefits of integration mentioned above in the literature prefer full integration, while firms who have probably faced or anticipated the difficulties of integration have opted to keep their MSs separated. The rest of the firms, which stay in a medium position with a partial level of integration, have decreased in number.

In order to compare the two surveys regarding the level of integration, the difference degree between the two samples was analyzed, using a Wilcoxon test for dependent samples (Novales, 1997). The Wilcoxon signed-rank test is a non-parametric statistical hypothesis test for the case of two related samples or repeated measurements on a single sample. It can be used as an alternative to the paired Student's *t*-test when the population cannot be assumed to be normally distributed like in our samples.

The Wilcoxon test provides the statistic (*Z*) and the related bilateral significance. The significance level for the integration degree (0.003) is lower than 0.05, therefore we can reject the null hypothesis of equality of means and conclude that the compared variables (level of integration in 2006 and 2010) are significantly



**Fig. 2.** Integration level 2006–2010. Source: own elaboration.



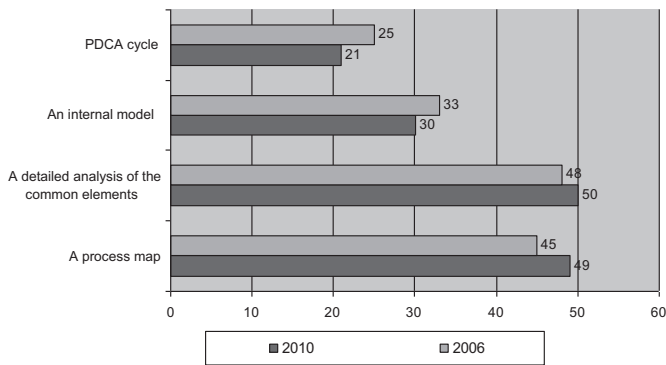


Fig. 3. Tools used during the integration process 2006–2010. Source: own elaboration.

different. The Wilcoxon test subtracts one variable from another, giving positive and negative ranks as a result. In this case, the significance level is based on the positive ranks, that is, the integration level in 2010 is higher than in 2006. Therefore, we can say, with 95% confidence, that the integration level showed a statistically-significant higher level of integration in 2010 compared to 2006. This result makes sense, as firms with more than one MS prefer integration over disintegration (Bernardo et al., 2009; Douglas and Glen, 2000; Karapetrovic et al., 2006; Zeng et al., 2007).

#### 4.3. Tools used for integration

Regarding the use of different tools during the integration of the MSs, the survey explored the use of the process, PDCA and company-specific models, as well as whether or not the companies performed an analysis of the common elements of MSSs (Karapetrovic et al., 2006). The respondents gave responses on the use of one or more of these four tools. Therefore, the application of all four types of integration tools could be assessed.

The results show the dominance of the analysis of common elements of standards (Fig. 3). This method was used by 73.8% and 75.8% of the respondents in 2006 and 2010, respectively. A process map is the second most common tool used by companies to integrate their MSs (69.2% and 74.2%). On the other hand, 50.8% and 45.5% of companies used their own model, while 38.5% and 31.8% used the PDCA approach.

Although the most common tools used during the integration process were, both in 2006 and 2010 (48 and 50 companies respectively), a detailed analysis of the common elements of the

standards and a process map (45 and 49 firms), the use of these tools during the integration process differs between 2006 and 2010. In 2010, there is an even higher use of the common elements analysis and the process map, which means that the use of the PDCA cycle and internal models by firms has decreased. Such outcome goes along the theoretical notions presented in Karapetrovic and Willborn (1998), as well as Karapetrovic (2003), Labodova (2004), Karapetrovic et al. (2006) and (Asif et al., 2009).

In order to compare the two surveys regarding the tools used for integration, the degree of difference between the two samples was analyzed, using a McNemar's test for dependent samples and dichotomous variables (Novales, 1997). McNemar's test is a non-parametric test that is used when we analyze a study where subjects are accessed in consecutive time periods. In McNemar's test, significance is tested by using the chi-square table. If the  $\chi^2$  result is significant, this provides sufficient evidence to reject the null hypothesis, in favor of the alternative hypothesis, which would mean that the difference between the two related samples is significant.

McNemar results and the corresponding contingency table indicate that 36 firms were using a process map both in 2006 and 2010 to integrate their MSs. An analysis of common elements was used in both years by 20 firms, while 16 used an internal model. Only three firms used a PDCA cycle in 2006 and 2010. The  $\chi^2$  has a value of 8.036 with a  $p$ -value of 0.004 so we reject the null hypothesis and conclude that the difference between the two related samples is significant. In conclusion, firms in 2010 use different tools to integrate their MSs compared to the tools used in 2006.

#### 4.4. Resources involved in the different management systems

As Karapetrovic and Willborn (1998) state, an IMS can be conceptualized as a set of three elements that can be integrated, namely resources, goals and processes. Therefore, the survey included questions related to the degrees of integration specific to each of these MSs elements.

The first group of questions, related to the integration of human resources, was focused on knowing whether the responsibility for managing different MSs falls to the same person in the firm (Karapetrovic et al., 2006). This was studied at three levels of responsibility in the organization: top management, MS representatives and inspectors of the different MSs. The second group of questions was related to the integration of the documentation resources (manual, procedures, instructions and records) and goals (policy and objectives), while the third group of questions was aimed at assessing whether the procedures were integrated or not.

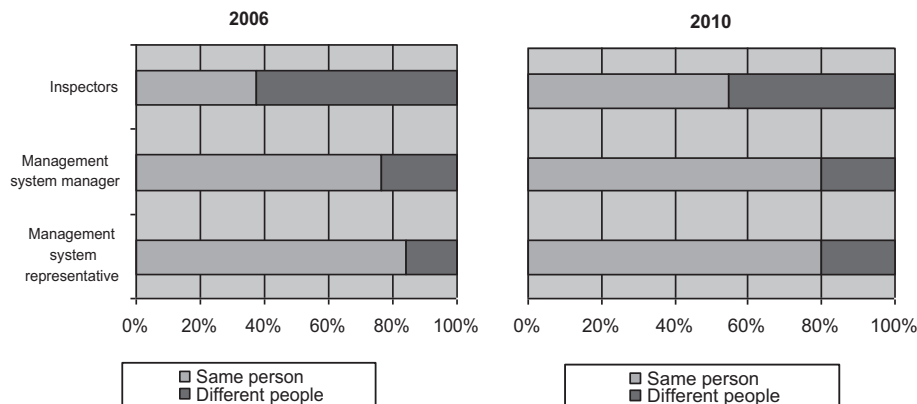


Fig. 4. Integration of human resources involved in the different MSs. Source: own elaboration.

**Table 2**  
Wilcoxon test for human resources integration level (2010–2006).

	Z	Sig. (p)
Management system representative	−0.447	0.655
Management system manager	−2.502	0.012 <sup>a</sup>
Inspector	−5.997	0.000 <sup>a</sup>

<sup>a</sup> Statistically significant based on positive ranks.

#### 4.4.1. Human resources

In terms of the human resources involved in the different MSs, Fig. 4 illustrates that both in 2006 and 2010, the level of integration is much higher at the top management level than at the shop floor level. This result is probably explained by the fact that MSs representatives are more trained and committed to manage the IMS, therefore showing a higher level of integration (Zutshi and Sohal, 2005). However, the results also show a 5% increase from 2006 to 2010 at the functional level (management system managers), as well as a 20% increase at shop floor level (inspectors), which means that the level of integration of these two types of human resources is approaching to the level of management integration (Table 2).

In order to compare the two surveys regarding the level of integration of the human resources, the degree of difference between the 2006 and 2010 samples was analyzed, using the Wilcoxon test. The table below shows the Wilcoxon statistic (Z) and the related bilateral significance for each group of human resources. Only the MSs managers and the inspectors show significant differences between years. Therefore, we conclude that the level of integration of these two groups of human resources is higher in 2010 than in 2006.

#### 4.4.2. Documentation and goals

Following Karapetrovic et al. (2006), “the integration of the documentation resources, including the management system objectives, was examined at the policy, objective, manual, procedure, instruction and record levels”. The results show that most firms have both in 2006 and 2010 a single policy, set of objectives and the MS manual (Fig. 5). However, in line with the results found by Karapetrovic et al. (2006), the integration level diminishes as we move toward the operational and tactical organizational levels. However, the use of integrated records, instructions or procedures significantly increases from 2006, when less than half of the firms had fully integrated these elements, to the year 2010, when between half and three quarters of the respondents had already integrated them fully (Fig. 5) (Table 3).

Comparing the 2006 and 2010 samples, the table above shows the Wilcoxon statistic (Z) and the related bilateral significance for

**Table 3**  
Wilcoxon test for documentation and goals integration level (2010–2006).

	Z	Sig (p)
Policy	−1.919	0.055
Objectives	−2.372	0.018 <sup>a</sup>
Manual	−0.034	0.973
Procedures	−1.966	0.049 <sup>a</sup>
Instructions	−0.500	0.617
Records	−3.126	0.002 <sup>a</sup>

<sup>a</sup> Statistically significant based on positive ranks.

each group of goals and documentation. Significant differences between years are shown in the objectives ( $p = 0.018$ ), procedures ( $p = 0.049$ ) and records ( $p = 0.002$ ). Therefore, we can conclude that the level of integration of these three elements is higher in 2010 than in 2006. One of the most important aspects of this analysis is that the significant variables are the ones related to the operational and tactical levels of the organization (objectives, procedures and records). Therefore, these are the elements that have experienced a major increase over this period of time, whereas strategic variables such as the policy or the manual have not experienced such an increase in the level of integration.

#### 4.4.3. Procedures

As in Karapetrovic et al. (2006), we examined the integration of different procedures covering activities, such as document and record control, determination of stakeholder requirements and auditing (Fig. 6).

High levels of integration were exhibited both in 2006 and 2010 in MS procedures, such as record and document control or preventive and corrective actions, while the elements integrated to a lesser extent were product realization and audits. In general, the overall level of integration of the procedures involved in the different MSs has increased and, in 2010, all the procedures have been fully integrated by at least 60% of the firms. However, in 2006, less than half of the firms had fully integrated most of the procedures. However, it is important to notice the increase of the integration level of one particular element, internal audits, which was the second least-integrated element in 2006. However, it became one of the most integrated procedures in 2010, with a level of full integration in more than 80% of the firms. This finding reveals the importance of internal audits and their integration as well as the increasing awareness of organizations about the benefits of audit integration. For instance, the optimized use of resources is mentioned by Karapetrovic and Willborn (1998), Douglas and Glen (2000), Karapetrovic (2002), Zeng et al. (2005, 2007), Zutshi and Sohal (2005), Pojasek (2006) and Salomone (2008), and the

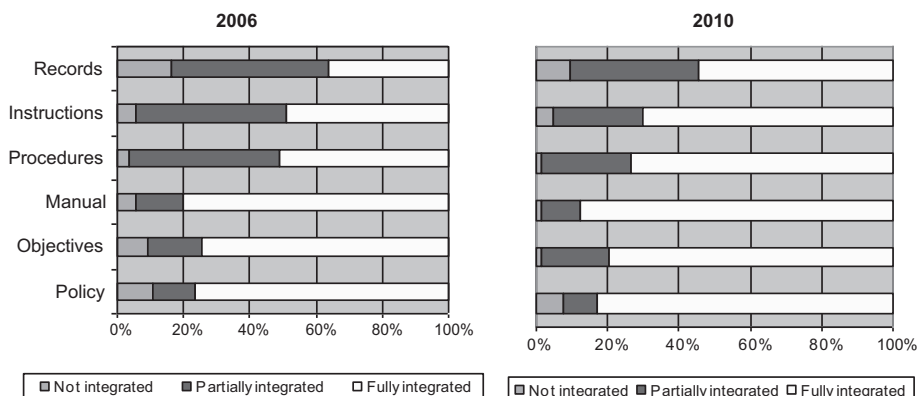


Fig. 5. Integration of documentation and goals 2006–2010. Source: own elaboration.

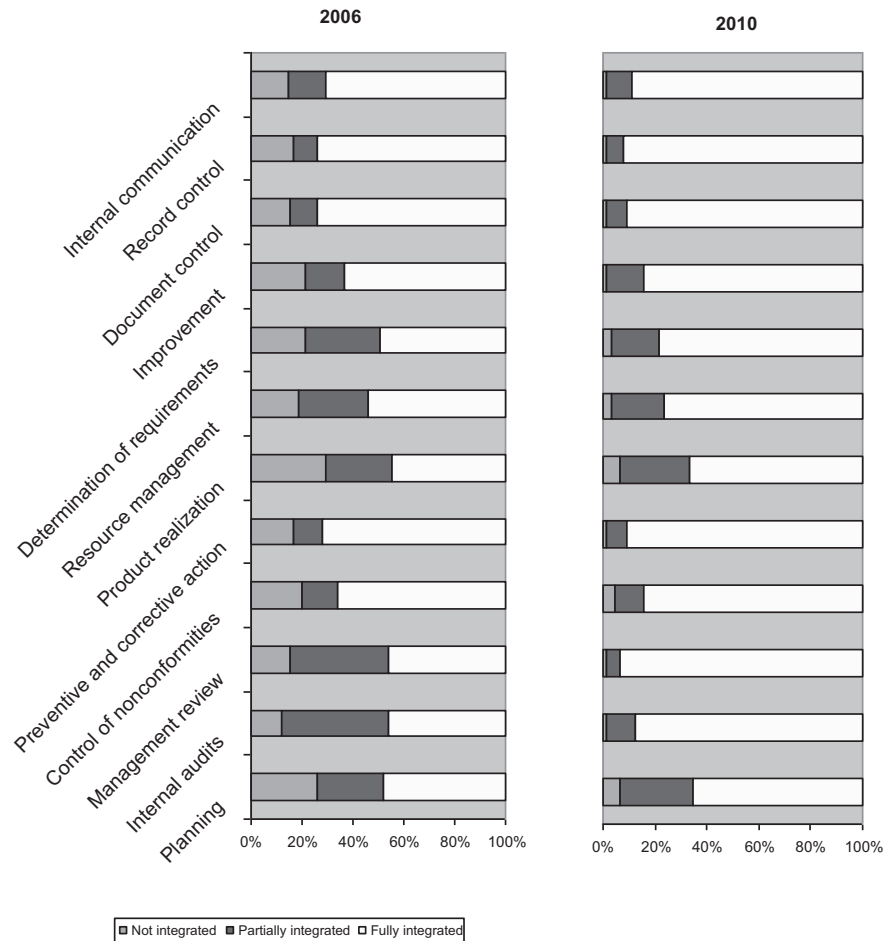


Fig. 6. Integration of procedures 2006–2010. Source: own elaboration.

establishment of auditor competence for different MSSs is considered by Douglas and Glen (2000), De Moor and De Beelde (2005) and Kraus and Grosskopf (2008). Moreover, the processes under review, along with all their controls (environmental, health, safety, and quality) have to be evaluated only once and there is less duplication of effort during the planning, execution, and even follow-up phases of the audit (Kraus and Grosskopf, 2008).

Table 4 shows the Wilcoxon statistic ( $Z$ ) and the related bilateral significance for each group of procedures in the 2006 and 2010 survey answers. Significant differences are shown in the planning ( $p = 0.000$ ), control of non-conformities ( $p = 0.008$ ), preventive and corrective actions ( $p = 0.014$ ), product realization ( $p = 0.000$ ), improvement ( $p = 0.011$ ) and requirements ( $p = 0.000$ ). These results show that the level of integration of these elements is higher in 2010 than in 2006 at a 95% confidence level. These procedures can be classified under the different requirements of ISO 9001: 2000 (ISO, 2000), 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 non-conformities, preventive and corrective action, improvements). Taking this classification into account, our results indicate that procedures related to product realization and procedures related to measurement, analysis and improvement are the ones that have

experienced a higher increase in their level of integration. This results differ in some ways to the results found by Bernardo et al. (2009), who found that procedures related to product realization were the least integrated, while procedures related to measurement, analysis and improvement had the highest degree of integration.

#### 4.5. The difficulties of integration over the years

Although the integration of MSs generally makes sense, organizations naturally encounter difficulties in the process

Table 4  
Wilcoxon test for procedures integration level (2010–2006).

	$Z$	Sig. ( $p$ )
Planning	−3.877	0.000 <sup>a</sup>
Internal audits	−1.414	0.157
Management review	−0.277	0.782
Control non-conformities	−2.652	0.008 <sup>a</sup>
Preventive and corrective actions	−2.449	0.014 <sup>a</sup>
Product realization	−3.601	0.000 <sup>a</sup>
Resource Management	−1.388	0.165
Requirements	−3.649	0.000 <sup>a</sup>
Improvement	−2.546	0.011 <sup>a</sup>
Document control	−1.414	0.157
Record control	−1.134	0.257
Internal communication	−1.789	0.074

<sup>a</sup> Statistically significant based on positive ranks.

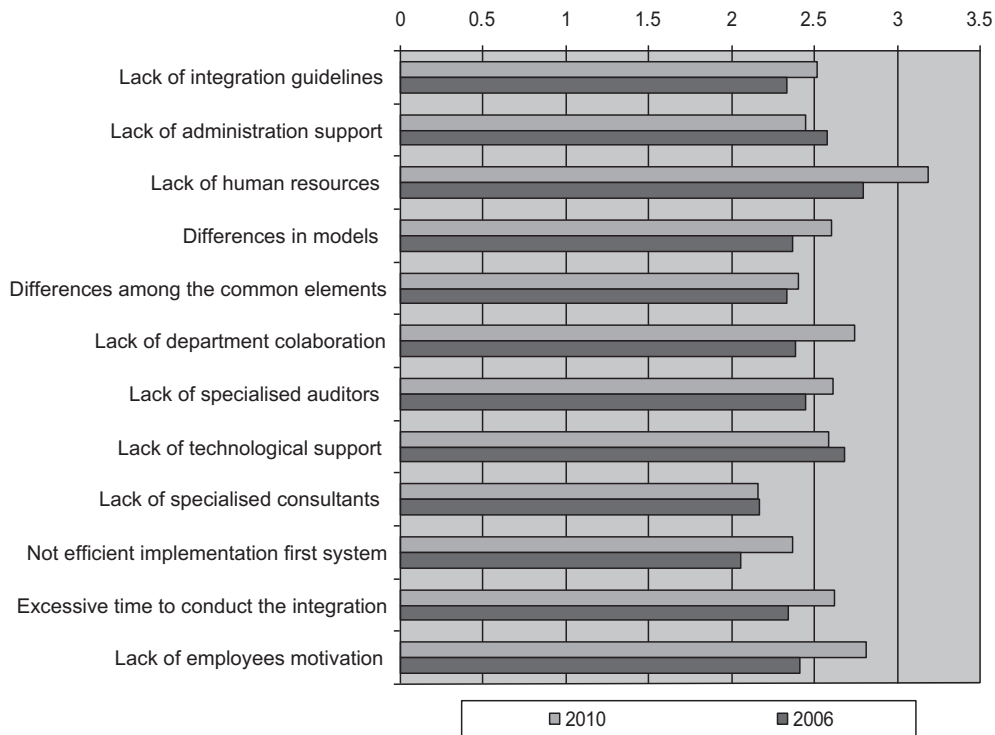


Fig. 7. Difficulties of integration 2006–2010. Source: own elaboration.

(Karapetrovic and Willborn, 1998; Karapetrovic, 2003). The surveys presented in this paper included one question about the integration difficulties (1–5 Likert scale), which was posed to organizations that reported full or partial integration of their standardized MSs, and explored the main difficulties encountered in the integration process (Karapetrovic and Willborn, 1998; Wassenaar and Grocott, 1999; Matias and Coelho, 2002; Zutshi and Sohal, 2005; Karapetrovic et al., 2006; Zeng et al., 2007; Asif et al., 2009; Asif et al., 2010). In order to evaluate the changes in the perceptions of the companies regarding the difficulties of MSs integration and address the gap in the current literature on this topic, the results obtained from 2006 and 2010 surveys are compared. The comparison of the importance of difficulties detected in both surveys is presented in Fig. 7.

In 2006, the difficulties most mentioned by firms regarding the integration of their MSs were the lack of human resources, with a mean importance level of 2.79, followed by the lack of technological support (2.68), and the lack of administration support (2.57). In 2010, the results change slightly, as the most-cited difficulty remains the lack of human resources (3.94), followed by the lack of employees motivation (2.81), and the lack of department collaboration (2.74). These results are specially relevant, as they show the importance of motivating and implicating the human resources in order to achieve a successful integration of the systems. The least important difficulty is the lack of specialized consultants (2.2 and 2.1 in 2006 and 2010 respectively).

In Table 5, a Wilcoxon test was performed on all twelve factors found in both surveys (three additional factors were studied in the 2010 survey only). With a 95% confidence, two factors (inadequate implementation of the initial system and excessive time to conduct the integration) indicated a statistically-higher level of perceived difficulties in 2010 compared to 2006, while one factor (lack of administration support) showed a statistically-lower level of difficulties in 2006 compared to 2010. The other eight factors showed no statistically-significant differences: lack of integration guidelines,

lack of human resources, differences in the models, differences in the common elements, lack of department collaboration, lack of specialized auditors, lack of technological support, lack of specialized consultants and lack of employees motivation. From the significant results, it is possible to extract two different types of difficulties experienced by firms regarding IMSs (Zeng et al., 2007). One of them is related to external factors (lack of government support), while the other two significant variables represent internal factors.

#### 4.5.1. Logistic regression 2006

In order to analyze the impact of the difficulties that firms have during the integration process on the level of integration, we use a logistic regression taking the level of integration (partial and full integration) as the dependent variable and the difficulties as the predictor variables. “No integration” is not considered in this analysis, as these firms have not undertaken the process of integrating their MSs and therefore have not experienced any difficulty regarding this topic. Logistic regression is a form of regression

Table 5  
Wilcoxon test for integration difficulties (2010–2006).

	Z	Sig. (p)
Lack of integration guidelines	−1.044	0.297
Lack of administration support	−2.300	0.021 <sup>b</sup>
Lack of human resources	−1.173	0.241
Differences in the models of systems	0.241	1.000
Differences in the common elements of systems	−2.231	0.26
Lack of department collaboration	−0.958	0.338
Lack of specialized auditors	−1.040	0.298
Lack of technological support	−2.381	0.17
Lack of specialized consultants	−0.779	0.436
Inadequate implementation of the initial system	−2.777	0.005 <sup>a</sup>
Excessive time to conduct the integration	−3.173	0.002 <sup>a</sup>
Lack of employees motivation	−1.626	0.104

<sup>a</sup> Statistically significant based on positive ranks.

<sup>b</sup> Statistically significant based on negative ranks.



**Table 6**  
Model evaluation and goodness-of-fit tests for the logistic regression.

Test	$\chi$	df	Sig. (p)
<i>Overall model evaluation</i>			
Likelihood ratio test	46.223		
<i>Goodness-of-fit tests</i>			
Hosmer–Lemeshow	5.869	7	0.555
Cox and Snell $R^2$	0.355		
Nagelkerke $R^2$	0.519		

Source: own elaboration.

which is used when the dependent is a dichotomy and the independents are of any type (Novales, 1997). Since logistic regression calculates the probability of success over the probability of failure, the impact of predictor variables is usually explained in terms of odds ratios. We use logistic regression as it does not assume linearity of relationship between the independent variables and the dependent does not require normally-distributed variables and does not assume homoscedasticity which is convenient for our samples. We use stepwise regression which is used in the exploratory phase of research making no a-priori assumptions regarding the relationships between the variables (Menard, 1995). Thus, our goal is to discover the relationship between the integration difficulties and the integration level.

In Table 6, a likelihood ratio test is used for the overall model evaluation. We also provide a goodness-of-fit measure, the Hosmer and Lemeshow (1989) test, as an indicator of model appropriateness. Two additional descriptive measures of goodness-of-fit, presented in Table 6, are the  $R^2$  indices, defined by Cox and Snell (1989) and Nagelkerke (1991), respectively. These indices are variations of the  $R^2$  concept defined for the OLS (Ordinary Least Squares) and can be used together.

The likelihood ratio value (46.22) indicates that the model is appropriate. Regarding the goodness-of-fit, the Cox and Snell  $R^2$  (0.335) and Nagelkerke  $R^2$  (0.519) present an acceptable value and the Hosmer–Lemeshow test shows a significance of 0.555. This test is statistically significant when it takes values over 0.05; therefore we accept our model as valid.

The results of the logistic regression in 2006 provide the statistical significance of individual regression coefficients (Bs) which are tested using the Wald chi-square statistic. In 2006, there are no significant difficulties that predict the integration level. Therefore, we cannot conclude that the integration level is related to the difficulties experienced by organizations during the integration process.

#### 4.5.2. Logistic regression 2010

Table 7 shows in 2010, a significant predictor for the integration level, which is the inadequate implementation of the initial system in the organization ( $p = 0.029 < 0.05$ ). This difficulty is found as a significant variable in 2010 but not in 2006. This might be explained because, in 2010, although companies are more experienced in managing and integrating management systems, they might have realized how the systems work together, and this difficulty has aroused as a problem for the organizations, realizing that they should have made more efforts to implement the first system (usually ISO 9001) better in the first place, in order to avoid problems with other systems in the future.

The odds ratio for the significant variable “inadequate implementation of the initial system” is 0.103. For this variable, when it increases in one unit, the level of integration decreases by 70.7% ( $1 - \text{odds} \times 100$ ).

Regarding the confidence interval on the odds ratio, “low” and “high” confidence values are provided. That is, when the 95% confidence interval around the odds ratio includes the value of 1.0, indicating that a change in value of the independent variable is not associated in change in the odds of the dependent variable assuming a given value, then that variable is not considered as a useful predictor in the model (Novales, 1997). Therefore, as the variable “inadequate implementation of the initial system” in our model has a confidence interval around the odds ratio which does not include the value of 1.0 (between 0.013 and 0.791), it indicates that the variable is considered as a useful predictor in the logistic model. So, when firms have difficulties when implementing the first system, they achieve a lower level of integration. This is an internal difficulty that should be solved by organizations in order to be able to achieve a high level of integration and benefit from the advantages of full integration (Salomone, 2008; Griffith and Bhutto, 2008; Asif et al., 2009; Khanna et al., 2010; Asif et al., 2010).

The results of the logistics regressions for 2006 and 2010 are especially relevant, as they have implications for the organizations willing to implement new systems and/or integrate the systems they already have. These firms should pay attention when implementing the first standard in the firm. This is the most relevant difficulty and it has an effect on the overall level of integration that organizations achieve. Therefore, organizations should introduce mechanisms such as the use of implementation guidelines, integration guidelines and the training of the systems managers responsible for the implementation and integration of the systems, in order to improve the efficiency of the implementation of these systems in the organization.

**Table 7**  
Logistic regression results 2010.

2010 Predictor	B	SE (B)	Wald's $\chi^2$	df	Sig. (p)	Exp (B) odds ratio	C.I. 95.0% for EXP (B)	
							Low	High
Constant	3.016	3.822	0.623	1	0.430	20.401		
Lack of integration guidelines	1.036	0.635	2.655	1	0.103	2.817	0.811	9.786
Lack of administration support	0.262	0.633	0.171	1	0.679	1.300	0.376	4.496
Lack of human resources	−0.293	0.615	0.227	1	0.633	0.746	0.224	2.488
Differences in models	0.325	0.697	0.217	1	0.641	1.384	0.353	5.429
Differences among the common elements	−0.145	0.893	0.026	1	0.871	0.865	0.150	4.978
Lack of department collaboration	0.201	0.632	0.101	1	0.751	1.222	0.354	4.222
Lack of specialized auditors	0.380	0.683	0.310	1	0.578	1.463	0.383	5.585
Lack of technological support	0.623	0.721	0.747	1	0.387	1.865	0.454	7.668
Lack of specialized consultants	−0.769	0.861	0.798	1	0.372	0.463	0.086	2.505
Lack of internal organizational culture	−1.228	0.637	3.715	1	0.054	0.293	0.084	1.021
Excessive time to conduct the integration	−1.007	0.681	2.185	1	0.139	0.365	0.096	1.389
Lack of employees motivation	2.194	1.156	3.603	1	0.058	8.971	0.931	86.434
Differences in the scope of the standards	1.489	0.919	2.623	1	0.105	4.432	0.731	26.853
Not efficient implementation of the first system	−2.271	1.039	4.777	1	0.029 <sup>a</sup>	0.103	0.013	0.791
Lack of certifying organizations support	−0.058	0.668	0.007	1	0.931	0.944	0.255	3.497

<sup>a</sup> Statistically significant at 95%.

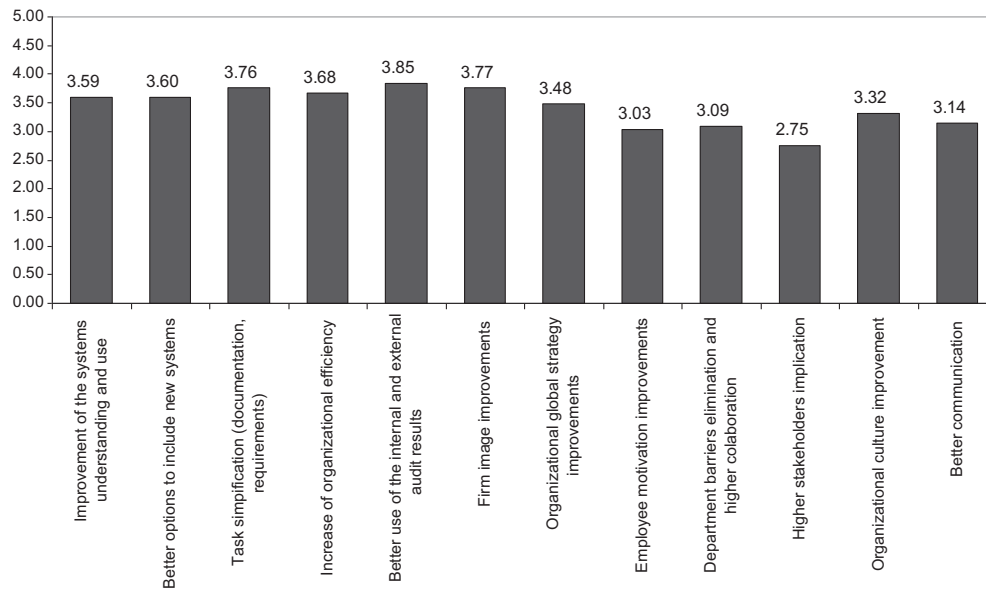


Fig. 8. Benefits of integration 2010. Source: own elaboration.

## 5. The benefits of integration in 2010

Firms can benefit from IMS which comply with several MS requirements jointly. Fig. 8 shows that integration has brought positive effects for most companies. Instead of analyzing the obtained benefits one by one, only the most important results are presented here. We show only results for the year 2010 because the benefits of integration were not included as a question in the 2006 survey. We cannot therefore study whether the benefits of integration have increased or decreased over time. However, knowing from the previous section that the majority of integration difficulties have decreased over time, we would infer that firms are positive about the integration their MSs. Some of the most positive points regarding integration of MSs are:

- Task simplification (documentation, requirements)
- Increase of organizational efficiency
- Better use of the internal and external audit results
- Firm image improvements.

These points suggest that firms benefit from both internal and external aspects as they increase their organizational efficiency (more efficient tasks and internal audits) as well as they improve external characteristics such as firm image and external audits. The benefits mentioned here are in line with the benefits found by authors like Karapetrovic and Willborn (1998), Wassenaar and Grocott (1999), Wilkinson and Dale (1999), Douglas and Glen (2000), Renzi and Cappelli (2000), Zutshi and Sohal (2005), Salomone (2008) and Asif et al. (2009). These authors present improvements related to having an integrated system similar to our findings as they highlight benefits such as simpler, more focused management systems in the organization; reduction in duplication of policies, procedures and records; improved multiple audits; and improved customer confidence and positive company image.

## 6. Conclusions

The main objective of this research is to contribute to the understanding to how IMSs evolve over time, as well as to analyze how the perception of the challenges related to the IMSs changes within a period of time. Additionally, the paper aims to evaluate the

extent of the integration and the difficulties experienced by firms during the implementation and integration of standardized MSs in organizations with more than one MS. In order to accomplish these objectives, the first study on the evolution of integration of MSs was undertaken. We conducted an empirical analysis which investigates data on the perception of quality and environmental system managers of the impact of MSs implementation and integration during a four-year period.

The first conclusion to be drawn from this study is that the majority of firms with more than one MS integrate them into a single system. Therefore, organizations seem to prefer integration over keeping their MSs separated and they evolve toward a state of complete integration (Douglas and Glen, 2000; Karapetrovic et al., 2006; Zeng et al., 2007; Salomone, 2008; Karapetrovic and Casadesus, 2009; Bernardo et al., 2009). Specifically, 89% of firms in 2006 and 84% of the organizations analyzed in 2010 decided to integrate their MSs. This is in line with the results found by Douglas and Glen (2000), Karapetrovic et al. (2006), Karapetrovic and Casadesus (2009) and Bernardo et al. (2009). These findings indicate that the majority of firms either integrate all their MSs or they choose not to integrate any of them. The rest of the firms, which stay in a medium position with a partial level of integration, are not so numerous.

Regarding the human resources involved in the different MSs, only the results of the MS managers and inspectors show significant differences from 2006 to 2010. Therefore, we conclude that, in 2010, the responsibility for managing different MSs falls to the same person more than in 2006. As for the work procedures, there is an increase of integration over time in planning, control of non-conformities, preventive and corrective actions, product realization, improvement and determination of stakeholder requirements. These results show that the level of integration of these elements is higher in 2010 than in 2006. Finally, comparing the 2006 and 2010 samples, the documentation resources and goals are shown to have different integration levels, with a higher integration level in 2010 for the objectives.

The third conclusion is that, for the analyzed samples, little relationship exists between the integration difficulties, on one hand, and the level of MS integration, on the other. The only difficulty that predicts the integration level is "inadequate implementation of the initial system". However, although not statistically

significant, the effect of time is present regarding the integration difficulties, as the perception of the difficulties we encountered was higher in 2006 than it is in 2010. Therefore, firms perceive a decline of the importance of the majority of difficulties over the four-year period.

As an exploratory study, this paper opens a new line of research in the field of MS integration and contributes to the understanding on how IMSs evolve over time. However, due to the unavailability of other similar studies of the impact of IMS over time in the literature, it was not possible to compare the results of these surveys to similar surveys conducted, for example, in a different country. Nevertheless, we expect we would probably obtain very similar results in that case, since the majority of the works studying IMS effects, although obtaining static results, lead to very similar conclusions. Moreover, there are dynamic studies about the evolution of ISO 9001 that prove that organizations benefit significantly from the certification and that these benefits increase over time (Terziovski et al., 2003; Dowlatshahi and Urias, 2004; Casadesus and Karapetrovic, 2005; McGuire and Dilts, 2008; Karapetrovic et al., 2010).

From the results of our study, it is essential that managers and practitioners become aware of the challenges and obstacles of systems integration. If these challenges are not addressed early in the process they can delay the completion of the integration process. Recommendations for managing IMS include obtaining commitment from the top management; using implementation and integration guidelines; having training across the organization in aspects of integration, and last but not least having integrated audits. Implementation of these recommendations may vary from one organization to another, however, it would result in less resistance for the organizations following them. Moreover, having IMSs is especially important for organizations willing to move toward continuous improvement and business excellence as it can help organizations to efficiently tackle quality and environmental issues more efficiently and systematically.

For future research, given the answers regarding the difficulties experienced by organizations, it would be interesting to further study these results and identify the relationship between the integration difficulties and financial performance measures. It would also be interesting to study how the perception of firms regarding the integration benefits evolves over time. Finally, another future research line could be directed toward exploring to which extent new standards contribute to integration, how the standards structure impacts integration and whether they have been written in order to facilitate integration.

## Acknowledgments

This article has been written as part of a research project entitled “Mejora de la satisfacción de los clientes en las empresas españolas mediante modelos y estándares de gestión de la calidad” (ECO2009-12754-C02-01) financed by the Ministry of Science and Innovation within the aid program for R & D projects and as a part of the Ministry of Science and Innovation aid Program for the Formation of University Researchers (Programa Nacional de Formación de Profesorado Universitario).

## References

Asif, M., Bruijn, E.J.D., Fisscher, O.A.M., Searcy, C., Steenhuis, H.-J., 2009. Process embedded design of integrated management systems. *International Journal of Quality and Reliability Management* 26 (03), 261–282.

Asif, M., Fisscher, O.A.M., Joost de Bruijn, E., Pagell, M., 2010. An examination of strategies employed for the integration of management systems. *The TQM Journal* 22 (6), 648–669.

Beckmerhagen, I.A., Berg, H.P., Karapetrovic, S.V., Willborn, W.O., 2003. Integration of management systems: focus on safety in the nuclear industry. *International Journal of Quality & Reliability Management* 20 (2), 210–228.

Bernardo, M., Casadesus, M., Karapetrovic, S., Heras, I., 2009. How integrated are environmental, quality and other standardized management systems? An empirical study. *Journal of Cleaner Production* 17, 742–750.

Bernardo, M., Casadesus, M., Karapetrovic, S., Heras, I., 2010. An empirical study on the integration of management system audits. *Journal of Cleaner Production* 18 (5), 486–495.

Brecka, J., 1994. Study finds that gains with ISO 9000 registration increase over time. *Quality Progress* 27 (5), 18.

Casadesus, M., Karapetrovic, S., 2005. The erosion of ISO 9000 benefits: a temporal study. *International Journal of Quality and Reliability Management* 22 (2), 120–136.

Casadesus, M., Marimon, F., Heras, I., 2008. ISO 14001 diffusion after the success of the ISO 9001 model. *Journal of Cleaner Production* 16 (16), 1741–1754.

Castka, P., Balzarova, M.A., 2008a. The impact of ISO 9000 and ISO 14000 on standardisation of social responsibility – an inside perspective. *International Journal of Production Economics* 113 (1), 74–87.

Castka, P., Balzarova, M.A., 2008b. ISO 26000 and supply chains – on the diffusion of the social responsibility standard. *International Journal of Production Economics* 111 (2), 274–286.

Corbett, C.J., Kirsch, D.A., 1999. The linkage between ISO 9000 and ISO 14000 standards: an international study. Working paper, Center for International Business Education & Research, UCLA Anderson School of Management, Los Angeles, CA.

Corbett, C.J., Kirsch, D.A., 2001. International diffusion of ISO 14000 certification. *Production & Operations Management* 10 (3), 327–342.

Cox, D.R., Snell, E.J., 1989. *Analysis of Binary Data*, second ed. Chapman and Hall, London.

De Moor, P., De Beelde, I., 2005. Environmental auditing and the role of the accountability profession: a literature review. *Environmental Management* 36 (2), 205–219.

Deming, W.E., 1982. *Quality, Productivity and Competitive Position*. MIT Center for Advanced Engineering, Cambridge.

Douglas, A., Glen, D., 2000. Integrated management systems in small and medium enterprises. *Total Quality Management* 11 (4–6), 686–690.

Dowlatsahi, S., Urias, C., 2004. An empirical study of ISO certification in the maquiladora industry. *International Journal of Production Economics* 88 (3), 291–306.

Ferguson, W., 1996. Impact of the ISO 9000 series standards on industrial marketing. *Industrial Marketing Management* 25, 305–310.

Franceschini, F., Galetto, M., Gianni, G., 2004. A new forecasting model for the diffusion of ISO 9000 standard certifications in European countries. *International Journal of Quality & Reliability Management* 21 (1), 32–50.

Forum Calidad, 2010. *Certificación en España según las normas ISO 9001 e ISO 1400*. Decimoquinto Informe de Forum Calidad 22 (210), 22–27.

Griffith, A., Bhutto, K., 2008. Improving environmental performance through integrated management systems (IMS) in the UK. *Management of Environmental Quality: An International Journal* 19 (5), 565–578.

Heras, I., Casadesus, M., 2006. Los estándares internacionales de sistemas de gestión: pasado, presente y futuro. *Boletín ICE - Revista del Ministerio de Industria, Turismo y Comercio* 2876, 45–61.

Hosmer, D., Lemeshow, S., 1989. *Applied Logistic Regression*. John Wiley and Sons, Inc.

ISO, 2000. ISO 9001:2000. International Standard: Quality Management Systems – Requirements. International Organization for Standardization, Geneva, Switzerland.

ISO, 2008. The Integrated Use of Management System Standards. International Organization for Standardization, Geneva, Switzerland.

ISO, 2009. Annual Report. International Organization for Standardization, Geneva, Switzerland. Available at: [http://www.iso.org/iso/annual\\_report\\_2009.pdf](http://www.iso.org/iso/annual_report_2009.pdf) (accessed 25.11.10).

ISO, 2010. The ISO Survey of Certifications – 2009. International Organization for Standardization, Geneva, Switzerland.

Jones, R., Arndt, G., Kustin, R., 1997. ISO 9000 among Australian companies: impact of time and reasons for seeking certification on perceptions of benefits received. *International Journal of Quality & Reliability Management* 14, 650–660.

Jørgensen, T.H., Remmen, A., Mellado, M., 2006. Integrated management systems—three different levels of integration. *Journal of Cleaner Production* 14 (8), 713–722.

Jørgensen, T.H., 2008. Towards more sustainable management systems: through life cycle management and integration. *Journal of Cleaner Production* 16 (10), 1071–1080.

Karapetrovic, S., Willborn, W., 1998. Integration of quality and environmental management systems. *The TQM Magazine* 10 (3), 204–213.

Karapetrovic, S., 2002. Strategies for the integration of management systems and standards. *The TQM Magazine* 14 (1), 61–67.

Karapetrovic, S., 2003. Musings on integrated management systems. *Measuring Business Excellence* 7 (1), 4–13.

Karapetrovic, S., Jonker, J., 2003. Integration of standardized management systems: searching for a recipe and ingredients. *Total Quality Management and Business Excellence* 14 (4), 451–459.

Karapetrovic, S., Casadesus, M., Heras, I., 2006. Dynamics and Integration of Standardized Management Systems. Documenta Universitaria, Girona, Spain.

Karapetrovic, S., Casadesus, M., 2009. Implementing environmental with other standardized management systems: scope, sequence, time and integration. *Journal of Cleaner Production* 17 (5), 533–540.

- Karapetrovic, S., Casadesus, M., Heras, I., 2010. What happened to the ISO 9000 lustre? An eight-year study. *Total Quality Management & Business Excellence* 21 (3), 245–267.
- Khanna, K.H., Laroia, S.C., Sharma, D.D., 2010. Integrated management systems in Indian manufacturing organizations: some key findings from an empirical study. *The TQM Journal* 22 (6), 670–686.
- Kraus, J., Grosskopf, J., 2008. Auditing integrated management systems: considerations and practice tips. *Environmental Quality Management* 18 (2), 7–16.
- Labodova, A., 2004. Implementing integrated management systems using a risk analysis based approach. *Journal of Cleaner Production* 12 (6), 571–580.
- Lagodimos, A.G., Chountalas, P.T., Chatzi, K., 2007. The state of ISO 14001 certification in Greece. *Journal of Cleaner Production* 15 (18), 1743–1754.
- Leung, H.K.N., Chan, K.C.C., Lee, T.Y., 1999. Costs and benefits of ISO 9000 series: a practical study. *International Journal of Quality & Reliability Management* 16, 675–691.
- López-Fresno, P., 2010. Implementation of an integrated management system in an airline: a case study. *The TQM Journal* 22 (6), 629–647.
- Marimon, F., Casadesus, M., Heras, I., 2006. ISO 9000 and ISO 14000 standards: an international diffusion model. *International Journal of Operations & Production Management* 26 (2), 141–165.
- Marimon, F., Llach, J., Bernardo, M., 2011. Comparative analysis of diffusion of the ISO 14001 standard by sector of activity. *Journal of Cleaner Production* 19 (15), 1734–1744.
- Matias, J.C.O., Coelho, D.A., 2002. The integration of the standards systems of quality management, environmental management and occupational health and safety management. *International Journal of Production Research* 40 (15), 3857–3866.
- McGuire, J., Dilts, D., 2008. The financial impact of standard stringency: an event study of successive generations of the ISO 9000 standard. *International Journal of Production Economics* 113 (1), 3–22.
- Menard, S., 1995. *Applied Logistic Regression Analysis*. Sage Publications. Series: Quantitative Applications in the Social Sciences, No. 106.
- Nagelkerke, N.J.D., 1991. A note on a general definition of the coefficient of determination. *Biometrika* 78, 691–692.
- Novales, A., 1997. *Estadística i Econometria*. McGraw-Hill, Madrid, España.
- Pojasek, R., 2006. Is your integrated management system really integrated? *Environmental Quality Management* 16 (2), 89–97.
- Renzi, M.F., Cappelli, L., 2000. Integration between ISO 9000 and ISO 14000: opportunities and limits. *Total Quality Management* 11 (4–6), 849–856.
- Salomone, R., 2008. Integrated management systems: experiences in Italian organizations. *Journal of Cleaner Production* 16 (16), 1786–1806.
- Saraiva, P.M., Duarte, B., 2003. ISO 9000: some statistical results for a world wide phenomenon. *Total Quality Management & Business Excellence* 14 (10), 1169–1178.
- Singels, J., Rüel, G., van de Water, H., 2001. ISO 9000 series: certification and performance. *International Journal of Quality & Reliability Management* 18 (1), 62–75.
- Singh, P.J., 2008. Empirical assessment of ISO 9000 related management practices and performance relationships. *International Journal of Production Economics* 113 (1), 40–59.
- Tang, S.L., Kam, C.W., 1999. A survey of ISO 9001 implementation in engineering consultancies in Hong Kong. *International Journal of Quality & Reliability Management* 16 (6), 562–574.
- Tarí, J.J., Molina-Azorín, J.F., 2010. Integration of quality management and environmental management systems. Similarities and the role of the EFQM model. *The TQM Journal* 22 (6), 687–701.
- Terziowski, M., Power, D., Sohal, A., 2003. The longitudinal effects of the ISO 9000 certification process on business performance. *European Journal of Operational Research* 146, 580–595.
- Wassenaar, P., Grocott, S., 1999. Fully integrated management systems. Paper Presented at the 3rd International and 6th National Research Conference on Quality Management, RMIT University, Melbourne, February 8–10.
- Wilkinson, G., Dale, B.G., 1999. Integrated management systems: an examination of the concept and theory. *The TQM Magazine* 11 (2), 95–104.
- Zeng, S.X., Tam, C.M., Tam, V.W.Y., Deng, Z.M., 2005. Towards implementation of ISO 14001 environmental management systems in selected industries in China. *Journal of Cleaner Production* 13 (7), 645–656.
- Zeng, S., Shi, J., Lou, G., 2007. A synergetic model for implementing an integrated management system: an empirical study in China. *Journal of Cleaner Production* 15 (18), 1760–1767.
- Zeng, S.X., Xie, X.M., Tam, C.M., Shen, L.Y., 2011. An empirical examination of benefits from implementing integrated management systems (IMS). *Total Quality Management & Business Excellence* 22 (2), 173–186.
- Zutshi, A., Sohal, A.S., 2005. Integrated management system. The experience of three Australian organisations. *International Journal of Quality and Reliability Management* 16 (2), 211–232.