An analysis of food safety management systems certification: the Portuguese case

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Abstract

The worldwide food safety management systems implementation and certification has significantly increased during the last few years, thus reflecting the importance that those standards has assumed in some activity sectors. Based on the literature reviews carried out up to now, we can infer that there is a large number of research projects related to this area. However, the nationwide research projects related to ISO 22000 are scarce as far as Portugal is concerned. Therefore, this paper reflects what we believe to be a pioneering contribution in order to characterize the adoption of food safety management systems by the Portuguese companies. In more detail, our aim is to provide fact-based insights, among others, into the following issues:

- *Which are ISO 22000 certification motivations and benefits?*
- *Which are ISO 22000 main obstacles, difficulties and drawbacks?*
- *What are the benefits and costs directly related to the food management system implementation, certification and maintenance?*
- *Which are the perspectivesin the evolution of the food management systems market ?*

In order to answer to the previous issues, our research methodology was based on a survey that was e-mailed to ISO 22000 Portuguese certified companies.

Key words: ISO 22000; food safety management systems; survey

Introduction

The food products safety was affected in previous years by successive crises in the alimentary chain. As a way to re-establish the confidence of the consumers, it is necessary that food organizations prevent this kind of situations.

The increasing concerns related to food safety among the consumers have been faced by competent authorities, through the publication of the communitarian legislation and of the ISO 22000:2005.

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In September 2005, the International Organization for Standardization (ISO) published the ISO 22000:2005 standard - Food safety management systems - Requirements, which is applicable to any organization in the food chain". This standard integrates the requirements defined by ISO 9001 and the methodology used by HACCP.

Based on the literature reviews that were ,we were able to discover that there are numerous studies related to the implementation and certification of food safety management systems, mainly related to HACCP. However, as far as Portugal is concerned, the research projects concerning this issue are scarce. Thus, our aim was to conduct a research project in order to study the ISO 22000 adoption by the Portuguese food companies.

The main goals of this work were the following ones:

- To identify ISO 22000 implementation and certification motivations;
- To identify ISO 22000 implementation benefits and difficulties;
- To identify ISO 22000 market evolution perspectives;
- To identify the costs and benefits directly related to the implementation and certification of food safety management systems.

In order to address previous research issues, we have conducted a large scale survey among all ISO 22000 Portuguese companies.

Literature review

ISO 22000:2005 standard is based on the Codex Alimentarius HACCP principles and was developed in line with the ISO 9001 standard in order to improve compatibility and integration with the quality management standard.

There was an advanced voluntary implementation in the group of enterprises within the HACCP system in full operation. Moreover, the prior adoption of ISO 9000 had a direct influence on the implementation of HACCP in these firms. As regards implementation, it is important that enterprises have the necessary information to concretely evaluate the magnitude of costs for each type of plant prior to implementation (Maldonado, 2005).

In practice, HACCP application in regulation contains elements of process, performance, and information standards. In the European Union, it replaces a more prescriptive regulation specifying GMPs (Good Manufacturing Practices), thus giving firms greater flexibility.

There is a general requirement now for food safety controls based on "HACCP principles" to be applied. However, there are no specifics on what these systems should include, and a certain degree of flexibility remains with member countries in the implementation phase (Unnevehr, 1999).

The adoption of HACCP as a regulatory standard has been motivated first by food safety concerns, and only afterwards by the desire to facilitate trade. The process of trade facilitation will require mutual recognition of HACCP regulations across national boundaries. One trend which may influence such recognition is the

use of HACCP as a private standard for international trade. The ISO 9000 certification series for food companies is being adapted for certification of private HACCP programmes. Such private developments may facilitate an eventual harmonization of HACCP regulation among countries (Unnevehr, 1999).

The identified CCP (Critical Control Points) numbers directly interfere with resources necessary to implement, develop and maintain an HACCP plan. Reduction of the identified CCP number caused a decrease in cumulative cost after the fourth month. Thus, the estimated costs for the implementation and maintenance of the HACCP plan (considering the previous compliance of industry with the pre-requisites) were lower than those spent with the HACCP plan without compliance with the GMP/SSOP (Good Manufacturing Practice'' and ''Sanitation Standard Operational Procedures) pre-requisites. This fact emphasizes the importance of a solid pre-requisite program to improve economic viability for HACCP implementation (Roberto, 2006).

The implementation and maintenance of the HACCP system can be enriched if the company takes in consideration the whole experience of the other implemented managements systems. If the company has other management systems implemented, the HACCP system should be integrated in the companies' management system. According to the ISO 22000 standard, the food safety management system will be more effective if established, operated and updated within the framework of a structured management system and if integrated in the overall organization management activities. Thus, there will be a maximum benefit for the organization and stakeholders. An ISO 22000 certified organization demonstrates the ability to provide safe products, in accordance with government requirements and regulations, and consumers needs, promoting continuous improvement.

There is a big confusion between pre-requisite programs and HACCP plan, their relations and how they should be managed. This gets worse because there is a lack of specific hazard analysis. The reasons for this misunderstanding are located on negative guideline factors and lack of understanding, being difficult to say which barrier takes place first. As all this occurs among industry personnel and external consultants, it generates a barrier of negative external factors. Administration should plan actions in order to develop clear and detailed guides in Spanish for HACCP system, with special attention to hazard analysis and pre-requisites programs and their relation with HACCP plan.

There are also interactions between attitude related barriers (lack of agreement and lack of outcome expectancy) which are obstructing the change of behavior although there is motivation to do so. It should be convenient to plan activities targeted to consultants, managers and owners with the aim of improving knowledge and understanding, and to improve the conviction that business management includes food safety. (Vela & Fernández, 2003)

The Pillsbury Company encountered this dilemma in the 1960s in its attempts to fulfill several food production contracts with the US Army and the National Aeronautics and Space Administration (NASA). NASA in particular had very stringent microbiological acceptance criteria, not wanting to risk the illness of an

astronaut during a space mission (what an inopportune time for a 'two-bucket' illness!). In essence, nothing short of 100% product testing could assure NASA that a particular packet of food was safe to consume. It was obvious to all involved that product testing could not be used to guarantee food safety. A much better system of food safety assurance was required.

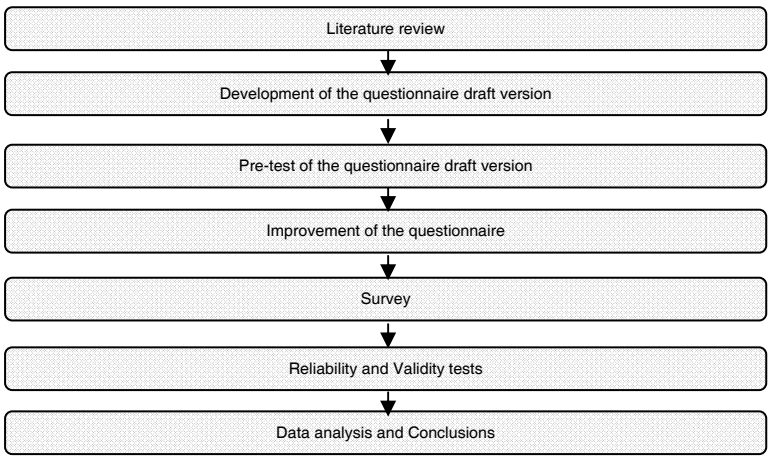
Thus, the genesis of the HACCP concept, a joint development by The Pillsbury Company, the US Army, and NASA. Unlike QC systems, HACCP is a preventive system in which food safety can be designed into the product and the process by which it is produced. It is a system of product design and process control. The HACCP system of food safety is very effective at controlling identified hazards. Most importantly, it does not rely upon product testing to assure food safety.

Over the next three decades, the HACCP system spread into the food processing industry of the US, and into other countries. Toward the end of this period, government regulatory agencies began to replace their inspection programs, based upon infrequent plant visits, with audit programs, and a review of continuous HACCP records; a development that led to the promulgation of several HACCP-based food safety rules. During the 1990s, the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) and the Codex Alimentarius Commission Committee on Food Hygiene (CACCFH) expanded the early HACCP applications and published documents on HACCP principles and guidelines for their implementation (Sperber, 2005).

Research methodology

Our research methodology was supported by the following phases (Figure 1):

Fig. 1: Research methodology



Source: our elaboration

The questionnaire was composed of 6 groups of questions. In the first group our aim was to collect general information related to the respondent company (companies' dimension and activity sector, whether the company had integrated the ISO 22000 standard with other management standards or not, etc.). The second group intended to identify the motivations which had lead the Portuguese organizations to implement and certify a food safety management system according to the ISO 22000 standard. In the third group our aim was to identify which had been the most import benefits deriving from the food safety management system implementation. Group four was related to implementation difficulties and drawbacks. Additionally, companies had to identify which of the standard clauses and sub-clauses had been more difficult to implement. Group five was related to implementation and certification costs and to the evaluation of the ISO 22000 certification impact on the final consumer. Finally, in group six we tried to evaluate the evolution perspectives concerning ISO 22000 certification.

The scale adopted in the questionnaire was a five-point Likert one.

Results obtained

The SPSS package version 18.0 was used to analyze the data.

Questionnaire Reliability and Validity

The questionnaire reliability and validity (content and construct) was tested. Reliability was assessed using Cronbach's alpha coefficient, which represents a measure of the questionnaire's internal consistency. Content and construct validities were also performed.

Construct validity was tested through the "Principal Components Analysis". The criterion which was used to retain components in one group was the latent root, which considers a component for inclusion if its eigenvalue is greater than unity. Additionally, the Kaiser-Meyer-Olkin (KMO) indicator was calculated to assess sample size adequacy. The minimum acceptable level is 0,5 (Brash, 2002). The KMO scores for ISO 22000 areas of impact and evolution perspectives were, respectively, 0,63 and 0,709.

Table 1: Management benefits component

Benefits
A cost reduction was verified.
The system implementation and certification allowed the company access to new markets.
An increase of the sales volume was verified.
An increased in the products' shelf time was verified .

Source: our elaboration

Table 2: Product benefits component

Benefits
A reduction of food risks was verified.
The product became safer.
The number of potential non-safety products has decreased.

Source: our elaboration

Table 3: Human resources benefits component

Benefits
The collaborators are more committed in hygiene and food safety aspects.
The collaborators are highly motivated.

Source: our elaboration

Table 4: Component 1 in food safety evolution scenarios

Evolution scenarios
Stagnation of the importance of food safety aspects / Increase in the importance of food safety aspects.
Stagnation of the importance of ASAE/ANESA in the diffusion of the food safety theme in Portugal / Increase in the importance of ASAE/ANESA in the promotion of the food safety theme in Portugal.
Reduced importance of food safety aspects in the Portuguese political agenda / Increase in the importance of food safety aspects in the Portuguese political agenda.
Decrease in the credibility of food safety aspects / Increase in the credibility of food safety aspects.

Source: our elaboration

Table 5: Component 2 in food safety evolution scenarios

Evolution scenarios
Diffusion of food safety standards / Convergence for global and integrated food safety standards.
Application of the food safety management systems current verification and improvement tools / Development of new tools and methodologies.
Food safety professionals with low skills / Food safety professionals with high competence and efficiency.

Source: our elaboration

As is illustrated in the previous tables (Table 1 to 5), we were able to extract 3 components in the benefits section and 2 components in the evolution scenarios section.

Cronbach's alpha, which represents the ratio between the true and the observed variance (Yu, 2002), was used to measure internal consistency; a low value of alpha indicates that the data are not homogeneous or that the sample of items performs poorly in capturing the construct or component (Churchil, 1979). An acceptable

Cronbach alpha should be higher than 0,7 (Husain, 2001). With the exception of the "Human Resources" benefits, the remaining ones do present a Cronbach Alpha higher than 0,7, thus showing that the questionnaire possesses an internal consistency and that the scales are reliable (Table 6 to 10).

Table 6: Cronbach Alpha for management impact category

Benefits	Cronbach Alpha
A cost reduction was verified. The system implementation and certification allowed the company access to new markets. An increase of the sales volume was verified. An increase in the products' shelf time was verified.	0,740

Source: our elaboration

Table 7: Cronbach Alpha for product impact category

Benefits	Cronbach Alpha
A reduction of the food risks was verified. The product became safer. The number of potential non-safety products has decreased.	0,685

Source: our elaboration

Table 8: Cronbach Alpha for human resources impact category

Benefits	Cronbach Alpha
Collaborators are more committed in hygiene and food safety aspects. Collaborators are highly motivated.	0,335

Source: our elaboration

Table 9: Cronbach Alpha in food safety evolution scenarios (component 1)

Evolution scenarios	Cronbach's Alpha
Stagnation of the importance of food safety aspects / Increase in the importance of food safety aspects. Stagnation of importance of ASAE/ANESA in the diffusion of the food safety theme in Portugal / Increase in importance of ASAE/ANESA in the promotion of the food safety theme in Portugal. Reduced importance of food safety aspects in the Portuguese political agenda / Increase in the importance of food safety aspects in the Portuguese political agenda. Decrease in the credibility of food safety aspects / Increase in the credibility of food safety aspects.	0,777

Source: our elaboration

Table 10: Cronbach Alpha for food safety evolution scenarios (component 2)

Evolution scenarios	Cronbach's Alpha
Diffusion of food safety standards / Convergence for global and integrated food safety standards.	0,802
Application of food safety management systems' current verification and improvement tools / Development of new tools and methodologies.	
Food safety professionals with low skills / Food safety professionals with high competence and efficiency.	

Source: our elaboration

Content validity is always subjectively evaluated by the researcher (Churchil, 1979). An instrument has content validity if it contains a representative collection of items and if sensible methods of the test construction were used (Yusof, 2000). The questionnaire was designed after an extensive literature review and was based on comments and suggestions from academics and company managers. Furthermore, the questionnaire was pre-tested and suggestions from respondents were incorporated into the final design.

A test for possible bias from respondents was also performed (Armstrong, 1977). The completed questionnaires were divided into two groups. The first group comprised the earlier respondents (40 questionnaires) and the second group the later ones (22 questionnaires). If there were significant differences among the characteristics of these groups' answers, the same outcome should be expected among non-respondents, because extrapolation methods are based on the assumption that subjects who respond less readily are more similar to non-respondents. It would be unwise to generalize findings from this study if the non-respondents had different characteristics to the ones that had responded. No significant differences were detected, allowing us to conclude that non-respondents have similar characteristics to respondents.

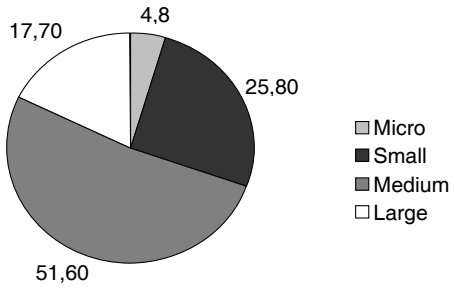
Results

In this section we present the main results obtained from this research.

General characterization of the organizations

Figure 2 illustrates the organization sample of our research. As can be verified, the majority of the surveyed companies were of medium dimension (51,6%).

Fig. 2: Companies' dimension



Source: our elaboration

As regards the companies' activity sector, the majority of the respondents' companies belong to the "Manufacture of other food products" (25,8%).

Furthermore we surveyed the companies in order to find out if they had an additional certification besides ISO 22000. Sixty eight per cent (68%) of the companies were certified according to other standards, and 36% presented a certified quality management system.

As is illustrated in Table 11, the majority of the companies became ISO 22000 certified in 2008 (27,4%) and 2009 (26,8%).

Table 11: Year of Certification

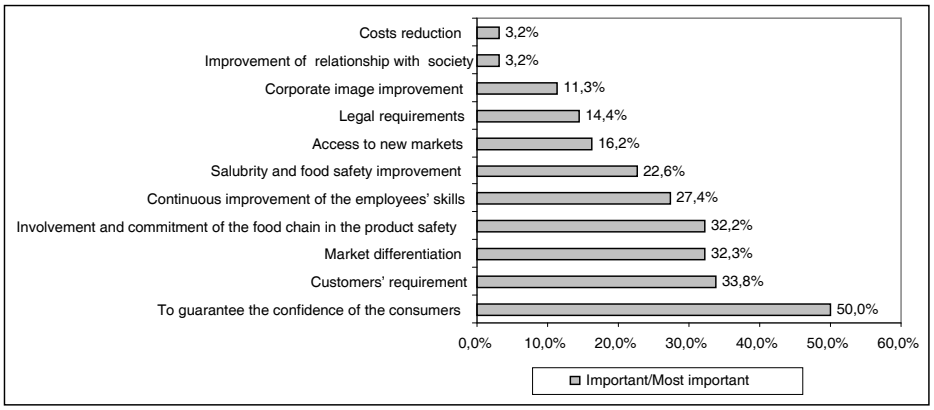
Year	# organization	(%)
2005	4	6,5
2006	5	8,1
2007	9	14,5
2008	17	27,4
2009	16	25,8
2010	5	8,1

Source: our elaboration

Motivations for ISO 22000 certification

As is illustrated in Figure 3, the surveyed ISO 22000 companies' most important motivation was "To guarantee the confidence of the consumers" with a score of 50%, followed by "Customers requirement" (33,8%). "Market differentiation" and "Involvement and commitment of the food chain in the product safety" were also appointed as important motivations for companies that implemented a food safety management system according to ISO 22000 with scores of, respectively, 32,3% and 32,2%. According to the results obtained, we can assume that the most important ISO 22000 motivation among the Portuguese certified companies is one of internal nature.

Fig. 3: ISO 22000 certification motivations

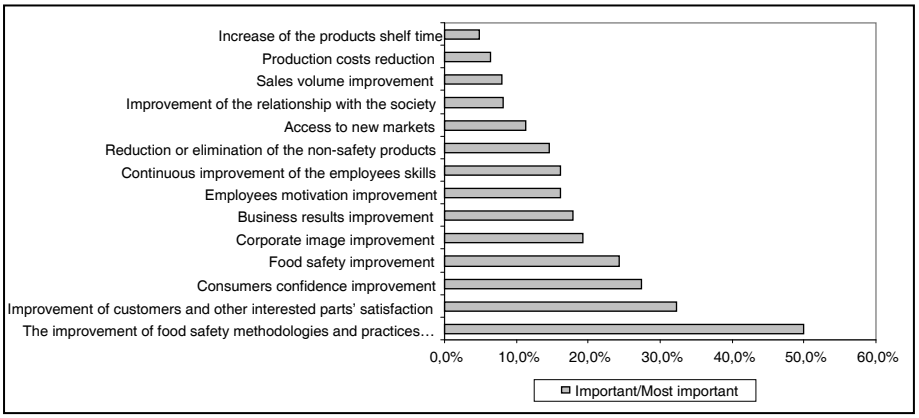


Source: our elaboration

Benefits for certification ISO 22000

In Figure 4 the ISO 22000 benefits' analysis is presented. As is illustrated in the figure, the most common ISO 22000 benefit cited by the inquired companies was "Improvement of food safety methodologies and practices, and management system related documentation" (50%), followed by "Improvement of customers and other interested parts satisfaction" with a score of 32,2%. As it was verified for the ISO 22000 certification motivations, the most important benefit stated by the respondents companies was of internal nature.

Fig. 4: ISO 22000 certification benefits



Source: our elaboration

Tables 12, 13 and 14 illustrate the areas where the implementation of the food safety management system had more impact. Following the system implementation company workers had become more food safety oriented (4,50).Furthermore, the product became safer (3,87), a decrease in food risks was verified (3,77) and the company's workers became more motivated (3,69). According to the respondents' companies, the food safety management system implementation had no significant impact on the products' shelf time (2,00).

Table 12: Food safety management system's impact

Benefits	Average	Standard deviation
The food safety management system implementation and certification allow access to new markets.	3,02	1,408
An increase in the sales volume was verified.	2,52	1,264
A reduction of the costs was verified.	2,35	1,294
An increase in the products' shelf time was verified.	2,00	1,255

Source: our elaboration

Table 13: Food safety product impact

Benefits	Average	Standard deviation
The product became safer.	3,87	0,877
A decrease in food risks was verified.	3,77	1,015
The number of non-conforming products has decreased.	3,39	1,178

Source: our elaboration

Table 14: Food safety human resources impact

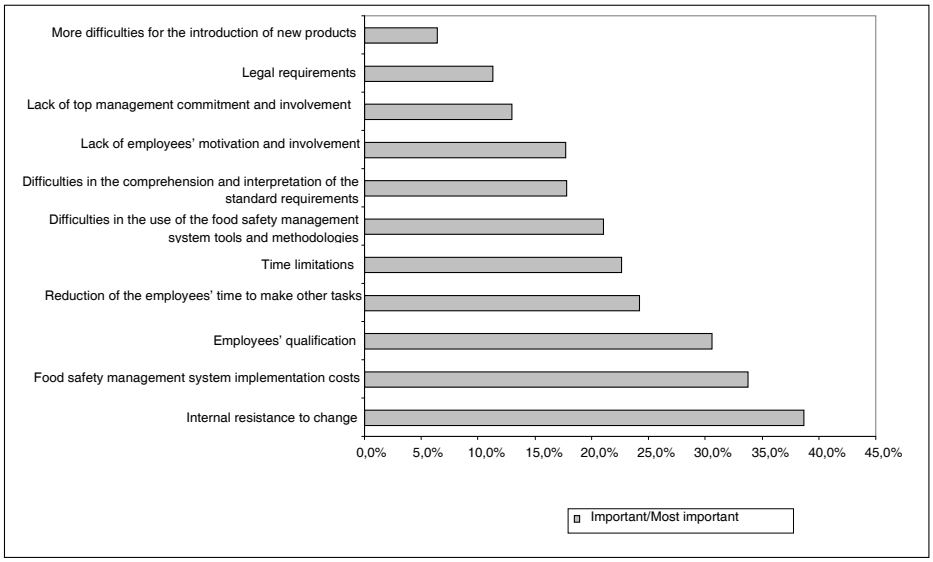
Benefits	Average	Standard deviation
The workers are more food safety oriented.	4,50	0,594
An increase in the workers' motivation was verified.	3,69	0,934

Source: our elaboration

Difficulties for certification ISO 22000

In this section we will analyze the food safety management system's most important difficulties and drawbacks. As is illustrated in Figure 5, the difficulty most cited by surveyed companies was "Internal resistance to change", with a score of 38,7%, followed by "Food safety management system implementation costs" (33,8%) and "Employees' qualification".

Fig. 5: Food safety management system implementation's difficulties



Source: our elaboration

ISO 22000 Clauses Implementation Difficulties

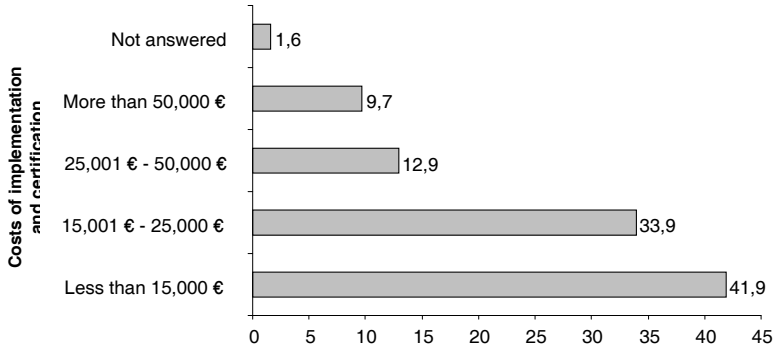
As regards the ISO 22000 clauses' difficulty level of implementation we were able to find out the following top 5: "Verification Plan" (37,1%), "Hazard Analysis" (33,9%), "Human Resources Competence, Awareness and Qualification" (30,6%), "Implementation of a HACCP Plan" (25.8%) and "Monitoring and Measurement Control" (22.6%).

Direct costs and benefits related to the food safety management system implementation

The direct costs related to the implementation and certification of the food safety management system include the employees' qualification and training, technical support, ISO 22000 certification and calibration of equipment.

As is illustrated in Figure 6, 41.9% of the surveyed organizations presented implementation and certification costs that were lower than 15.000€.

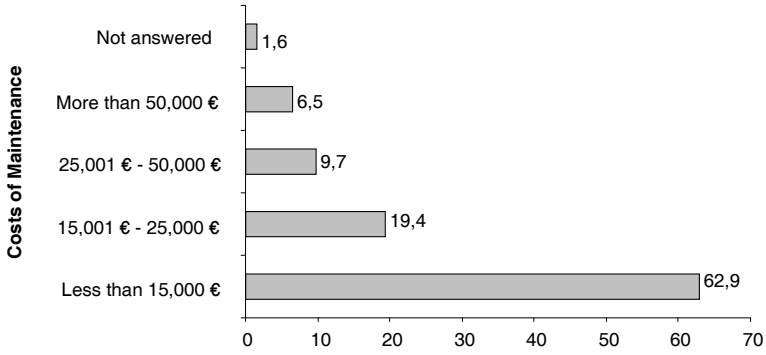
Fig. 6: ISO 22000 implementation and certification costs



Source: our elaboration

As regards maintenance costs (equipment and technology, employees' qualification and training, consultancy, certification and calibration of equipment), 62.9% of the companies stated costs that were lower than 15.000€ (Figure 7).

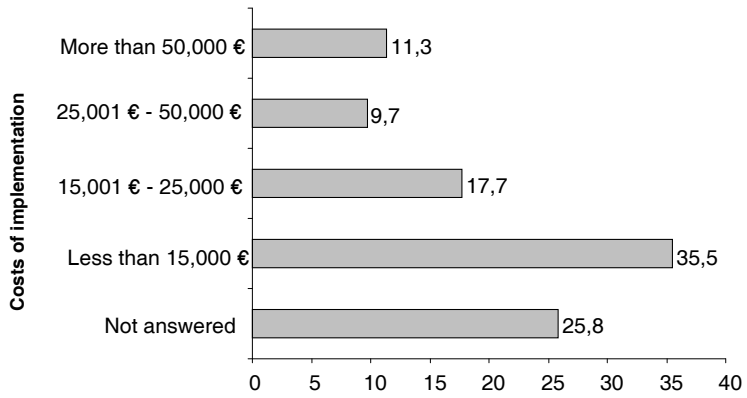
Fig. 7: ISO 22000 maintenance costs



Source: our elaboration

In addition, we also analyzed if the companies needed to perform any technological or equipment change as a result of the food safety management system implementation. As reported in Figure 8, 35,5% of the surveyed companies indicated that they had performed technological changes with a total cost that was lower than 15.000€ .

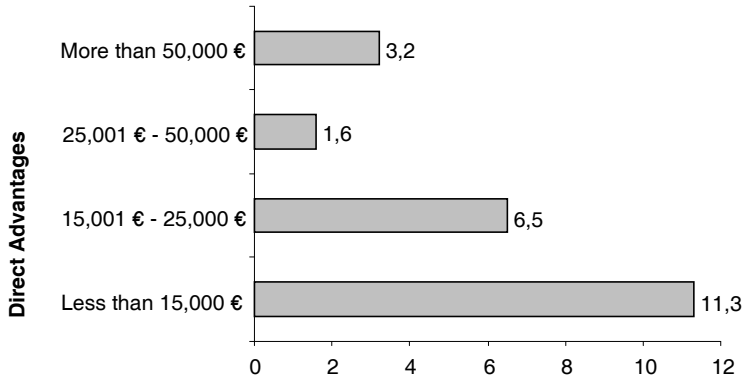
Fig. 8: Implementation costs related to technological or equipment changes



Source: our elaboration

As regards the financial benefits that have directly derived from the implementation and certification of the food safety management system, 75,81% of the companies stated that they were not able to quantify those improvements. As regards the firms which were able to quantify them, as is illustrated in Figure 9, the majority of them had reported financial benefits below 15.000€ (11,3%).

Fig. 9: ISO 22000 implementation and certification financial benefits



Source: our elaboration

It is important to point out that 64,5% of the companies reached the expected benefits as a result of the food safety management system implementation. The organizations that did not reach the expected benefits pointed out the following

reasons: “The market does not recognise the importance of ISO 22000 certification” (9,7%), “The implementation and maintenance costs are higher than the benefits obtained” (6,5%), and finally “Increase in bureaucracy as a result of the food safety management system implementation” (3,2%).

Fifty three per cent (53,2%) of the companies stated that the benefits derived from the ISO 22000 implementation were higher than the associated costs, and 40,3% stated that ISO 22000 was the final consumer’s perspective.

In the last section of the questionnaire we analyzed the ISO 22000 certified companies’ perception concerning the future of food safety management systems. Thus we were able to verify that, on average, for all proposed scenarios the companies’ feeling was more oriented towards a positive scenario (right side of Figure 10). With the exception of “Application of the food safety management systems current verification and improvement tools / Development of new tools and methodologies” scenario, the remaining ones present average scores higher than 5,00. The scenario with the highest average score (8,40) was “Stagnation of the importance of food safety aspects / Increase in the importance of food safety aspects”.

Fig. 10: Food safety evolution scenarios

Diffusion of food safety standards					Convergence for global and integrated food safety standards				
1	2	3	4	5	6,92	7	8	9	10
Application of food safety management systems current verification and improvement tools					Development of new tools and methodologies				
1	2	3	4	5,34	6	7	8	9	10
Stagnation of the importance of food safety aspects					Increase of the importance of food safety aspects				
1	2	3	4	5	6	7	8,40	9	10
Stagnation of importance of ASAE/ANESA in the diffusion of the food safety theme in Portugal					Increase of importance of ASAE/ANESA in the promotion of the food safety theme in Portugal				
1	2	3	4	5	6,32	7	8	9	10
Food safety professionals with low skills					Food safety professionals with high competence and efficient				
1	2	3	4	5	6	7,44	8	9	10
Reduced importance of food safety aspects in the Portuguese political agenda					Increase in the importance of food safety aspects in the Portuguese political agenda				
1	2	3	4	5	6,63	7	8	9	10
Decrease of the credibility of food safety aspects					Increase in the credibility of food safety aspects				
1	2	3	4	5	6	7,60	8	9	10

Source: our elaboration

Conclusions

As far we were able to analyse, this research is a pioneering contribution to the food safety research area. Our aim was to produce a set of both qualitative and quantitative statistical analyses, , in order to characterize the ISO 22000 certification among Portuguese companies.

As far as the ISO 22000 main motivations are concerned, we were able to find out that Portuguese companies become ISO 22000 certified mainly to improve the consumers' confidence and because this kind of registration is a customers' and other interested parts' requirement. Regarding the benefits obtained, the surveyed companies pointed out an improvement of food safety methodologies and practices. As was verified for ISO 22000 certification motivations, the most important benefit stated by the respondents' companies was of an internal nature. Regarding implementation barriers, two main difficulties have been highlighted: "Internal resistance to change" and "Food safety management system implementation costs".

Some of the issues raised here will continue to deserve additional research and are at the core of the authors' future work, in relation with a global data based analysis of the ISO 22000 certification worldwide phenomenon.

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