

Ana P. A. Fiore
Ana L. F. Facin¹
Jorge Muniz Jr.

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INFORMATION SECURITY AND QUALITY MANAGEMENT SYSTEMS INTEGRATION: CHALLENGES AND CRITICAL FACTORS

Abstract: *Implementing a new management system in organizations that already have a certified management system can be challenging. This research discussed enabler factors that influence the integration of an information security management system certified following ISO 27001 with a quality management system certified following ISO 9001. Five factors were identified as the basis of this research: Implementation Model, Human Resources, Resources Availability, Standard Issues, and Standards Integration. Four factors were validated through the qualitative study with consultants specialized in implementing and integrating these standards. Then, by prioritizing these factors through the Analytic Hierarchy Process method, it was found that the most relevant aspect is Standards Integration for the managers from the institution object of study. For specialist consultants, the most pertinent factor is Human Resources.*

Keywords: *Enabler Factors, Integrated Certified Management Systems, ISO 27001, ISO 9001, Analytic Hierarchy Process*

1. Introduction

Only organizations that take advantage of the benefits that the best information can provide for decision-making can better thrive in a competitive world (Fomin, Vries, & Barlette, 2008; Proença & Borbinha, 2018). This idea has been reinforced in the current scenario in which the "economy and society are becoming increasingly data-driven" (Culot, Nassimbeni, Podrecca, & Sartor, 2021, p.76), and companies have been boosted in understanding how to extract value from data to stand out in the market. With technological advances, access to privileged information can become a significant differential. However, companies have been subject to invasion by malicious people or organizations. Information leakage

can damage companies' reputations and competitiveness (Fazenda & Fagundes, 2015; Proença & Borbinha, 2018; Schlackl, Link, & Hoehle, 2022).

In this sense, the adequacy of organizations to standard information security management systems like ISO 27001 can allow them to conduct and effectively protect critical information, reflect the assessment of information processes, take a proactive attitude about information security, and show that, in compliance with an international standard, the institution can be more trustworthy (ABNT, 2013). Besides, in a competitive market, ISO 27001 can differentiate an organization from competitors (Fomin et al., 2008; Hsu, Wang, & Lu, 2016; Longras, Carneiro, Pereira, & Pinto, 2018).

¹ Corresponding author: Ana L. F. Facin
Email: affacin@gmail.com

Moreover, the certified management systems implementation aims to improve companies' results in continuous professionalization and efficiency gains. The business success depends on the customer's expectations in service quality questions being satisfied, meeting the agreed terms, and the reliability and security of the information are also critical issues.

Adequacy to certified systems makes processes more efficient, improves specifications, and provides greater control. The process standardization and the definition of responsibilities make companies more organized, with less rework and waste, generating increased efficiency and quality of products and services (Maekawa, Carvalho, & Oliveira, 2013).

Many companies have implemented more than one certified management system to guarantee their process's effectiveness and reliability. The integration of certified management systems can be understood as a combination of different systems in a single, more effective one (Beckmerhagen, Berg, Karapetrovic, & Willborn, 2003; Bernardo, Casadesus, Karapetrovic, & Heras, 2008). The need to have a global view of these systems, align the objectives, and facilitate decision-making can provoke the desire to integrate the systems (Mesquida, Mas, Amengual, & Cabestrero, 2010).

The literature has addressed the challenges faced by companies in integrating management systems (e.g., Abad, Cabrera, & Medina-león, 2016; Alheriani, Brkić, & Perišić, 2021; Ikram, Sroufe, & Zhang, 2020; Nadae, Carvalho, & Vieira, 2021; Nunhes, Motta, & Oliveira, 2016). The literature review indicates research gaps related to the proposal of a model to guide the integration of management systems (Alheriani et al., 2021; Rebelo, Santos, & Silva, 2015), understanding factors to support the integration of the management systems (Ikram et al., 2020), and how implementing an integrated management system in a synergistically and effective way

(Nadae et al., 2021).

This research aimed to discuss factors that influence the integration of a certified information security management system based on ISO 27001 with an already certified quality management system based on ISO 9001 to guide resource allocation during implementation projects. An institution that provides services for competitions, entrance exams, and educational assessments, with 40 years of experience with 220 employees working annually on more than 120 projects, evaluating about 3 million people, and dealing with classified and/or confidential exam information and candidates data was studied. The exam organization market is competitive, involves many resources, and impacts many people, so its information security system is a constant target for invasion attempts.

The problem of selecting factors, establishing a relationship among them, and assessing their influence on the institution is a case of a decision by multi-criteria analysis because it supports a wide range of factors related to ISO 9001 and ISO 27001. This problem occurs in situations in which more than one criterion is considered, and this criterion has different judgments of importance by different people. Applying the Analytic Hierarchy Process (AHP) method is also effective for ranking alternatives (Muniz Jr., Hong, Oliveira, Wintersberger, & Popadiuk, 2019; Muniz Jr., Wintersberger, & Hong, 2021).

In this context, we chose to use AHP to deal with different factors that affect the institution in different ways, according to the perception of each interviewee (consultants and managers), which usually brings conflict that is minimized using multi-criteria methods. Additionally, Ikram et al. (2020) affirm that AHP results can be seen as a foundation for understanding important and less important criteria for decision-makers and researchers as they can discover new insights into significant sub-criteria.

This study collaborates with the current literature, increasing the existing content about information security and quality management systems integration based on enabler factors, which are relevant to ensure that managers allocate resources appropriately when implementing and maintaining an integrated certified management system. One of the companies' challenges is to ensure that the customer does not choose the product/service only by its price but by the cost-benefit of selecting an institution with a certified quality management system. Moreover, the information security system certification could show a strong commitment to ethics, transparency, and confidentiality.

This article is structured as follows: Section 2 contains a literature review on certified management systems, quality management systems, information security management systems, and integration of accredited management systems, followed by a presentation of the method used in this research in section 3. Subsequently, in section 4, the empirical results are presented and discussed. Section 5 presents the conclusion, followed by bibliographic references.

2. Literature review

According to the International Organization for Standardization (ISO) standards, the adoption of certified management systems, which are accepted worldwide, is a reality justified by competitive factors or customers' formal requirements. Certification brings procedures more accurate and transparent and influences competition in globalized markets (Britvic, Blazevic, & Vlainic, 2014; Longras et al., 2018; Majernik, Daneshjo, Chovancová, & Sančiová, 2017; Nunhes et al., 2016; Oliveira, 2013; Rebelo et al., 2015; Tarí, Molina-azorín, & Heras, 2012).

When implementing a quality management system, companies focus on improving their processes' efficiency to provide more value

to their customers and stakeholders. Continuous improvement of processes and product quality leads to increased revenues through product reliability and reduced costs (Tarí et al., 2012).

There are many benefits perceived with ISO 9001, such as improvement in internal organization, information flow and in the ability of employees to develop new products, progress in communication and company's routine, greater clarity of objectives with strategic guidelines and business goals, and reliability of the company's brand with consumers (Almeida, Pradhan, & Muniz Jr., 2017; Maekawa et al., 2013; Santos, Mendes, & Barbosa, 2011). ISO 9001 directly improves decision-making flow by improving procedures and policies and can be a catalyst for change at all hierarchical and process levels (Almeida et al., 2017).

2.1. Information security management systems

Driven by competition, improved services, and work efficiency, most organizations work more with information technology. With the increase in cyber-attacks and viruses, it is necessary to adopt strict security procedures (Abusaad, Saeed, Alghathbar, & Khan, 2011).

According to Boehmer (2009), the companies most susceptible to loss of profit due to a successful cyber-attack are those that would have an interest in protecting information technology assets. Therefore, it would be possible to think that only companies that deal with critical and confidential information, such as information technology, banks, financial institutions, and telecommunications industries, could benefit from ISO 27001 certification. Recently, information security has become one of the most critical issues for all organizations (Culot et al., 2021).

Managing and protecting information has become a challenge because companies'

assets are increasingly digitized; gradually, the work is more based on information technology, and the interaction between institutions is critical (Fomin et al., 2008; Khajouei, Kazemi, & Moosavirad, 2017; Proença & Borbinha, 2018).

Longras et al. (2018) released data from a report that analyzed 53,000 information security incidents and 2,216 data breaches. The conclusion points out that part of the attacks is committed by internal agents of the organizations, demonstrating that the human factor is one of the vulnerability points, increasing the difficulty of preventing incidents.

Several organizations seek ISO 27001 to comply with information security rules, aiming to feel more secure and at the same time demonstrate their credibility to customers. Certification enables companies to meet security auditing demands and promotes confidence in the organization's stakeholders by establishing appropriate control processes to manage and protect confidential information. Monitoring is necessary to verify that the system's performance reached the expected (Longras et al., 2018).

The establishment of an information security management system may not immediately reduce risks. Still, it could be a tool that allows the organization to systematically control information security and performance (Britvic, Kovacevic, & Cingel, 2013; Longras et al., 2018). The objective of the ISO 27001 standard is to manage the system to avoid losses. It is necessary to identify, control, and treat the organizations' existing risks, minimizing their effects (Hsu et al., 2016; Longras et al., 2018).

Fazenda & Fagundes (2015) conducted qualitative approach interviews in ISO 27001 certified companies or with the established management system and identified the main benefits that the establishment of this management system was bringing to organizations: image and marketing improvements increased the

availability of information technology infrastructure environments, reduction in infrastructure costs, necessary support in the governance process, mapping of security flaws in organizational settings and credibility with customers.

2.2 Certified management systems integration

Maintaining separate certified management systems requires duplicate tasks, causes complexity in internal management, increases failures possibilities, low efficiency, cultural incompatibility, increases costs, and harms most stakeholders, including employees and customers (Beckmerhagen et al., 2003; Heston & Phifer, 2011; Nunhes et al., 2016; Zeng, Shi, & Lou, 2007). In a survey carried out with 176 companies, Karapetrovic & Casadesús (2009) concluded that 85% of them decided to implement certified management systems in an integrated manner. A similar conclusion was reached by Britvic et al. (2014) in a survey of 210 companies in Croatia.

With the certified management systems integration, the organization can realize many advantages, such as eliminating conflicts between individual management systems, optimizing resources, strategic organizational benefits, reducing the number of audits, as well as the time spent and the associated costs (Nadae et al., 2021; Olaru, Maier, Nicoară, & Maier, 2014; Oliveira, 2013; Rebelo et al., 2015; Santos et al., 2011; Salomone, 2008; Simon, Karapetrovic, & Casadesús, 2012; Tarí et al., 2012).

Actions for the efficient management of resources and establishing a plan with specific objectives are recommended. Motivating the people involved is also an important action for integration success. These actions could be a way to deal with the challenges faced in integrating management systems related to organizational culture, financial resources (Abad et al., 2016; Nadae et al., 2021), and

bureaucracy (Ikram et al., 2020; Nadae et al., 2021).

In this sense, the current editions of ISO standards are organized in a high-level structure and allow greater management systems integration effectiveness. Therefore, attempts to maintain several management systems simultaneously are difficult (Fomin et al., 2008; Majernik et al., 2017; Mesquida et al., 2010; Zeng et al., 2007).

Table 1 summarizes the factors identified in the literature review that influence certified management systems integration.

Rebelo et al. (2015) and Zeng et al. (2007) indicate the need for a model to guide integration and technical guidance. Some authors mention other factors in the researched literature. The factors identified in the literature review are described below:

- Implementation model: refers to the importance of having a model to guide the management systems integration (Rebelo et al., 2015). Having technical guidance and material adapted to large and small companies' different management systems is considered a relevant factor (Zeng et al., 2007).
- Human resources: having internal competence to deal with integrated management systems can facilitate the process (Rebelo et al., 2015; Simon et al., 2012); Resistance to change occurs because people do not want to change the way they do things, so changing requires extra work and new procedures (Nadae et al., 2021, Zeng et al., 2007).
- Resource availability: the adequate availability of resources for integrating management systems is a relevant factor (Nadae et al., 2021; Rebelo et al., 2015; Olaru et al., 2014; Simon et al., 2012).
- Standards issues: the aspect most reported by the authors was the importance of knowledge about the standards (Oliveira, 2013; Simon et

al., 2012; Santos et al., 2011; Salomone, 2008; Zeng et al., 2007); The need for support from certification bodies was also evidenced (Salomone, 2008; Zeng et al., 2007).

- Standards integration: accomplish the necessary tasks for the management systems integration, such as the identification of common denominators for many business functions is relevant (Rebelo et al., 2015; Olaru et al., 2014; Oliveira, 2013; Simon et al., 2012; Zeng et al., 2007; Beckmerhagen et al., 2003).

3. Methods

We applied a qualitative approach (Bernardes, Muniz Jr., & Nakano, 2019) to raise the judgment of experts about enabler factors to support the integrated implementation of ISO 9001 and ISO 27001, which was carried out following the steps: (1) identification of relevant factors from the literature, (2) raising enabler factors based on the research question, (3) comparison and ranking of factors using AHP questionnaire (see details in Almeida et al., 2017). To guarantee a reliable evaluation of the implementation factors, steps (2) and (3) required the participation of subject matter experts (consultants and company managers).

Enabler factors of ISO 9001 and ISO 27001 implementation were selected based on a literature review (step 1) on Web of Science and Scopus databases (2003-2022), using the strings: "ISO 9001", "ISO 27001", "challenges ISO 27001", "barriers ISO 27001", "critical factors ISO 27001", "challenges ISO 9001" "integrated systems", "implementing ISO 27001 after ISO 9001" (Nakano & Muniz Jr., 2019).

We received email responses from 11 consultants (step 2) with over ten years of experience in standards implementation (ISO

27001 and ISO 9001 consultants) regarding factors that influence the integration of ISO 27001 and ISO 9001 standards and activities to facilitate the integration of management systems. The Incomplete Pairwise Comparison (IPC) technique was used to reduce judgments for selecting criteria and alternatives (Harker, 1987). AHP-IPC is

adapted from the AHP multi-criteria decision-making method (Saaty, 2013), and it was applied to prioritize the enabler factors through judgments of seven consultants and seven company managers. The method divides complex decision-making problems into subproblems with hierarchical levels.

Table 1. Factors in certified management systems integration (Elaborated by the authors)

Factor	Description	Authors
Implementation Model	It is important to have a model to support the integration process.	Alheriani et al., 2021; Rebelo et al., 2015; Muniz Jr., Batista, & Loureiro, 2010
	Technical guidance.	Ikram et al., 2020; Zeng et al., 2007
Human Resources	Internal competence to deal with integrated systems.	Nadae et al., 2021; Rebelo et al., 2015; Simon et al., 2012
	Training and changes in the organization's methods and culture.	Ikram et al., 2020; Santos et al., 2011
	Job maintenance security, despite the combination of activities and possible misalignments of operational targets.	Beckmerhagen et al., 2003
	Employee resistance to change.	Abad et al., 2016; Ikram et al., 2020; Rebelo et al., 2015; Zeng et al., 2007
Resource Availability	Resources provision for integration.	Nadae et al., 2021; Oлару et al., 2014; Rebelo et al., 2015; Simon et al., 2012
	Higher costs to deploy simultaneously than individually; long implementation time.	Santos et al., 2011
Standards Issues	Importance of knowledge about implementation and certification standards.	Oliveira, 2013; Santos et al., 2011; Salomone, 2008; Simon et al., 2012; Zeng et al., 2007
	Support from certification bodies.	Salomone, 2008; Zeng et al., 2007
	The perception is that management systems are revolutionary and bureaucratic.	Ikram et al., 2020; Nadae et al., 2021; Oлару et al., 2014
	Need for an international standard for integrated systems.	Rebelo et al., 2015
Standards Integration	Importance of finding common denominators for many business functions.	Rebelo et al., 2015; Oлару et al., 2014; Oliveira, 2013; Simon et al., 2012; Zeng et al., 2007; Beckmerhagen et al., 2003
	The perception is that there is an identity loss of specific function systems.	Beckmerhagen et al., 2003
	Importance of making it clear that systems integration is an objective.	Rebelo et al., 2015
	Importance of integrated audits.	Zeng et al., 2007
	The relevance of assigning importance levels to each system.	Salomone, 2008
	The need to organize the integrated system.	Santos et al., 2011; Salomone, 2008
	Changes in management system due to operational changes.	Santos et al., 2011

We adopted a convenience sampling approach (Rea & Parker, 2014). This sampling option provides significant support in collecting data and useful information that would not be possible using probabilistic sampling techniques. In this case, the survey data were used as a knowledge base and not generalized beyond the sample.

We apply enabler factors based on literature (Table 1) and requirements of ISO 27001 and ISO 9001 standards: Planning, Support, and Operation, as criteria for integrating ISO

27001 with ISO 9001. The order in which the requirements appear in the standards does not reflect their importance nor imply the order they must be implemented.

For the definition of alternatives, we used the factors identified in the literature. Figure 1 shows the analytical hierarchical structure created to support the assessment of enabler factors of ISO 27001 and ISO 9001 integration and their prioritization.

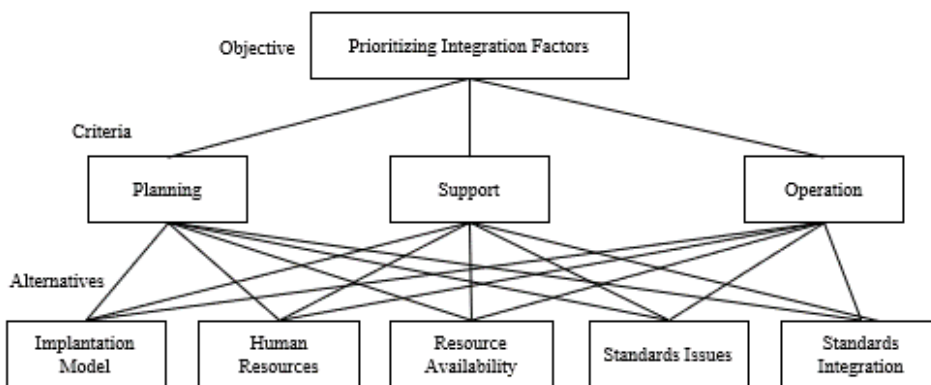


Figure 1. Hierarchy for prioritizing factors that influence the integration of ISO 27001 and ISO 9001 standards (Elaborated by the authors)

4. Results and discussion

4.1. Comparing literature and empirical results about integration factors

Heston & Phifer (2011) and Rebelo et al. (2015) agree that organizations that have a structured model to systematize the integration, with clear guidelines to support the development of alignment and integration of management system requirements, and that be faster and more efficient in the integration process provide a competitive advantage. However, according to the questionnaires' responses (about some difficulties faced in the integration process or what could have been done to reduce the problems), the interviewees did not mention the need for a model to guide the implementation of integrated management

systems.

The availability of resources for integration is relevant in the integration planning stage and must be outlined through careful work to respond to all regulatory requirements effectively. The lack of resources can lead to inefficiencies and deviations (Rebelo et al., 2015). One of the benefits perceived after completing the process is cost reduction. However, Santos et al. (2011) showed higher costs to implement the management systems simultaneously than individually.

The survey conducted with the consultants revealed the difficulty with the availability of resources. One of the consultants described the inappropriate allocation at the beginning of the process and its improvement with the integrated system's maturity.

Knowledge about certification standards has become increasingly important, not only for implementation but also for the operation and maintenance of an integrated management system (Zeng et al., 2007). In this sense, consultants highlighted the need to plan the integration project to respect the organization's culture and guidelines.

Regarding the integration of the ISO 27001 and ISO 9001 standards, difficulties in finding common denominators for various business functions (Rebelo et al., 2015; Olaru et al., 2014; Oliveira, 2013; Simon et al., 2012; Zeng et al., 2007; Beckmerhagen et al., 2003) and the disappearance of unique identities of specific function systems (Beckmerhagen et al., 2003), are some obstacles on the way to management systems integration. Consultants pointed out these barriers when reporting the understanding that integration is not simple because it impacts all areas of the company, showing the need for commitment to pursue the goal and efficient communication.

Some of the interviewed consultants' suggestions were to guide and make employees aware of the integration process phases and train the personnel involved to minimize the integration process problems.

The interviewees perceived several benefits of integrating the ISO 27001 and ISO 9001 standards, such as: taking advantage of the resources of the existing management system, aligning objectives, lower cost, less resource allocation, time optimization, a single management control base allowing reduction of risks in strategic decision making, better synergy and internal communication, less difficulty in employee participation and contraction of the impact of information leakage. Table 2 summarises the consultants' answers to the open questions associated with each factor identified in the literature.

4.2. Results from the application of the AHP method to prioritize the integration factors

We used the consultants' and managers' answers to the closed questionnaire to carry out the mathematical calculations provided for the AHP method. Table 3 summarizes the data.

In the managers' judgment, the most relevant criterion is Support with 44.4%, followed by Planning (37.0%) and Operation (18.6%). Support is related to providing the necessary resources for the implementation, maintenance, and continuous improvement of management systems. This criterion also involves making competent people available and promoting awareness, communication, and control of the relevant documented information. In this sense, the interviews with the managers show the importance of this criterion.

Regarding the alternatives, it is observed that managers attributed the factor Standards Integration (the effective accomplishment of the necessary tasks for the process of management systems integration) to the highest importance index with 29.5%, followed by the factors Standards Issues (24.2%), Human Resources (18.5%), Resource Availability (17.1%) and Implementation Model (10.7%).

In the consultants' view, the most relevant criterion is Planning with 55.5%, followed by Support (39.1%) and Operation (5.4%). For consultants, the Human Resources factor, which is related to the existence of internal competence to deal with integrated management systems as a facilitating aspect during the process, is the one with the highest

importance index with 25.0%, followed by Standards Integration (22.6%), Resource Availability (21.6%), Standards Issues (18.2%) and Implementation Model (12.7%).

Table 2. Consultants' answers about ISO 27001 and ISO 9001 standards integration (Elaborated by the authors)

Factor	Consultants' answers
Implementation Model	Respondents did not report this factor.
Human Resources	Information Technology employees felt that they lost strength and power in the integration process. Problems with staff training and understanding of how integrated systems work. At the beginning of the process, people show some resistance concerning losing access to information. The resistance of information security personnel. Resistance due to the understanding that standards should be kept separate.
Resource Availability	In the beginning, the resource allocation was made inappropriately due to a lack of knowledge. Still, with the maturity in using the management system tools, the allocation became more predictable.
Standards Issues	An attention point was the need to plan the system's implementation by creating rules and methods that met the standards while respecting the organization's culture and guidelines.
Standards Integration	Integration is not an easy process, as it involves all company areas.

Table 3. Summary of judgments of managers (M) and consultants (C) (Elaborated by the authors)

Criteria and Alternatives	Aggregation of individual judgments - AIJ (1) %							
	M1	M2	M3	M4	M5	M6	M7	Priority
Planning	14.9	33.3	33.3	86.0	13.0	71.4	13.0	37.0
Support	74.5	33.3	33.3	12.3	65.2	14.3	65.2	44.4
Operation	10.6	33.3	33.3	1.8	21.7	14.3	21.7	18.6
Implantation Model	8.4	3.1	20.0	66.3	8.9	11.7	11.6	10.7
Human Resources	58.8	27.5	20.0	9.8	9.4	2.3	28.5	18.5
Resource Availability	8.9	27.5	20.0	2.6	5.5	11.9	15.3	17.1
Standards Issues	3.7	15.5	20.0	18.2	31.1	9.3	29.4	24.2
Standards Integration	20.3	26.5	20.0	3.1	45.2	64.9	15.3	29.5
Criteria and Alternatives	Aggregation of individual priorities - AIP (2) %							
	C1	C2	C3	C4	C5	C6	C7	Priority
Planning	11.1	8.9	86.0	71.4	89.0	15.3	46.7	55.5
Support	77.8	79.8	12.3	23.8	9.9	76.3	46.7	39.1
Operation	11.1	11.4	1.8	4.8	1.1	8.5	6.7	5.4
Implantation Model	5.2	1.4	10.7	7.2	44.8	10.8	1.6	12.7
Human Resources	8.1	9.8	74.9	36.2	5.0	34.4	9.5	25.0
Resource Availability	44.8	68.9	10.8	12.1	0.6	34.4	9.5	21.6
Standards Issues	8.1	9.8	3.1	37.1	5.0	15.0	38.7	18.2
Standards Integration	33.7	10.0	0.6	7.4	44.8	5.5	40.8	22.6

Notes:

(1) The Aggregation of Individual Judgments (AIJ) is the approach to be

followed when specialists participate in the same group, in this case, the managers of the institution under study, using the geometric

mean to synthesize the matrices of judgments (Forman & Peniwati, 1998).

(2) The Aggregation of Individual Priorities (AIP) is the approach to be followed when specialists participate in different groups, in this case, expert consultants, using the arithmetic mean to synthesize the matrices of judgments (Forman & Peniwati, 1998).

4.3. Discussion

Regarding the Integration of Standards factor (the most significant to managers), the best way to start the management systems integration is to seek common ground and ensure the sharing between each one of the largest possible numbers of documented processes and procedures. Identifying common areas and management systems' requirements versus the correspondences and similarities between them enhances a methodology to develop and structure integration (Santos, Barros, Mendes, & Lopes, 2013).

In the qualitative and quantitative research, the consultants emphasized the Human Resources factor. Human resources, not financial resources, are the main factor affecting the integrated management system implementation (Zeng et al., 2007). For Nadae et al. (2021), one of the biggest challenges in the integrated management systems implementation is dealing with the motivation and commitment of human resources.

In quantitative research, consultants pointed to Resource Availability in the third position and managers in position four. Additionally, disseminating and developing human resources knowledge increases the team's bond and positively affects business efficiency (Boon, Eckardt, Lepak, & Boselie, 2018). Companies that seek effective management systems implementation should promote the employees' qualifications through training (Nadae et al., 2021; Parra-Parra-López, Hinojosa-Rodríguez, Carmona-Torres, & Sayadi, 2016; Huo, Han, & Prajogo, 2014).

After analyzing the data displayed in Table 3 and the interviewees' justifications, we noted that although the global priority of the criteria obtained different values for managers and consultants, in the individual judgment, they divided the attributions in a similar way for Support and Planning criteria. Also, it was possible to see the equivalence in the comments that motivated the choices.

Still, in this sense, there was compatibility in the analysis carried out by managers and consultants about the importance of involving people in the process of integrating standards. Managers chose the Support criterion, which refers to the provision of resources and the competence of individuals. The consultants chose the Human Resources factor related to internal competence to deal with integrated management systems as facilitators during the process. The Standards Integration factor, selected as the most relevant in the managers' analysis, was the factor pointed out in second place for consultants, demonstrating its value in the integration process.

This research presents some practical implications for managers considering the literature review and our complementing study. By prioritizing factors, it is possible to understand their roles in the process of standards integration. This work also presents some suggestions to facilitate the project and highlights an important point about managers making it clear to those involved in the integration and certification process: the institution's objectives.

Finally, it is necessary to look for points in common between the two standards, aggregate as many activities as possible, and create policies to guide the work. It is also necessary to empower those involved and keep them engaged and aware of all stages to be successful. It is also essential that the top management commits to providing resources, communicating objectives, and motivating employees.

5. Conclusion

This research identified and ranked factors that influence the integration of the information security management system (ISO 27001) with the quality management system (ISO 9001). We present the prioritized factors according to expert consultants' judgment in the ISO 27001 and ISO 9001 standards implementation and managers who participate in the integration of these standards in a recognized Brazilian institution that provides services for competitions, entrance exams, and educational assessments. In this type of organization, it is crucial to maintain the confidentiality of information.

The results indicate that consultants and managers (indoor approach) think differently and complementary. The Standards Integration was identified as the most relevant factor for the institution's managers since adequate activities development facilitates understanding of the standard guidelines. According to the consultants' analysis, the most pertinent factor was those related to Human Resources. The right competence of those involved in the process provides more effectiveness in executing tasks, and engagement is necessary to achieve successful integration.

As a theoretical contribution, this study allows complementation of the current literature, offering more subsidies to understand and discuss the issues related to the problem of integration of information security and quality management systems.

As a practical contribution to the institution under study, this research allows the understanding of critical factors' relevance considering the managers' view who

participate in the ISO 27001 and ISO 9001 standards integration, thereby providing managers with additional information to assist their activities in the integration process, as they need to be aware that the implementation of an integrated management system is necessary for the sustainable future of the institution. Besides, it was possible to direct the consultancy's work and adjust the integration procedures.

Other organizations can also benefit from this prioritization, using this work as supporting a preventive manner to anticipate the main challenges faced in the information security and quality management systems integration.

Considering the factors that we identified and analyzed in this research, in future works, a study could be carried out in different market segments and in different geographical contexts, which may allow a comparison between the results and the identification of new challenges that impact the integration of certified management systems. This research's conclusions are limited to the group of respondents (managers and consultants) but reveal information that could be statistically investigated in the future.

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References:

- Abad, J., Cabrera, H. R., & Medina-león, A. (2016). An analysis of the perceived difficulties arising during the process of integrating management systems. *Journal of Industrial Engineering and Management*, 9(3), 860-878. doi: 10.3926/jiem.1989

- Abusaad, B., Saeed, F. A., Alghathbar, K., & Khan, B. (2011, december). Implementation of ISO 27001 in Saudi Arabia - Obstacles, motivations, outcomes, and lessons learned. In *Proceedings of the 9th Australian Information Security Management Conference*. Perth Western, Australia
- Alheriani, N. M. S., Brkić, V. K. S., & Perišić, M. B. (2021). Novel risk management integrated model implementation: comparison between manufacturing and service companies. *Journal of Engineering Management and Competitiveness*, 11(1), 13-19. doi: 10.5937/jemc2101013A
- Almeida, D., Pradhan, N., & Muniz Jr, J. (2017). Assessment of ISO 9001:2015 implementation factors based on AHP: Case study in Brazilian automotive sector. *International Journal of Quality & Reliability Management.*, 35(7), 1343-1359. doi: 10.1108/IJQRM-12-2016-0228
- ABNT (Associação Brasileira de Normas Técnicas). (2013). NBR ISO/IEC 27001:2013: Tecnologia da informação – técnicas de segurança - sistemas de gestão da segurança da informação – requisitos.
- Beckmerhagen, I., 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. doi: 10.1108/02656710310456626
- Bernardes, E., Muniz Jr., J., & Nakano, D. (2019). *Pesquisa qualitativa em engenharia de produção e gestão de operações*. São Paulo, SP: Atlas.
- Bernardo, M., Casadesus, M., Karapetrovic, S., & Heras, I. (2008). How integrated are environmental, quality and other standardized management systems? An empirical study. *Journal of Cleaner Production*, 17(8), 742-750. doi: 10.1016/j.jclepro.2008.11.003
- Boehmer, W. (2009, march). Cost-benefit trade-off analysis of an ISMS based on ISO 27001. In *Proceedings of the 2009 International Conference on Availability, Reliability and Security*. Fukuoka, Japan.
- Boon, C., Eckardt, R., Lepak, D. P., & Boselie, P. (2018). Integrating strategic human capital and strategic human resource management. *The International Journal of Human Resource Management*, 29(1), 34-67. doi: 10.1080/09585192.2017.1380063
- Britvic, J., Blazevic, Z., & Vlainic, D. (2014). Application of integrated management systems in entrepreneurship. *Economy of eastern Croatia yesterday, today, tomorrow*, 3, 594-603, Retrieved from <http://www.efos.unios.hr/repec/osi/eecytt/PDF/EconomyofeasternCroatiaYesterdayTodayTomorrow03/eecytt0359.pdf>
- Britvic, J., Kovacevic, A. P., & Cingel, M. (2013). Integration possibilities of ISO 9001:2008 quality management system with ISO 27001:2010 information security management system. *Economy of Eastern Croatia Yesterday, Today, Tomorrow*, 2, 368-373. Retrieved from <http://www.efos.unios.hr/repec/osi/eecytt/PDF/EconomyofeasternCroatiaYesterdayTodayTomorrow02/eecytt0242.pdf>
- Culot, G., Nassimbeni, G., Podrecca, M., & Sartor, M. (2021). The ISO/IEC 27001 information security management standard: literature review and theory-based research agenda. *The TQM Journal*, 33(7), 76-105. doi: 10.1108/TQM-09-2020-0202
- Fazenda, R., & Fagundes, L. (2015, may). Análise dos desafios para estabelecer e manter sistema de gestão de segurança da informação no cenário brasileiro. In *Proceedings of the 11th Brazilian Symposium on Information System*. Goiânia, GO.

- Fomin, V. V., Vries, H. J., & Barlette, Y. (2008, september). ISO/IEC 27001 Information systems security management standard: Exploring the reasons for low adoption. In *Proceedings of the 3rd Euromot European Conference on Management of Technology*. Nice, France.
- Forman, E., & Peniwati, K. (1998). Aggregating individual judgments and priorities with the analytic hierarchy process. *European Journal of Operational Research*, 108(1), 165-169. doi: 10.1016/S0377-2217(97)00244-0
- Harker, P. T. (1987). Incomplete pairwise comparisons in the analytic hierarchy process. *Mathematical Modelling*, 9(11), 837-848. doi: 10.1016/0270-0255(87)90503-3
- Heston, K. M., & Phifer, W. (2011). The multiple quality models paradox: How much 'best practice' is just enough? *Journal of Software Maintenance and Evolution: Research and Practice*, 23, 517–531. doi: 10.1002/smr.481
- Hsu, C., Wang, T., & Lu, A. (2016, january). The impact of ISO 27001 certification on firm performance. In *Proceedings of the 49th Hawaii International Conference on System Sciences*. Koloa, HI, USA.
- Huo, B., Han, Z., & Prajogo, D. (2014). The effect of ISO 9000 implementation on flow management. *International Journal of Production Research*, 52(21), 6467-6481. doi: 10.1080/00207543.2014.895063
- Ikram, M., Sroufe, R., & Zhang, Q. (2020). Prioritizing and overcoming barriers to integrated management system (IMS) implementation using AHP and G-TOPSIS. *Journal of Cleaner Production*, 254, 120-121. doi: 10.1016/j.jclepro.2020.120121
- Karapetrovic, S., & Casadesús, M. (2009). Implementing environmental with other standardized management systems: Scope, sequence, time and integration. *Journal of Cleaner Production*, 17(5), 533-540. doi: 10.1016/j.jclepro.2008.09.006
- Khajouei, H., Kazemi, M., & Moosavirad, S. H. (2017). Ranking information security controls by using fuzzy analytic hierarchy process. *Information Systems and e-Business Management*, 15(1), 1-19. doi: 10.1007/s10257-016-0306-y
- Longras, A., Carneiro, P., Pereira, T., & Pinto, P. (2018, september). On the track of ISO/IEC 27001:2013 implementation difficulties in Portuguese organizations. In *Proceedings of the 2018 International Conference on Intelligent Systems*. Madeira Island, Portugal.
- Maekawa, R., Carvalho, M., & Oliveira, O. (2013). Um estudo sobre a certificação ISO 9001 no Brasil: Mapeamento de motivações, benefícios e dificuldades. *Gestão & Produção*, 20(4), 763-779. doi: 10.1590/S0104-530X2013005000003
- Majernik, M., Daneshjo N., Chovancová J., & Sančiová G. (2017). Design of integrated management systems according to the revised ISO standards. *Polish Journal of Management Studies*, 15(1), 135-143. doi: 10.17512/pjms.2017.15.1.13
- Mesquida, A. L., Mas, A., Amengual, E., & Cabestrero, I. (2010). Sistema de gestión integrado según las normas ISO 9001, ISO/IEC 20000 e ISO/IEC 27001. *Revista Española de Innovación, Calidad e Ingeniería del Software*, 6(3), 25-34.
- Muniz, J., Jr., Batista, E. D., Jr., & Loureiro, G. (2010). Knowledge-based integrated production management model. *Journal of Knowledge Management*, 14(6), 858–871. doi: 10.1108/13673271011084907
- Muniz Jr., J., Hong, J., Oliveira, S., Wintersberger, D., & Popadiuk, S. (2019). Knowledge sharing in the automotive sector: a comparative study of Chinese and Brazilian firms. *Production*, 29. doi: 10.1590/0103-6513.20180084

- Muniz Jr., J., Wintersberger, D., & Hong, J. L. F. (2021). Worker and manager judgments about factors that facilitate knowledge sharing: Insights from a Brazilian automotive assembly line. *Knowledge and Process Management*, 29(2), 132-146. doi: 10.1002/kpm.1693
- Nakano, D., & Muniz Jr., J. (2018). Writing the literature review for empirical papers. *Production*, 28. doi: 10.1590/0103-6513.20170086
- Nadae, J., Carvalho, M.M. & Vieira, D.R. (2021). Integrated management systems as a driver of sustainability performance: exploring evidence from multiple-case studies. *International Journal of Quality & Reliability Management*, 38(3), 800-821. doi: 10.1108/IJQRM-12-2019-0386
- Nunhes, T. V., Motta, L. C. F., & Oliveira, O. J. (2016). Evolution of integrated management systems research on the Journal of Cleaner Production: identification of contributions and gaps in the literature. *Journal of Cleaner Production*, 139, 1234-1244. doi: 10.1016/j.jclepro.2016.08.159
- Olaru, M., Maier, D., Nicoară, D., & Maier, A. (2014). Establishing the basis for development of an organization by adopting the integrated management systems: comparative study of various models and concepts of integration. *Procedia - Social and Behavioral Sciences*, 109(8), 693-697. doi: 10.1016/j.sbspro.2013.12.531
- Oliveira, J. O. (2013). Guidelines for the integration of certifiable management systems in industrial companies. *Journal of Cleaner Production*, 57, 124-133. doi: 10.1016/j.jclepro.2013.06.037
- Parra-López, C., Hinojosa-Rodríguez, A. Carmona-Torres, C., & Sayadi, S. (2016). ISO 9001 implementation and associated manufacturing and marketing practices in the olive oil industry in southern Spain. *Food Control*, 62, 23-31. doi: 10.1016/j.foodcont.2015.09.038
- Proença, D., & Borbinha, J. (2018). Information Security Management Systems - A Maturity Model Based on ISO/IEC 27001. In: Abramowicz, W., Paschke, A. (eds) *Business Information Systems. BIS 2018. Lecture Notes in Business Information Processing*, vol 320. Springer, Cham.
- Rea, L. M., & Parker, R. A. (2014). *Design and conducting survey research: A comprehensive guide* (4th ed). San Francisco: Jossey-Bass.
- Rebelo, M. F., Santos, G., & Silva, R. (2015). Integration of standardized management systems: A dilemma? *Systems*, 3(2), 46-59. doi: 10.3390/systems3020045
- Saaty, T. L. (2013). The modern science of multicriteria decision making and its practical applications: The AHP/ANP approach. *Operations Research*, 61(5), 1101-1118. doi: 10.1287/opre.2013.1197
- Santos, G., Barros, S., Mendes, F., & Lopes, N. (2013). The main benefits associated with health and safety management systems certification in Portuguese small and medium enterprises post quality management system certification. *Safety Science*, 51(1), 29-36. doi: 10.1016/j.ssci.2012.06.014
- Santos, G., Mendes, F., & Barbosa, J. (2011). Certification and integration of management systems: The experience of Portuguese small and medium enterprises. *Journal of Cleaner Production*, 19(17-18), 1965-1974. doi: 10.1016/j.jclepro.2011.06.017
- Salomone, R. (2008). Integrated management systems: experiences in Italian organizations. *Journal of Cleaner Production*, 16(16), 1786-1806. doi: 10.1016/j.jclepro.2007.12.003

- Schlackl, F., Link, N., & Hoehle, H. (2022). Antecedents and Consequences of Data Breaches: A Systematic Review. *Information & Management*, 59(4), 103638. doi: 10.1016/j.im.2022.103638
- Simon, A., Karapetrovic, S., & Casadesús, M. (2012). Difficulties and benefits of integrated management systems. *Industrial Management & Data Systems*, 112(5), 828-846. doi: 10.1108/02635571211232406
- Tarí, J. J., Molina-azorín, J. F., & Heras, I. (2012). Benefits of the ISO 9001 and ISO 14001 standards: A literature review. *Journal of Industrial Engineering and Management*, 5(2), 297-322. doi: 10.3926/jiem.488
- 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. doi: 10.1016/j.jclepro.2006.03.007

Ana Paula Alves Fiore

São Paulo State University
(UNESP),
São Paulo,
Brazil
ana.fiore@unesp.br
ORCID 0000-0002-7005-1626

Ana Lucia Figueiredo Facin

São Paulo State University
(UNESP) and Paulista
University (UNIP),
São Paulo,
Brazil
ana.facin@unesp.br
ORCID 0000-0003-0379-4574

Jorge Muniz Jr.

São Paulo State University
(UNESP),
São Paulo,
Brazil
jorge.muniz@unesp.br
ORCID 0000-0003-3496-0256
