Certification, maintenance and decertification of standardised innovation management systems: Motivations, barriers and benefits

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This is the Accepted Version of the following article[1]:

Saboya, L.M., Cândido, C.J.F., and Cesário, M.I.S. (2025). Certification, maintenance and decertification of standardised innovation management systems: Motivations, barriers and benefits. *Creativity and Innovation Management*, https://doi.org/10.1111/caim.12655

Abstract

The role of standardised innovation management systems (SIMS) in fostering organisational innovation has been largely overlooked in the literature. This study addresses this gap by investigating the certification, maintenance, and decertification of SIMS. Using a descriptive and inductive methodology, the research analyses primary data from 94 Portuguese organisations with certified SIMS. The findings reveal a strong prevalence of internal motivations for certification, low implementation obstacles, and significant benefits, suggesting that these firms have successfully internalised the SIMS standard into their innovation management processes. Maintenance motivations are also strong, particularly internal ones, which align well with the critical success factors for sustaining certification. The benefits of maintaining SIMS are substantial, particularly internal benefits, as initial external motivations for certification often evolve into internal maintenance motivations. Decertification motivations and propensity are weak among the sample firms. Expectations of negative performance impacts following potential decertification are also low, likely because these organisations have effectively internalised the SIMS standard. This study is the first to explore the maintenance and decertification of SIMS, providing evidence that SIMS can deliver substantial benefits, be efficiently maintained, and continuously enhance innovation and competitiveness. As a result, most organisations exhibit little interest in decertification. The findings offer significant contributions to research and provide actionable insights for practitioners, suggesting that innovation management systems can indeed be standardised with considerable benefits.

Keywords: barriers, benefits, cancellation, critical success factors, innovation, ISO 56001, ISO 56002, ISO 9001, motivations, NP 4457, obstacles, propensity, revocation, standardised management systems, SIMS, UNE 166002, withdrawal.

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[1] Which has been published in final form at https://doi.org/10.1111/caim.12655. This article may be used for non-commercial purposes in accordance with the Wiley Self-Archiving Policy (http://www.wileyauthors.com/self-archiving).

1. Introduction

Innovation is a key driver of organisational development, competitiveness, and sustainability (Porter, 1991; Tidd, 2021). For long term success, organisations must effectively manage their innovation processes (O'Connor, 2008; Mir et al., 2016; Martínez-Costa et al., 2019). Standardised innovation management systems (SIMS) have emerged to address this need, providing a framework for systematically managing innovation within organisations (Mir *et al*., 2016). These systems are based on standards issued by national standardisation bodies, with notable examples including the British Standard BS 7000-1:1989, the Spanish UNE 166602:2006, and the Portuguese NP 4457:2007 (Mir et al., 2016).

The purpose of the standards is to strengthen innovation management capabilities by establishing a common language and systematising processes, procedures, and tools to improve efficiency in innovation (Mir et al., 2016). However, an inherent (in)compatibility exists between the concepts of innovation, creativity, and standardisation (Wright et al., 2012; Garechana et al., 2017). This tension has been explored since researchers began investigating whether standardised quality management systems (QMS) could foster innovation (e.g., Manders et al., 2016), and later extended to innovation management systems after the emergence of SIMS (e.g., Mir and Casadesús, 2011).

Critics argue that innovation cannot be standardised because standardisation is an impediment to innovation (Wright *et al*., 2012; Alfaro, 2019; Tidd and Bessant, 2021:578). Innovation challenges or supersedes accepted patterns of behaviour and introduces organisational changes whereas standardisation is based on efficiency rules that impose 'similarity, uniformity and continuity of behaviour' (Birkinshaw *et al*., 2008; Wright *et al*. 2012; Tidd and Bessant, 2021:578). Thus, standardisation introduces routines, rigidity and resistance to change (Mir *et al*., 2016; Tidd and Bessant, 2021:578) reducing the flexibility essential for creativity and innovation (Mir and Casadesus, 2011). Conversely, other researchers suggest that innovation can benefit from standardisation (Wright *et al*., 2012), that it can be more effectively managed through standardised management systems (Mir *et al*., 2016), and that standardisation may even be necessary to address specific challenges in innovation processes (Alfaro, 2019). With arguments (and evidence) both supporting and opposing the standardisation of innovation management systems, SIMS appear to strike a reasonable balance between these perspectives in practice (Mir and Casadesús, 2011; Wright et al., 2012). In fact, empirical evidence indicates that organisations implementing SIMS derive significant benefits (Mir et al., 2016; Garechana et al., 2017). This success, also observed among the sample firms in this study, has sustained the continued development and adoption of these systems across organisations over the last two decades.

The broader concept of innovation management system likely emerged as a response to address persistent challenges in innovation activities (Van de Ven, 1986; O'Connor, 2008). Innovation processes often depend on passionate and self-motivated individuals (O'Connor, 2008; Robbins and O'Connor, 2023; Kihlander et al., 2024) who are scarce and prone to abandoning the organisation (Kihlander et al., 2024). Moreover, these processes are frequently characterised as scattered, fragmented, unstructured, and ultimately ineffective (Van de Ven, 1986; Hollins, 1999; O'Connor, 2008; Robbins and O'Connor, 2023; Kihlander et al., 2024). Common challenges include resistance to change, internal politics, involvement of multiple actors, poor coordination, and inadequate infrastructure (Van de Ven, 1986). To address these issues, organisations need to adopt 'comprehensive, coherent, and consistent approaches for managing innovation activities' (Van de Ven, 1986; O'Connor, 2008; Kihlander et al., 2024). Innovation management systems offer such approaches by integrating 'all necessary elements in the chain of innovation activities' (Van de Ven, 1986; O'Connor, 2008; Kihlander et al., 2024). Despite the necessity of these systems, research in the field of innovation management

systems remains in its infancy, with limited theoretical development (O'Connor, 2008; Idris and Durmuşoğlu, 2021). Research has predominantly focused on innovation processes, methods, and tools rather than on the broader concept of innovation systems (Kihlander et al., 2024). Standards for innovation management systems offer a promising framework for guiding organisations in developing these structured and effective systems (Robbins & O'Connor, 2023; Kihlander et al., 2024).

While the standardisation of innovation management systems has attracted research attention, the existing literature remains limited in both volume and scope (Espín *et al*., 2023; Kihlander et al., 2024). Current studies focus on topics such as the feasibility of standardising innovation management processes (Mir and Casadesús, 2011; Wright et al., 2012), the development and refinement of innovation management standards (e.g., Hyland and Karlsson, 2021; Tidd, 2021), the implementation of these standards (Pellicer et al., 2012, 2014; Yepes et al., 2016; Cerezo-Narváez et al., 2019; Kihlander et al., 2024), and the integration of different standards, including UNE 166002, ISO 9001 and ISO 14001 (González et al., 2012). Additionally, research has addressed the motivations, barriers and critical success factors of SIMS implementation (Pellicer et al., 2012, 2014), the benefits of SIMS for innovation capability and firm performance (Garechana et al., 2017; Martínez-Costa et al., 2019; Mir et al., 2016, 2022, Espín *et al*., 2023), and the contribution of SIMS to sustainable development (Khan et al., 2021). Research specifically on the Portuguese standard (NP 4457:2007) is scarcer and mainly conceptual, focusing on the motivations, barriers, and benefits of SIMS implementation (Lopes et al., 2012; Caetano, 2017; Santos et al., 2019).

All these studies focus on the feasibility, development, refinement and integration of standards. They also focus on the implementation of the standards, exploring motivations, barriers, critical success factors and benefits. However, no studies to date address two critical topics for SIMS: (1) the maintenance and improvement of innovation management systems (IPQ, 2007b; ISO, 2019) and (2) the decertification of standardised management systems. These topics have received minimal attention even in the ISO 9001 literature (e.g., Castka, 2018; Ferreira and Cândido, 2021; Clougherty and Grajek, 2023), and none, to the authors knowledge, in the SIMS literature. Since SIMS require maintenance and improvement (IPQ, 2007b; ISO, 2019), just like QMS (Wahid et al., 2011, Castka, 2018), this lack of research constitutes an important research gap. Additionally, the recent decline in the number of organisations certified under different standards, including ISO 9001 and NP 4457 (IPAC, 2021; Podrecca et al., 2021; Clougherty and Grajek, 2023), is another phenomenon unexamined in the SIMS literature, presenting and equally important research gap.

With scarce literature (Espín *et al*., 2023; Kihlander et al., 2024) addressing the initial stage of the certification process, and none focusing on the maintenance and withdrawal stages, this study aims to contribute to filling these research gaps. In accordance, the study explores the 3 stages of (1) SIMS certification, (2) certification maintenance and (3) decertification, using the case of the Portuguese standard (NP 4457), and exploring several aspects along the certification-maintenance-decertification process. In particular, the study explores (1) the motivations, barriers and benefits of SIMS certification; (2) the motivations, critical success factors (CSFs) and benefits of certification maintenance; and (3) the motivations, propensity and consequences of a possible decertification.

2. Literature review and research questions

2.1. Standardised innovation management systems

Schumpeter (1934) defined innovation as an invention with commercial value. That is, a new combination of knowledge and resources aimed at exploiting a market opportunity. This

concept translates into new products, processes, markets, materials, and new forms of organisation of the firm or the industry. However, innovation should not be seen as an isolated event but rather as the result of a continuous process that integrates several organisational elements and uses diverse sources (O'Connor, 2008; Karlsson and Magnusson, 2019; Tidd and Bessant, 2021:vi,45,166; Gimenez-Fernandez et al., 2021; Micheli et al., 2020). Innovation management seeks to structure and reconcile organisational areas, resources, processes and practices so that innovation is not random, sporadic and fragmented but rather an organised, continuous and manageable process (O'Connor, 2008; Correa et al., 2007; Nagano et al., 2014; Karlsson and Magnusson, 2019; Tidd and Bessant, 2021:vi,45,166; Kihlander et al., 2024). Therefore, innovation management can be understood as a system that helps the organisation to implement and effectively manage the processes and practices that contribute to the development of innovation and value creation (Correa et al., 2007; O'Connor, 2008; Hyland and Karlsson, 2021; Tidd and Bessant, 2021:vi,45,166; Kihlander et al., 2024).

In accordance, a standardised innovation management system (SIMS) is a set of interrelated elements that contribute to value creation (ISO, 2019; Tidd, 2021). SIMSs aim to facilitate the incorporation of new ideas and increase the organisation's ability to acquire, develop and apply new knowledge, thus intensifying the organisation's innovation capacity (Correa et al., 2007; Karlsson and Magnusson, 2019; Kihlander et al., 2024). These SIMSs are based on standards created to guide the implementation of innovation systems. Pioneering examples of these standards are the British BS 7000-1:1989, the French FD X50-901:1991, the Spanish UNE 166002:2006, and the Portuguese NP 4457:2007 (Mir and Casadesús, 2011; Idris and Durmuşoğlu, 2021).

The Portuguese NP 4457:2007 is an adaptation of the Spanish standard, which is, in turn, based on Kline's (1985) chain-linked model of innovation (AENOR, 2006; IPQ, 2007a; Mir and Casadesús, 2011). The NP 4457 aims to help organisations to define, implement, maintain, and improve an innovation management system capable of ensuring the definition and successful execution of an organisational innovation policy (IPQ, 2007b). The standard shares several concepts with the ISO 9001 standard, including a similar structure and the Plan-Do-Check-Act (PDCA) cycle of management, on which QMS are also based. Accordingly, the standard is divided into four main parts: (1) management responsibilities, (2) planning, (3) implementation and operations, and (4) assessment and improvement of the system. Just like other ISO standards, the NP 4457 can be applied to firms of all sizes and complexity degrees, in any sector, without complete uniformity of management systems across organisations. It can help to promote all types of innovation (products, processes, organisational forms, and marketing initiatives) and can be certifiable by an independent third party (IPQ, 2007b).

ISO 9000 is a standard for the certification of QMS developed in 1987 and revised four times (1994, 2000, 2008 and 2015) which has approximately 1.25 million certified organisations worldwide and has achieved its maturity stage (Sampaio *et al*., 2014; ISO, 2023). A quality management system involves activities for quality planning, quality control, quality improvement, and risk management (ISO, 2015). Quality management aims for continuous (incremental) improvements, efficiency, control, conformity, and it can be defined as a 'variation reduction activity' (Benner and Tushman, 2003; Wright *et al*., 2012). Innovation, on the other hand, aims for the exploration of new ways, introduces significant organisational changes and can be seen as a 'variation increase activity' (Benner and Tushman, 2003; Reinertsen and Shaeffer, 2005; Wright *et al*., 2012). The value of quality management is on improving current processes and products (ISO, 2015) whereas the value of innovation is on cannibalising and replacing processes and products (Hollins, 1999). These activities can be contradictory and vary significantly in their controllability (Lill *et al*., 2021; Tidd and Bessant, 2021:426,462,474,578). However, many organisations used quality tools in R&D departments

for the development of innovation capability (Mir *et al*., 2016). That is why it seemed sensible to develop innovation management standards based on quality management principles (Mir *et al*., 2016). In the same vein, SIMS standards, and the NP 4457 standard in particular, have been aligned with ISO 9001, ISO 14001, and other standards to facilitate an easy integration of different management systems. In fact, several organisations have already implemented integrated management systems, including quality management, environmental management, health/safety management and innovation management into one whole integrated management system (Gonzalez *et al*., 2012; Hernandez-Vivanco and Bernardo, 2022). Gonzalez *et al*. (2012) argue that not only are the standards compatible but that there is also a need for organisations to implement complementary standards (NP 4457, ISO 9001, ISO 14001, and OHSAS 18001).

ISO has recently published the new international standard ISO 56002:2019 which led to an update of NP 4457, published in December 2021. The publication of the new version of the Portuguese NP 4457:2021 standard constitutes an excellent opportunity to make an assessment of the NP 4457:2007. These new standards are also proof of the compatibility and integration of different standards. In accordance, given the similarities in structure and complementarity of the standards, in this study, the researchers support their arguments in both the SIMS research and the ISO 9001 literature, although clearly identifying each of the standards in every situation where support is sought from previous research.

2.2. SIMS certification: motivations, barriers and benefits

Certification motivations. Adopting an innovation management system is a strategic decision motivated by the system's benefits (COTEC, 2010:18; Nagano et al., 2014; Cândido, 2024). Organisations may be motivated to implement and certify an innovation management system to increase their competitiveness, improve innovation capability, satisfy their customers (Correa et al., 2007), stimulate business growth (Badrinas and Vilà, 2015), create value, and improve business performance (Santos et al., 2019). Certification of a SIMS can also be motivated by a desire to develop a culture of innovation, improve innovation processes, offer innovative products, and improve the external image (Mir et al., 2016). Public organisations may also be motivated to improve efficiency, increase citizens' benefits, and offer tax reductions (Araya and Paz, 2019). There is a considerable diversity of motivations and a lack of consensus among studies. In general, however, implementing management standards is motivated internally by the organisational improvements it can stimulate and externally by marketing reasons related to organisational image and legitimacy (Djofack and Camacho, 2017; Kakouris and Sfakianaki, 2018; Ferreira and Cândido, 2021). This distinction between internal and external motivations is evident in the ISO 9001 literature. Still, the distinction is not usually explored in SIMS research (except in Mir et al., 2016), despite examples of both types of motivations being found in the SIMS literature.

The first column of Table 1 shows the motivations for SIMS certification, and Table A1, in Appendix A, the sources for these motivations. The ISO 9001 literature is included in the sources because of the scarcity of research on SIMS and the common framework shared by the standards (Section 2.1). To summarise, given the shortage of research on SIMS, the lack of consensus on certification motivations, and the end of the NP 4457:2007 validity in December 2023, the first research question addressed in this study is:

RQ1: What are the (most important) motivations for SIMS certification?

Certification barriers. The implementation and certification of SIMS can face several barriers (Martínez-Costa et al., 2019). Among these barriers are the time required for the implementation, total cost involved, bureaucratic burden (Martínez-Costa et al., 2019), lack of organisational resources, low staff qualifications (Caetano, 2017), low management

commitment, misalignment with the strategy, lack of systems approach, and resistance to change (Santos et al., 2019). Other related barriers include organisational structure (Lopes et al., 2012), organisational culture (Mir and Casadesús, 2011), lack of financing, and various external risks (legal, social, technological, and economical; Lopes et al., 2012; Santos et al., 2019).

There is some overlap of obstacles reported in previous studies, but, despite the partial overlap of research findings, the lack of consensus is evident, with even some contradictions. For instance, Pellicer et al. (2012) conclude that innovation culture permeates the organisation gradually and, consequently, organisational culture is not an implementation obstacle. But this conclusion is in disagreement with prior research on SIMS (Mir and Casadesús, 2011) and on ISO 9001 (Esgarrancho and Cândido, 2020). In general, however, research suggests that there are certification obstacles of two major types, internal and external. Internal obstacles are those created by internal forces and under management control, whereas external barriers are generated by the environment and are outside of management control (Cândido and Ferreira, 2023). Table 2 shows the barriers considered in this research and Table A1 the literature they are based on.

To summarise, given the scarcity of research on SIMS, the lack of consensus on certification barriers, and the validity expiration of NP 4457:2007 in 2023, the second research question addressed in this study is:

RQ2: What are the (most important) barriers to SIMS certification?

Certification benefits. This is the most researched aspect of SIMS, but the research is still incipient, with only a small number of studies (13, see Table A1). Most of these are conceptual papers and case studies (10 of the 13), emphasising the lack of quantitative research. The focus on certification benefits, however, is understandable because of the need to assess the impact of the system and justify the impact of the considerable organisational investment involved in the development of the SIMS. Extant research seems to suggest a positive impact of certification on organisations, but there is no consensus on what types of benefits the certification provides. Two quantitative studies using structural equation modelling conclude that there is a direct relationship between SIMS certification and business performance (Mir et al., 2016; Martínez-Costa et al., 2019); two case studies conclude that there is an improvement in firm performance after the implementation of SIMS (Pellicer et al., 2012; Yepes et al., 2016); and two conceptual studies and a systematic literature review advocate this positive relationship as well (Lopes et al., 2012; Idris and Durmuşoğlu, 2021) and the contribution to the United Nations sustainable development goals (Khan et al., 2021). Most studies, however, do not report on the impact of SIMS on business performance. Some studies (Pellicer et al., 2012; Yepes et al., 2016) emphasise the need for more quantitative research to clarify whether there is a direct relationship between SIMS certification and performance.

The most frequently reported benefit is the improvement in the capacity for innovation (all SIMS studies on certification benefits in Table A1). Other frequently reported benefits are the systematisation of research information (Yepes et al. 2016; Garechana et al., 2017; Santos et al., 2019), development of a culture of innovation (Yepes et al. 2016; Garechana et al., 2017; Santos et al., 2019; Khan et al., 2021), improvement of organisational competitiveness (Pellicer et al., 2012; Khan et al., 2021), business development and growth (Yepes et al., 2016), creation of value for customers (Santos et al., 2019); increase in customer satisfaction (Pellicer et al., 2012; Khan et al., 2021), improvement of company image (Pellicer et al., 2012; Yepes et al. 2016; Santos et al., 2019; Khan et al., 2021), and easier access to tax benefits and financing (Pellicer et al., 2012; Yepes et al. 2016; Garechana et al., 2017; Santos et al., 2019; Khan et al., 2021).

The first five benefits are all internal, and the remaining are external. Although this

distinction between internal and external benefits has yet to be explored in the SIMS literature, the ISO 9001 literature can help to provide a definition. Accordingly, internal benefits are associated with the process effectiveness and efficiency improvements in the organisation, whereas external benefits are related to stakeholders' relationships, company image and external legitimacy (Ferreira and Cândido, 2021). The ISO 9001 research also suggests that firms with internal (external) motivations achieve mostly internal (external) benefits (Ferreira and Cândido, 2021). This relationship has not yet been investigated in the SIMS literature (Cf. Mir et al., 2016). It might be questioned whether the same type of relationship between motivations and benefits can be found in the case of SIMS, because of the different nature of innovation activities, more concerned with creativity and disruption than efficiency. However, given the similarities between standards, and the motivations and benefits already identified in the SIMS literature, it is reasonable to assume that the same type of relationship should be found in this context although, in the case of the internal benefits, a higher emphasis seems to be put in the effectiveness of the innovation process (creativity) than in its efficiency (Lill *et al*., 2021; Tidd and Bessant, 2021:462,474,578).

Taken as a whole, research suggests that SIMS implementation and certification can contribute to several positive organisational features and, possibly, to performance improvement. These results are in line with the stated purposes of SIMS standards (AENOR, 2006, IPQ, 2007b) and with a significant part of the research on ISO 9001 registration. However, there is a lack of consensus on the type of benefits that SIMS certification can offer, insufficient research on the relationship between certification and benefits, and an insufficient base of empirical research to support that relationship. Thus, the third research question of this study is:

RQ3: What are the (most important) benefits of SIMS certification?

2.3. SIMS certification maintenance: motivations, critical success factors and benefits

Certification maintenance motivations. Certified organisations need to appropriately maintain their SIMS (AENOR, 2006; IPQ, 2007b; ISO, 2019). Appropriate maintenance involves the development of a plan of action to monitor, assess, maintain and improve the SIMS (COTEC, 2010; ISO, 2019; Santos et al., 2019). Certified organisations must periodically demonstrate their capability to improve and maintain the SIMS, both in internal and external surveillance audits, during the certification validity period of 3 years, and in the recertification audit, at the end of the validity period (AENOR, 2006; IPQ, 2007b; ISO, 2019). This maintenance requires data collection, analysis of the data collected, identification of nonconformances with the standard, corrective actions to eliminate nonconformances, and preventive actions to maintain and improve the SIMS (AENOR, 2006; IPQ, 2007b; ISO, 2019). Specific maintenance activities include audits, documentation, management reviews, corrective actions, and follow-up activities to ensure the SIMS's continuing suitability, adequacy, effectiveness and efficiency (AENOR, 2006; IPQ, 2007b; ISO, 2019).

Several motivations for maintaining the SIMS (and the certification) may exist. One of the most important motivations emerges from the standards' requirements themselves. SIMS standards include specific requirements regarding maintenance and improvement (AENOR, 2006; IPQ, 2007b; ISO, 2019). If the organisation does not maintain and improve the SIMS, the certification can be withdrawn. Thus, maintenance motivations include the standard requirements and the threat of possible decertification. Additional important motivations are the potential benefits that the maintenance of the certification can provide. Some of these can be identified in the SIMS standards (AENOR, 2006; IPQ, 2007b; ISO, 2019) and adapted from the ISO 9001 literature (e.g., Low and Omar, 1997; Water, 2000; Wahid et al., 2011; Castka, 2018), because of the lack of SIMS research on maintenance. The ISO 9001 literature is

relevant and compatible because all standards considered in this research have a similar structure, follow a Plan-Do-Check-Act (PDCA) approach, are aligned with ISO standards, and their corresponding management systems can all be integrated into a whole integrated management system (Section 2.1). Thus, drawing from the standards and the ISO 9001 literature, the SIMS maintenance motivations might include, for instance, maintenance and development of the ability to anticipate market requirements, reinforcement of the innovation culture, promotion of continuous improvement, maintenance of the organisational competitiveness, and pressure from customers and stakeholders (Tables 4 and A2).

In summary, given the standards requirements for SIMS maintenance and the complete absence of empirical research on this topic, the fourth research question is:

RQ4: What are the (most important) motivations for SIMS certification maintenance?

Maintenance critical success factors (CSFs). According to the SIMS standards (AENOR, 2006; IPQ, 2007b; ISO, 2019), proper maintenance of SIMS requires top management's continued commitment and support, a responsibility that cannot be transferred to others in the organisation. The regularity of review meetings is an example of top management's continued commitment as a major contributor to an effective system maintenance (AENOR, 2006; IPQ, 2007b; ISO, 2019).

Another set of factors that can be relevant for the effective maintenance of SIMS is the organisational culture and the emphasis on teamwork. Teamwork requires personnel competence, awareness, involvement, and commitment which, in turn, require personnel training to raise awareness and empower the staff (AENOR, 2006; IPQ, 2007b, Wahid et al., 2011; Basir and Davies, 2018; ISO, 2019). Effective management of human capital and collaborative relationships can provide a wealth of knowledge to significantly impact the quantity and quality of innovation in the organisation and promote innovation continuously and sustainably (Banerjee, 2013).

In accordance, it can be suggested that some of the most important CSFs for SIMS maintenance are top management commitment, organisational culture, teamwork, personnel involvement, staff training, availability of resources, focus on continuous improvement, internal and external collaborative relationships, performance recognition, and rewards (Low and Omar, 1997; AENOR, 2006; IPQ, 2007b; Wahid and Corner, 2009; Wahid et al., 2011; Basir and Davies, 2018; ISO, 2019; Sanchez-Lizarraga et al., 2020).

Unfortunately, there is currently no research on SIMS maintenance to support this claim. Given the above list of possible CSFs, drawn partly from the SIMS standards and adapted from the ISO 9001 literature (see Table A2), the fifth research question is:

RQ5: What are the (most important) CSFs for SIMS certification maintenance?

Maintenance benefits. Maintenance benefits may constitute a continuation, intensification, or reduction of previous certification benefits. There may be differences in the extent and type of benefits achieved in the maintenance phase. Thus, it is relevant to investigate the benefits during this phase.

As noted previously, there is no research on SIMS maintenance, including maintenance benefits. Similarly, research on ISO 9001 maintenance benefits is also scarce (Castka, 2018). In the case of ISO 9001, however, Lo and Chang (2007) suggest that firms that maintain the certification achieve higher perceived benefits. Prajogo (2008) conclude that most ISO 9001 implementation benefits can be sustained during the maintenance stage of the certification. Wahid and Corner (2009) and Wahid et al. (2011), in turn, identify several of the maintenance benefits, and Castka (2018) suggest that firms that implement complex maintenance activities reap higher benefits.

In the broader innovation management literature, research on continuous innovation also

suggests that the performance impact is positive, including on economic-financial indicators (Khosravi et al., 2019; Latan et al., 2020). Given the specific nature of the standardised innovation management systems and the lack of research on SIMS maintenance, it is, thus, relevant to investigate:

RQ6: What are the (most important) benefits of SIMS certification maintenance?

2.4. SIMS decertification: motivations, propensity and consequences

Decertification motivations. Certification has a 3-year validity period (COTEC, 2010; Santos et al., 2019). Before the end of this period, organisations can apply for recertification and then must pass the corresponding external certification audit. The organisations that do not pass the audit lose the certification. Table B1, in Appendix B, shows the decline in the number of certified organisations in Portugal over the last 6 years. Except for 2021, which shows a partial recovery in the number of certificates, the total number of certified organisations declined consistently from 179, in 2015, to 144, in 2020. This represents an average decline of seven organisations per year, which constitutes 12.7% of the certified organisations that must renew the certificate every year (roughly 1/3 of the certified organisations).

A similar decertification trend is that of the ISO 9001 standard, which is approximately 18% yearly (Ferreira and Cândido, 2021). This comparison suggests that both standards have achieved a similar stage of maturity, with both having reached a plateau in the number of certificates and exhibiting significant rates of decertification.

Some of the main reasons for the ISO 9001 withdrawal are related to the time spent with recertification, the cost of maintaining the certificate, perception of diminishing certification benefits (Lo and Chang, 2007; Kafel and Nowicki, 2014; Cândido et al., 2016; Simon and Kafel, 2018; Cândido et al., 2021; Cândido and Ferreira, 2023) and financial difficulties faced by organisations (Lo and Chang, 2007; Alič, 2014; Simon and Kafel, 2018). Another motivation that contributes to decertification is the loss of competitive value attributed to the certificate, either due to its generalised adoption by competitors in the same industry (Sampaio et al., 2014; Cândido et al., 2016, 2021), customers no longer demanding the certification (Chiarini, 2019), or the emergence of alternative standards that are more sophisticated or suitable for the activity (Simon and Kafel, 2018; Cândido et al., 2021; Cândido and Ferreira, 2023). When not eliminated, obstacles to the initial certification can also contribute to decertification (Ferreira and Cândido, 2021; Cândido and Ferreira, 2022, 2023).

Given the relevance of the topic and the complete absence of studies on SIMS decertification, the seventh research question is:

RQ7: What are the (most important) motivations for SIMS decertification?

Decertification propensity. The propensity for decertification is the inclination or probability that an organisation might lose its certification. As already mentioned, the decertification propensity from 2015 to 2020 can be estimated at 12.7% for NP 4457:2007, and 18% for ISO 9001:2015. Ferreira and Cândido (2021) is the only study investigating the propensity for decertification. This study suggests that ISO 9001 decertification propensity is determined primarily by internal and external decertification motivations and, to a lesser extent, by other factors. Given the importance of this topic, the complete absence of studies on SIMS decertification, and the strong recovery in the number of certified SIMS in the last year (2021), the eighth research question is:

RQ8: What is the current propensity for SIMS decertification?

Decertification consequences. Decertification can have strong repercussions on organisations. These consequences have been scarcely researched for the ISO 9001 standard, and so far, there is no consensus regarding what happens after withdrawal. Joubert (1998)

predicts that the loss of ISO 9001 certification can be worse for organisational reputation than having no certification at all. In accordance, Alič (2014) and Sansalvador and Brotons (2015) argue that the cancellation of ISO 9001 certification leads to a drop in performance, a decrease in company value, and even firm liquidation or bankruptcy. In contrast, Cândido et al. (2016) conclude that the withdrawal of the ISO 9001 certificate does not significantly affect a firm's economic-financial performance because firms can (partially) internalise the standard in their management processes. In fact, decertified firms maintain the management system (or at least part of it) even after the decertification event (Kafel and Nowicki, 2014). In starker contrast, Podrecca et al.'s (2021) study on social accountability (SA8000) certification concludes that firms exhibit a statistically significant increase in productivity and profits after the certification withdrawal.

Given the current lack of consensus on decertification consequences and the complete absence of research on SIMS decertification, the ninth and last research question is:

RQ9: What are the (most important) consequences of SIMS decertification?

The third stage of the certification process involves a decision to recertify or decertify. To make this decision organisations must consider the information they have. This includes the motivations to maintain the certification, the motivations to decertify, previous certification benefits and the expected decertification consequences (Ferreira and Cândido, 2021; Cândido, 2024). Thus, this decision to recertify or decertify should not be seen as a simple repetition of the initial decision to certify (where there were no decertification motivations, previous benefits, or decertification consequences) nor as a repetition of previous recertification decisions (because circumstances can change significantly at every recertification cycle).

3. Research methodology

3.1. Population, sample, data collection and statistical power

This study addresses the case of the Portuguese innovation management standard NP 4457, issued in 2007 and still in use until December 2023. The study population comprises all organisations with a certified innovation management system based on this standard. The population had 169 public and private organisations on 31 December 2021, according to the Portuguese Institute of Accreditation (IPAC, 2021).

Given the size of the population, the invitation to participate in the study was sent to all certified organisations in the country. The invitation was sent by email containing an introduction with the purpose of the study, the researchers' identification, and the link to the website Google Forms, where the questionnaire was stored. To avoid response bias, the authors previously contacted all organisations to identify the most suited individual to provide the answers and sent the email invitation directly to this individual. The data collection started on 27 April 2022 and lasted approximately 2 months, until 24 June 2022. Five of the organisations responded that they had lost the certification in the first semester of 2022 and were excluded from the sample. Ninety-four other organisations (94) replied with complete, valid responses, corresponding to a valid response rate of 55.6%.

The authors used the software G*Power (Faul *et al*., 2007) to calculate the minimum sample size. Considering a significance level of 5%, a statistical power of 90%, an effect size of 0.20, a test proportion π of 0.5, and the unilateral binomial tests to perform in the study, the minimum sample size is n=53. The sample size obtained (n=94) is clearly larger than the minimum size. With this sample size (n=94), and everything else unchanged, the statistical power is 98.8%.

3.2. Questionnaire and variable measurement

The research instrument is divided into four groups of questions. The first group consists of 3 questions related to the NP 4457:2007 certification. The second group addresses the maintenance of the certification with 3 more questions; and the third group consists of 3 additional questions related to decertification. All questions in the 3 groups comprise several items, each requiring a response on a rating scale of five points. The researchers developed the items (shown in tables 1 to 9) from previous studies (shown in Appendix A). The rating scale is also shown in tables A1 to A3 in the appendix. The fourth and last group includes several questions for the characterisation of the sample organisations and the individuals that responded.

The questionnaire is written in clear, neutral, and concise language and includes one short section with instructions for the response. This section informs the respondents that (1) the research questions have no correct or incorrect answers and that respondents should reply as closely as possible to what they honestly believe, (2) all data collected is anonymous and will be kept under strict confidence, and (3) only the aggregate results will be published. Besides these ex-ante precautions to avoid common-method bias (Podsakoff et al., 2003; Chang et al., 2010), the researchers pre-tested the questionnaire with a small sample of 6 NP 4457:2007 certified organisations, which led to some minor changes in the final version of the questionnaire

3.3. Data analysis

Data analysis includes: (1) descriptive statistics to characterise the respondents and their organisations, (2) randomness and bias tests for an initial assessment of the sample data, (3) descriptive statistics of the sample data per research question and item, and (4) binomial tests per item to consider the generalisability of the descriptive statistics' conclusions to the whole population.

Binomial tests based on data from five-point rating scales require previous data aggregation. The answers of 1 (very weak), 2 (weak) and 3 (average) are aggregated into one category (very weak, weak or average), and the responses 4 (strong) and 5 (very strong) are similarly condensed into another category (strong or very strong). Although aggregation of data in this manner is not rare in research (e.g., Kennedy *et al*., 2014; Jasti *et al*., 2016), there seems to be scarce investigation on the effects of the aggregation of Likert scales (DiStefano *et al*., 2021). Extant research points to good results without the introduction of bias. Tueller et al (2016) conclude that collapsing categories is a viable option for factor analysis with negligible effects. DiStefano *et al*. (2021) conclude that condensing categories is more advantageous than modelling sparse data, 'yielding higher convergence rates, more accurate estimation of parameters and standard errors' in confirmatory factor analysis. Colvin and Gorgun (2020) argue that collapsing response scales can lead to similar average scores, correlations, and factor structures. Grandy (1996) found that after collapsing the 5-point Likert scale used in the research, the averages of the response groups considered in the study still maintained the differences between them. In spite of none of these studies addressing the specific case of binomial tests, the general conclusion is that Likert data aggregation does not significantly change the main results, nor does it introduce bias in the research. The authors have no reason to believe that this conclusion should be different in the case of binomial test and proceed with their calculations for this research.

In this study, the binomial test, performed for each item, assesses the hypothesis that the proportion of organisations in the population that have a strong or very strong opinion, π, is a minority (H_0: $\pi \leq 0.5$). If the significance level of the test is lower than 0.05, the hypothesis is

rejected, and the conclusion is that the majority of the population has that opinion (*i.e.*, strong or very strong).

4. Results

4.1. Sample description

Almost all respondents are managers (96.8%), and approximately half are innovation managers (46.8%). These managers have an average of more than 6 years in their current position. Almost 80% of the organisations they manage are in the second, third or subsequent period of certification, and 50.0% of the organisations are in the third or subsequent period. All organisations are considered innovative to some extent. Some organisations are only 'scarcely innovative' (11.7%), but more than half of the organisations (64.9%) are considered 'innovative', and more than 20% are 'very innovative'. Most organisations are in service industries (58.5%) with a presence in both national and international markets (81.9%), which are mostly considered innovative or very innovative (82.9%). The majority of sample organisations are small and midsize enterprises (SMEs) with a business volume between two and 50 million euros (63.8%).

4.2. Randomness and bias tests

Since the questionnaire was sent to all organisations in the population, and 'only' 55.6% replied, it is important to examine data randomness, non-response bias and common-method bias. Randomness was examined with the Wald-Wolfowitz runs-test for all 77 items in the questionnaire (tables 1 to 9). For most items (94.8%), the p-value is higher than 0.05, suggesting that the null hypotheses of random data should not be rejected. Thus, taken together, the statistical tests suggest that the sample data is random.

Non-response bias was assessed with the Kruskal-Wallis and the Jonckheere-Terpstra tests. The latter was performed twice, with both alternative options 'from largest to smallest' and 'from smallest to largest'. The sample was previously divided into two groups, one corresponding to the early respondents (50%) and another to the late respondents (50%). The tests' results indicate that, for most items (96.1%), there is no significant difference between the two groups, suggesting that there is no evidence of non-response bias (Wagner and Kemmerling, 2010).

Lastly, the Harman single-factor test was performed to examine common-method bias. The unrotated single factor extracted with the principal axis factoring method explains 30.8% of the total variance contained in the sample data, which is significantly less than the 50% maximum (Podsakoff et al., 2003; Chang et al., 2010). This test has limitations, but together with the ex-ante preventive measures that were taken (Section 3.2), it provides some evidence that there is no common-method bias.

4.3. SIMS certification: motivations, barriers, and benefits

Motivations for SIMS certification. The sample organisations generally have strong motivations to seek certification under NP 4457:2007. All motivations considered in the study (Table 1) show an average between 3.5 and 4.0, which can be considered strong on a scale of 1 (very weak) to 5 (very strong). The stronger motivations (strong or very strong) are the development of a culture of innovation (77.7% of the responses), the quest to improve the company's image (76.6%), the creation of value for customers (69.1%), the improvement of business performance (68%) and the increase of innovation capability (67%). In accordance with these results, the null hypothesis that only a minority of the companies in the population

(H0: $\pi \leq 0.5$) have strong/very strong motivations for certification is rejected for all motivations except CM3. This result suggests that the motivations for most of the organisations in the population are, in fact, strong or very strong.

Table 1. Motivations for SIMS certification (NP 4457:2007)

Certification motivations	Mean	SD	Sig.
Develop a culture of innovation (CM5, I)	4.00	0.892	0.000**
Improve the company image (CM7, E)	3.96	0.903	0.000**
Create value for customers (CM4, E)	3.80	0.979	0.000**
Increase the innovation capability (CM1, I)	3.78	0.869	0.001**
Improve company performance (CM8, I)	3.78	0.882	0.000**
Increase the company's competitiveness (CM2, I)	3.72	0.999	0.025**
Business development and growth (CM6, I&E)	3.62	0.929	0.009**
Increase customer satisfaction and trust (CM3, E)	3.59	0.966	0.090

Notes: Global mean: 3.78. I: internal. E: external. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. **Significant at the 5% level. n=94.

Barriers to SIMS certification. Regarding the difficulties experienced during the innovation management system certification process, the responses (Table 2) show an average below the midpoint of the response scale (<3.0). The 3 obstacles pointed out with greater intensity (strong/very strong) are: the too formal and time-consuming process (26.6% of the responses), the organisational culture (26.5%) and the unavailability of necessary resources (26.6%). The 3 obstacles pointed out with less intensity (weak/ very weak) are: the lack of commitment and support from senior management (67%), the misalignment of the SIMS with the strategy and objectives of the business (65.9%) and the organisational structure of the company (55.3%). In accordance, the null hypothesis that only a minority of the population (H0: $\pi \leq 0.5$) faces strong/very strong obstacles is not rejected for all obstacles. These results suggest that the majority of the population does not face strong barriers. Consequently, the obstacles are considered weak or very weak and do not compromise the successful certification of the SIMS. The strong certification motivations (see the previous section) may have also contributed to lowering the certification barriers.

Table 2. Barriers to SIMS certification (NP 4457:2007)

Certification obstacles	Mean	SD	Sig.
Formal, complex, and time-consuming process (CBAR9)	2.86	1.043	1.000
Organisational culture (CBAR2)	2.85	1.136	1.000
Insufficient resources (time, money, personnel, equipment, materials…) (CBAR8)	2.80	1.043	1.000
Resistance to change (CBAR10)	2.80	1.103	1.000
Lack of a systemic approach to innovation management (CBAR7)	2.74	1.107	1.000
Cost of SIMS implementation and certification processes (CBAR3)	2.59	0.873	1.000
Low qualifications of staff (CBAR1)	2.51	1.075	1.000
Organisational structure not conducive to innovation (CBAR5)	2.49	1.207	1.000
Misalignment of the SIMS with strategy (CBAR4)	2.14	1.033	1.000
Lack of commitment and support from senior management (CBAR 6)	2.10	1.117	1.000

Notes: Global mean: 2.59. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. n=94.

Benefits from SIMS certification. As for the intensity of the benefits obtained with the certification, the responses (Table 3) show an average clearly above the midpoint of the scale (>3.0). The most significant gains (strong/very strong) are the improvement in the innovation capability (72.4% of the respondents), the development of an innovation culture (69.10%), the improvement of the company image (67.1%), the creation of value for customers (64.9%) and

the improvement of company performance (55.3%). In accordance, the null hypothesis that only a minority of the population has strong/very strong benefits is rejected for four of the benefits (CBEN3, CBEN4, CBEN6 and CBEN8). These results suggest that the population of certified organisations achieves significant improvements with the implementation and certification of their SIMS, and that for some of these benefits, a majority of the companies in the population achieve strong or very strong benefits.

Table 3. Benefits from SIMS certification (NP 4457:2007)

Certification benefits	Mean	SD	Sig.
Development of a culture of innovation, communication and internal discussion (CBEN4, I)	3.85	1.016	0.000**
Improvement of company image (CBEN8, E)	3.82	0.939	0.001**
Improved capacity for innovation (CBEN6, I)	3.77	0.955	0.000**
Creating value for customers (CBEN3, E)	3.60	0.987	0.003**
Improved company performance (CBEN9, I)	3.49	0.864	0.177
Improved company competitiveness (CBEN7, I)	3.43	0.956	0.379
Easy access to tax benefits and financing (CBEN1, E)	3.39	1.263	0.128
Business development and growth (CBEN5, I&E)	3.35	0.924	0.621
Increased customer satisfaction and trust (CBEN2, E)	3.32	1.049	0.541

Notes: Global mean: 3.56. I: internal. E: external. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. **Significant at the 5% level. n=94.

The conjoint analysis of the certification motivations (Table 1) and the benefits obtained (Table 3) suggests an almost perfect correspondence between the strongest motivations and the strongest benefits. In fact, with the two exceptions of value for customers and the ability to innovate, the order of the stronger motivations (in Table 1) and the stronger benefits (in Table 3) is identical. This correspondence between motivations and benefits is expectable and desirable because it shows that organisations achieve results consistent with their motivations. In addition, a majority (four) of the 6 main reasons for certification and a majority (four) of the 6 main benefits are internal (exceptions are 'company image' and 'customer value'). This suggests that firms are mostly internally motivated and achieve mostly internal benefits.

4.4. SIMS certification maintenance: motivations, critical success factors and benefits

Maintenance motivations. Table 4 exhibits a wide variation in average responses, which shows that some motivations are strong, others moderate, and some weak. The strongest motivation is the promotion of continuous improvement of the SIMS. Approximately 69.2% of the respondents considered this a strong or very strong motivation for maintaining the management system. Other strong motivations are the reinforcement of the company's innovation culture (69.1% of the respondents), the maintenance of certification benefits (61.7%), and the need to remain competitive (61.7%). In contrast, the weakest motivations are the customers' requirement to maintain the certification (11.7%) and the fear of losing the certificate (23.4%). The null hypothesis that only a minority of the population has strong/very strong motivations for the maintenance of certification is rejected for the first four motivations (MM4, MM5, MM7 and MM9). This suggests that most of the population considers these motivations to be strong or very strong. The remaining motivations in Table 4 are moderate, weak, or very weak for most of the population.

In general, the stronger motivations are internal. Four of the 6 stronger motivations in Table 4 are internal, and two include both internal and external motivations. None of the 6 stronger motivations is clearly and exclusively external. On the other hand, all weaker motivations are external (the last 3 in the table). This predominance of strong internal motivations in the maintenance stage is even more evident than in the certification stage (Cf.

Table 1), where two of the 6 stronger motivations are clearly external. This suggests that motivations can evolve toward strengthening the internal motivations and demotion of the external ones. In other words, external motivations can be replaced or 'converted' into internal ones.

Table 4. Motivations for maintaining SIMS certification (NP 4457:2007)

Maintenance motivations	Mean	SD	Sig.
Promotion of continuous improvement (MM7, I)	3.88	0.890	0.000**
Reinforcement of the company's innovation culture (MM9, I)	3.84	0.859	0.000**
Maintenance of certification benefits (MM4, I&E)	3.68	1.029	0.015**
The company's need to remain competitive (MM5, I)	3.60	1.040	0.015**
Greater ability to anticipate market requirements (MM3, I)	3.48	1.055	0.090
Business expansion (MM2, I&E)	3.01	1.169	0.999
Pressure from stakeholders for certification maintenance (MM6, E)	2.90	1.236	0.999
Fear of losing the certificate (MM8, E)	2.61	1.175	1.000
Customer requirement to maintain certification (MM1, E)	2.20	1.103	1.000

Notes: Global mean: 3.24. I: internal. E: external. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. **Significant at the 5% level. n=94.

Critical success factors for SIMS certification maintenance. All CSFs considered in this study exhibit an average above the midpoint of the response scale (Table 5), with only one exception (CSF10). The factors that more strongly contribute to certification maintenance success are the ability of the staff to work as a team (71.2% of the respondents), the focus on continuous improvement (70.2%), the commitment and support of senior management (69.1%), and the organisational culture conducive to change and innovation (63.8%). Surprisingly, respondents did not consider performance recognition and rewarding systems as an important CSF (27.6%) for the maintenance of the SIMS. In accordance, the null hypothesis that only a minority of the population considers the CSFs in Table 5 as strong or very strong is rejected for CSF1, CSF2, CSF3, CSF4, CSF6, and CSF8.

Table 5. Critical success factors for SIMS certification maintenance (NP 4457:2007)

Critical success factors	Mean	SD	Sig.
Commitment and support from senior management (CSF2, I)	3.93	0.942	0.000**
Focus on continuous improvement (CSF6, I)	3.90	0.843	0.000**
Ability of staff to work as a team (CSF1, I)	3.84	0.807	0.000**
Organisational culture and climate conducive to change, innovation and improvement (CSF3, I)	3.74	0.983	0.005**
Motivation and commitment of workers (CSF8, I)	3.67	0.872	0.015**
Definition, documentation and clear communication of assignments, responsibilities and authorities (CSF4, I)	3.66	0.887	0.015**
Training of the personnel involved (CSF7, I)	3.59	0.873	0.128
Availability of resources (time, money, personnel, equipment, materials…) (CSF5, I)	3.40	0.884	0.459
Collaborative relationship with suppliers and subcontractors (CSF9, E)	3.16	1.061	0.975
Performance recognition and/or reward system (CSF10, I)	2.87	1.119	1.000

Notes: Global mean: 3.58. I: internal. E: external. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. **Significant at the 5% level. n=94.

Benefits of SIMS certification maintenance. Regarding the perceived benefits of maintaining the SIMS certificate, all average responses are higher than the midpoint of the response scale (>3.0). This suggests that the sample companies have benefited considerably from maintaining the SIMS. The stronger benefits (strong/very strong) are the systematisation and improvement of processes (75.5% of the respondents), the gain in the maturity of the SIMS (74.5%), the development of a culture of innovation (71.3%) and the improvement of the

company's capacity for innovation (70.2%). The null hypothesis that only a minority of the companies in the population consider the certification maintenance benefits as strong or very strong is rejected for MB1, MB4, MB5 and MB9. These are all internal benefits. Thus, most of the population considers these internal benefits as strong or very strong.

Table 6. Benefits from maintaining SIMS certification (NP 4457:2007)

Maintenance benefits	Mean	SD	Sig.
Systematisation and improvement of processes (MB9, I)	3.89	0.809	0,000**
Development of a culture of innovation, communication and internal discussion (MB1, I)	3.84	0.919	0,000**
SIMS maturity (MB4, I)	3.83	0.923	0,000**
Improved innovation capability (MB5, I)	3.77	0.921	0,000**
Maintenance of certification benefits (MB3, I&E)	3.54	0.958	0,128
Improved company performance (MB7, I)	3.51	0.901	0,128
Customer satisfaction (MB8, E)	3.38	0.974	0,303
Improved trust between stakeholders (MB6, E)	3.33	0.988	0,235
Business expansion (MB2, I&E)	3.26	0.950	0,765

Notes: Global mean: 3.59. I: internal. E: external. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. **Significant at the 5% level. n=94.

Comparing the maintenance benefits (Table 6) with the certification benefits (Table 3) reveals that the benefits common to both tables maintain relatively stable positions. Culture (CBEN4 and MB1) is in the first two places of the tables, innovation capacity (CBEN6 and MB5) in the middle third/fourth positions, company performance (CBEN9 and MB7) in the second half of the table (fifth and sixth places), business development and expansion (CBEN5 and MB2) in the last places, and stakeholder satisfaction (CBEN2, MB6 and MB8) also at the end of both tables. The averages of the responses to these benefits are also almost identical in both tables. In addition, the Student t-tests and the Wilcoxon signed-rank tests retain the null hypotheses of equal means for all pairs of variables (p-values>0.10). This evidence suggests that SIMS certification and SIMS maintenance have similar benefits. These results also suggest that when organisations have internal motivations and their SIMS are properly maintained, the certification benefits tend to persist over time, instead of waning away, even in the long run (77.7% of the sample organisations have more than 3 years of certification and 50.0% have more than 6 years).

4.5. SIMS decertification: motivations, propensity, and consequences

Motivations for SIMS decertification. The decertification motivations are generally weak or very weak (Table 7). All motivations but one exhibit an average below the midpoint of the response scale (<3.0). In this context of low motivations for decertification, the stronger motivations that could lead the sample organisations to a possible loss of the certification are a low value added by certification (only 36.2% of strong/very strong responses), financial problems faced by the company (30.9%), formality and resource consuming certification process (30.9%), the existence of alternative standards/certifications (28.7%) and the loss of the competitive value of the certificate (27.7%). The weaker motivations are the belief that the organisation might fail in renewing the certificate (7.5%), customers no longer requiring certification (8.5%), persistence/resurgence of certification barriers (10.6%), and the negative effects of inadequate implementation of the standard (12.8%). Following these results, the null hypothesis that only a minority of the population has strong/very strong motivations for decertification is not rejected for all possible motivations considered in the study.

Propensity for SIMS decertification. All indicators considered in the estimate of the propensity for SIMS decertification show an average that is clearly below the midpoint of the

response scale (Table 8). These results illustrate the low propensity of the sample organisations to decertify from the SIMS standard in the near future. Approximately 94.4% of the firms indicate a low probability of failing in the external audit, 81.9% reveal that they have no plans to abandon the certification, 79.8% indicate a low probability of losing or abandoning the certification, and 79.7% show an intention to renew the certification. In accordance with these results, the null hypothesis that only a minority of the population has a strong/very strong propensity for decertification is not rejected for all indicators.

Table 7. Motivations for SIMS decertification (NP 4457:2007)

Decertification motivations	Mean	SD	Sig.
Existence of alternative standards/certifications (DM4)	3.09	1.044	1,000
Value added by certification does not justify the costs (DM11)	2.96	1.383	0,997
Financial problems faced by the company (DM8)	2.80	1.357	1,000
Formal, complex, expensive and time-consuming process (DM10)	2.79	1.252	1,000
Loss of competitive value of the certificate (DM7)	2.71	1.197	1,000
Expected savings from decertification (DM5)	2.51	1.225	1,000
Standard already internalised in organisational processes (DM6)	2.45	1.179	1,000
Persistence/resurgence of barriers that the company felt during the certification (DM9)	2.26	1.047	1,000
Negative effects of an inadequate implementation of the standard (DM3)	2.09	1.123	1,000
Customers no longer require certification (DM1)	1.85	1.107	1,000
Belief that the organisation will fail the certification renewal audit (DM2)	1.77	0.955	1,000

Notes: Global mean: 2.48. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. n=94.

This low decertification propensity is reasonable, given previous results of this research. In fact, in the initial certification stage, the companies were strongly motivated to obtain the certification (Table 1) and achieved considerable benefits (Table 3). In the maintenance stage, the companies continued to be strongly motivated to keep the certification (Table 4) and achieved strong certification benefits (Table 6). Lastly, the companies exhibit low motivations to decertify (Table 7) and, in accordance, they show a low propensity for losing the certification (Table 8).

Table 8. Propensity for SIMS decertification (NP 4457:2007)

Propensity for decertification	Mean	SD	Sig.
Intention not to renew the NP 4457 certification (PRO1)	1.70	1.046	1,000
Plan to abandon NP 4457 at the end of the certification period (PRO2)	1.61	1.039	1,000
Probability of losing the NP 4457 certification at the end of the certification period (PRO3)	1.61	0.953	1,000
Probability of failing the external audit for certification renewal (PRO4)	1.43	0.726	1,000

Notes: Global mean: 1.59. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. n=94.

Probable consequences of SIMS decertification. The last research question addresses the consequences of an eventual decertification. Table 9 shows the repercussions that sample firms expect. Most possible consequences exhibit an average below the response scale's midpoint (<3.0). Only one consequence (loss of certification benefits) is close to the midpoint (3.13), and all other consequences have much lower averages. It is important to note that despite companies expecting a moderate negative impact on certification benefits (3.13), these organisations do not expect more than a weak impact on economic-financial performance, which is the weakest of all possible consequences (2.18). In accordance, the null hypothesis that only a minority of the population expects strong/very strong consequences from an

eventual decertification is not rejected for all considered performance indicators.

Table 9. Expected consequences of SIMS decertification (NP 4457:2007)

Consequences of decertification	Mean	SD	Sig.
Loss of certification benefits (DC7)	3.13	1.305	0,765
Loss of company value (DC5)	2.52	1.095	1,000
Loss of stakeholder trust (DC1)	2.50	1.114	1,000
Loss of competitiveness (DC3)	2.40	1.167	1,000
Break in efficiency (DC2)	2.24	1.064	1,000
Decrease in customer satisfaction (DC6)	2.24	1.034	1,000
Decrease in economic-financial performance (DC4)	2.18	0.961	1,000

Notes: Global mean: 2.46. H_0: $\pi \leq 0.5$. H_A: $\pi > 0.5$. n=94.

5. Discussion and contributions

This study contributes to a better understanding of the SIMS certification phenomenon by providing empirical evidence on the whole process of certification, maintenance, and decertification, which is absent in the field of SIMS certification. The incipient extant research on SIMS, largely composed of conceptual papers and case studies, focuses only on the first stage of the certification process, specifically in the adoption, implementation and certification of the SIMS. Current research addresses mostly the benefits of the certification and, in some cases, also covers the motivations and barriers of the certification. However, there is currently no research on the maintenance and decertification stages of the SIMSs. To fill this gap, the present study aims to simultaneously explore the 3 stages of the certification process (certification, maintenance, and decertification) and to contribute to a more encompassing understanding of SIMSs certification.

Regarding the first stage, this paper shows that certification is mainly motivated by strong internal reasons such as developing a culture of innovation, increasing innovation capability, and improving company competitiveness. This result agrees with the only SIMS study that addressed internal and external motivations (Mir *et al*., 2016), but contrasts with research on other standards (*e.g*., ISO 9001), where external motivations frequently predominate (Casadesús and Karapetrovic, 2005; Sampaio *et al*., 2014; Mir *et al*., 2016; Kakouris and Sfakianaki, 2019). This disparity in research findings between different standards may stem from the widespread adoption of ISO 9001 certification, with a substantially larger number of certified organisations (approximately 6,000 in Portugal) when compared to NP 4457 (approximately 170), and from a higher concentration of larger companies among the NP 4457-certified entities, with 64.9% having 50 or more employees (in this study), as opposed to 47.3% among the ISO 9001-certified sample of 221 companies studied by Ferreira and Cândido (2021). In fact, prior research on ISO 9001 suggests that larger companies tend to exhibit greater internal motivations and more mature management systems (Bravi and Murmura, 2022). The predominance of internal SIMS motivations means that organisations are committed to internalising the standard in their innovation management processes and are not merely interested in using the certification as a marketing tool (Sampaio et al., 2014; Tari et al., 2020). Having internal motivations can be very important for SIMS success because previous research on ISO 9001 shows that internal motivations are associated with higher certification benefits (Djofack and Camacho, 2017; Tari et al., 2020, Ferreira and Cândido, 2021).

Alongside the strong internal motivations and commitment to internalise the standard, the companies in this study also exhibit weak certification obstacles. The global average of the obstacles in Table 2 (2.59) is much smaller than that for the sample of 221 ISO 9001-certified

organisations in Ferreira and Cândido's (2021) study (3.62). Being used to face significant challenges during innovation processes and failure (Van de Ven, 1986; O'Connor, 2008; Robbins and O'Connor, 2023; Kihlander et al., 2024) may have led the sample organisations to consider the SIMS implementation barriers as low. And may also have led them to be more careful with the SIMS implementation processes then organisations implementing ISO 9001. These reasons, together with the strong motivations and commitment to internalise the standard probably explain the weakness of the SIMS barriers. Motivations and commitment can also explain the type of obstacles that the organisations face during SIMS certification, mostly related to the complexity of the implementation process, time consumption, lack of resources and resistance to change. Externally motivated organisations are likely to experience higher barriers (Boiral and Roy, 2007) and other types of obstacles, such as the cost of the implementation, misalignment of the management system with the strategy, and lack of commitment (*cf.* Delfino et al., 2024). Unfortunately, previous studies (including ISO 9001 studies) rarely establish a relationship between motivations and obstacles (*cf*. Cândido and Ferreira, 2023), which prevents a comparison with the current SIMS results.

The paper also shows that the certification benefits are strong and mostly internal, which correspond with the types of motivations that the organisations had for the certification. This correspondence between motivations and benefits shows that certified organisations achieve results that are consistent with their motivations. While previous empirical research on ISO 9001 established a similar relationship (Ferreira and Cândido, 2021), this association has not been previously explored in the context of SIMS. Notably, the findings reveal that internal motivations in the SIMS are stronger than those reported in the ISO 9001 research (3.82>3.59), as are internal benefits (3.64>3.53).

Taken together, the research results of the certification stage suggest that strong internal motivations contribute to lower certification obstacles, leading to a successful implementation of the SIMS and to stronger internal benefits. These findings are relevant and original to the SIMS field since previous research does not explore (1) the association between motivations, obstacles, and benefits, nor (2) the distinction between internal and external motivations and benefits. However, more quantitative research on SIMS certification is deemed necessary to substantiate these findings, particularly (co)variance-based research and longitudinal studies.

Table 10. Evolution of SIMS motivations, from certification stage to maintenance

Average motivations	Certification stage	Maintenance stage
Average internal motivations	3.82	3.70
Average external motivations	3.78	2.57

Notes: Computed with the data from tables 1 and 4 for motivations that are exclusively internal or external. n=94.

The second stage analysis shows that the stronger motivations for SIMS certification maintenance are continuous improvement, innovation culture, and organisational competitiveness, all of which are internal motivations. The predominance of internal motivations detected in the first stage is strengthened in the maintenance stage, with the external motivations becoming much weaker (Table 10). This means that external motivations can be replaced or 'converted' into internal ones. This evidence is novel for the SIMS field and constitutes a significant contribution to the literature on certification maintenance. There is only scarce evidence on ISO 9001 studies to suggest that external motivations can be converted into internal ones (Kakouris and Sfakianaki, 2019). This study shows clear evidence (Table 10) and suggests that this conversion may be valid across different standards. However, the degree of the conversion may depend on the type of standard and on the context of the organisation, particularly its size, maturity level of the management system, and on the possession of other

certifications.

Consistent with the results on maintenance motivations, the study shows that the most important critical success factors for SIMS certification maintenance are continuous improvement, innovation culture, management commitment, and teamwork. These results are similar to those attained in the ISO 9001 literature (e.g., Wahid and Corner, 2009; Wahid et al., 2011; Basir and Davies, 2018), which places management commitment, continuous improvement, organisational culture, and teamwork as relevant factors for the continuity of an effective management system. However, the order of importance of the CSFs differs significantly from one standard to the other. For instance, in the case of ISO 9001, managers and employees attribute a much higher importance to rewards and recognition and a much smaller importance to continuous improvement (Wahid *et al*., 2012) than the respondents in this SIMS study. This difference may be explained, again, by the predominance of external motivations in ISO 9001-certified firms (Casadesús and Karapetrovic, 2005; Sampaio *et al*., 2014; Mir *et al*., 2016; Kakouris and Sfakianaki, 2019) and by other variables.

Importantly, the research results show that there is an alignment between the stronger maintenance motivations and the stronger CSFs. The two most important maintenance motivations (continuous improvement and innovation culture) are among the four most important CSFs. As far as the authors are aware, there are no similar studies on other standards to allow a comparison with this result, which is an original contribution of this study and begs for similar research on other standards. This alignment of motivations and CSFs, however, is extremely important, because it is probably one of the reasons why the sample firms in this study have successfully maintained their certification.

Consistent with the stronger motivations and CSFs identified, the study shows that the stronger maintenance benefits are innovation process improvement, innovation culture reinforcement, SIMS maturity, and improved innovation capability, all of which are internal benefits. Thus, the stronger motivations, as well as the stronger CSFs and benefits, are almost all internal to the organisation, with only the exceptions of MM2, MM4 and MB3 (which, nevertheless, include both internal and external motivations/benefits, *cf.* tables 4 and 6).

In addition, the study shows that both the strength and type of maintenance benefits are similar to those of the certification stage, which indicates that if the SIMS is properly maintained, the certification benefits can persist over the years. The persistence of certification benefits after several years of certification is still a matter of debate in the ISO 9001 literature (Cândido et al., 2016). However, in the case of SIMS (based on NP 4457), this study shows novel empirical evidence to suggest that benefits tend to persist over time (and over several cycles of certification, as 77.7% of the sample organisations are in the second, third or subsequent periods of certification).

Taken together, the research results of the second stage suggest that organisations with strong maintenance motivations, particularly internal ones, which are aligned with the maintenance CSFs, can contribute to successfully maintaining the SIMS and retaining the certification benefits, mostly internal benefits, during the maintenance stage. In this stage, some of the initial external certification motivations can be converted into internal maintenance motivations. These findings are relevant and original to the SIMS field since previous research does not explore the maintenance of SIMS certification. There is also no empirical evidence of the conversion of external motivations into internal ones in the SIMS literature. And there has been no comparative study of the degree of motivations and benefits between the two initial stages of the certification process (even in the ISO 9001 field). Additional research is still, necessary to substantiate these findings, particularly (co)variance-based research and longitudinal studies.

The results of the third stage of the certification process show that decertification

motivations are weak (global average of Table 7 is only 2.48). Even weaker than in the ISO 9001 literature, where Ferreira and Cândido (2021) found a higher average of decertification motivations (2.66, on a similar five-point scale). This difference may be explained, at least in part, by the lower ISO 9001 internal motivations (Casadesús and Karapetrovic, 2005; Sampaio *et al*., 2014; Mir *et al*., 2016; Kakouris and Sfakianaki, 2019).

Regarding the type of decertification motivations, the most important ones are those related to the standard itself (NP 4457), *i.e*., to the value added by the certification under this standard, the competitiveness provided by the certification, and the availability of other competitive standards. This is a novel result for the literature, which means that if a new standard is made available (e.g., ISO 56001) and is seen as superior to NP 4457, these organisations might decide to decertify to obtain certification under the superior standard. This (predictable) behaviour is consistent with the strong internal motivations of these organisations since a superior standard can, in theory, lead to a higher level of SIMS performance.

The study also shows that motivations to decertify are not simply the opposite of the motivations to certify, as there is no parallel for several decertification motivations in the certification motivations (*cf*. Tables 1, 4 and 7). That is the case of, for instance: the existence of alternative standards (DM4), the standard being already internalised by the company (DM6), negative effects of an inadequate implementation of the standard (DM3), financial problems in the company (DM11), and loss of competitive value of the certification (DM7).

Consistent with the low decertification motivations of the sample firms, the propensity for decertification that they report is also weak (global average of Table 8 is 1.59). Even lower than in the ISO 9001 literature, where Ferreira and Cândido (2021) found an average decertification propensity of 1.98 (using a similar five-point scale). The recent revision of the NP 4457:2021, to align the standard with the ISO 56002:2019, may have responded to a possible increase in the frequency of decertification and contributed to the low current NP 4457 decertification motivations and propensity.

Lastly, the results of this study show that organisations expect a negative impact in case they decertify, but this impact is considered weak for most of the indicators. When the global impact is considered (loss of certification benefits, DC7), the average response is 3.13, i.e., a moderate negative impact of decertification. However, when asked about the expected decrease in economic-financial performance, the organisations report only a weak impact (2.18). These results contrast with some of the studies on ISO 9001 decertification consequences (Alič, 2014; Sansalvador and Brotons, 2015), which conclude that the loss of the certification impacts so negatively on the economic-financial performance that it leads some of the decertified firms to liquidation and bankruptcy. However, these results are in accordance with the results of Cândido et al. (2016), who conclude that decertification has no significant impact on economic performance; and are partially in accordance with Podrecca et al. (2021), who conclude that SA8000 decertification has no significant impact on sales volume and has a positive impact on economic-financial performance. There may be an explanation for the low impact of an eventual SIMS decertification. The sample organisations, due to their internal motivations, have already internalised the standard in their processes, and as such they do not expect the loss of the certificate to impact significantly on processes that have long been internalised. As long as organisations continue to be motivated internally, the consequences of decertification should be low. But if more organisations become NP 4457 certified for external reasons, the loss of the certificate might become more frequent and may have more adverse consequences.

Taken together, the findings of the third stage of the certification process suggest that because of the strong internal motivations and strong benefits, in both the certification and maintenance stages, the sample companies exhibit low motivations to decertify (Table 7) and, consequently, low propensity to lose the certification (Table 8). This is, to some extent, in

accordance with the only study on ISO 9001 that has addressed these relationships (Ferreira and Cândido, 2021). The research findings are relevant and original since previous studies do not explore the decertification of SIMS. More research is still, necessary to support the findings advanced in this paper.

While some parallels between SIMS and ISO 9001 have been observed, for instance, regarding the correspondence between motivations and benefits, the relationship between external motivations and higher obstacles, the conversion of motivations, or the persistency of benefits over the years, it is important to underscore that the motivations and benefits considered within SIMS and ISO 9001 are in part different. Although both standards categorise motivations and benefits similarly as internal or external, the constituents of these categories diverge. SIMS internal motivations and benefits include developing a culture of innovation and increasing innovation capability (see Tables 1, 3, 4, and 6), whereas ISO 9001's include quality improvement, reduction of complaints, and cost reductions. Naturally, there are several overlapping motivations and benefits, such as continuous process improvement, competitiveness, performance improvement, improvement of the ability to anticipate market needs, customer satisfaction, and others. However, the distinctions persist, stemming directly from the distinct nature of the activities of an innovation management system. SIMS place greater emphasis on the effectiveness of the innovation process (creativity) than on its efficiency (Lill *et al*., 2021; Tidd and Bessant, 2021:462,474,578). Consequently, it is important to bear these similarities and differences in mind when extrapolating from this study to other standards. While generalisations may hold validity for external motivations and benefits, as well as for similar types of internal motivations and benefits, generalisations for dissimilar internal motivations and benefits necessitate further investigation and may not even be possible, given the lack of a parallel in other standards. In cases where generalisability is challenging, independent research must be conducted in each respective field (such as SIMS, QMS, and others). This particularly applies to motivations and benefits related to innovation culture and innovation capability. The distinct nature of SIMS renders some of the results and implication of this study original, specific, and relevant to the innovation management field, while certain findings can still be applicable to other standards.

6. Conclusion, implications, and further research

Extant research on standardised innovation management systems (SIMS) does not address the various stages of the certification process. Even within the well-established ISO 9001 literature, studies addressing these stages remain scarce (Camango and Cândido, 2023). This study addresses this gap by providing a comprehensive overview of the SIMS certification process, spanning from the certification stage to the decertification phase. In doing so, the study offers several main contributions.

First, this study is the first to explore the 3 main stages of SIMS certification process: certification, maintenance and decertification.

Second, it presents empirical evidence for these 3 stages of the certification process, filing an important gap in the extant literature.

Third, based on this empirical evidence, the study suggests several relationships between motivations, benefits, maintenance, and decertification. Specifically, it shows that firms with certified SIMS have strong internal motivations for certification, which persist throughout the maintenance stage. The strong and stable motivations enable them to overcome certification barriers with relative ease and to sustain alignment with the CSFs of the maintenance stage. As a result, these firms achieve strong internal benefits during both the certification and maintenance stages, which contribute to their low motivations for certification withdrawal. These weak decertification motivations are primarily linked to a perceived decline in

competitive value of the standard and the emergence of potentially superior alternative standards. Importantly, most certified organisations have maintained their certification for more than 6 years. This longevity suggests that they have effectively internalised the standard, leading them to anticipate low negative consequences from potential decertification, particularly concerning economic-financial performance.

Fourth, these findings underscore the need for further research, particularly through (co)variance-based and longitudinal studies, to validate and expand on the relationships identified. This research, therefore, paves the way for future empirical investigations into SIMS certification lifecycle.

Fifth, the study provides evidence supporting the standardisation of innovation management systems. Earlier research suggests that standardisation and innovation can be contradictory activities (Lill *et al*., 2021; Tidd and Bessant, 2021:426,462,474,578) raising the question of the feasibility of standardising innovation management systems (Mir and Casadesús, 2011; Wright et al., 2012). This study provides empirical evidence suggesting that firms implementing SIMS experience strong benefits, including enhanced innovation culture, increased innovation capability, and improved value creation (Tables 3 and 6). These benefits are not only strong but also sufficiently compelling to motivate these firms to maintain their SIMS, as evidenced by a low propensity for decertification. The findings demonstrate that innovation management systems can be effectively standardised to deliver significant benefits, fostering both organisational innovation and commitment to maintaining these systems. A plausible explanation for the success of SIMS may lie in a selective approach to standardisation. Effective standardisation does not necessitate to eliminate or reduce all types of variation, only those that do not create value or create inefficiencies (Reinertsen and Shaeffer, 2005). This nuanced approach likely underpins the positive outcomes observed in firms implementing SIMS, enabling them to optimise processes while preserving flexibility and adaptability in areas critical to innovation.

However, the extension of the success of SIMS may be questioned based on the findings of this study. Most of the motivations and potential benefits in tables 3, 4 and 6 are not strong/very strong for the majority of the firms in the population (last column). In addition, the calculated global means for maintenance motivations (3.2) and benefits (3.6) may not be as high as one might expect, considering the response scale of 1 to 5, adopted in the study. This raises questions such as the following: Should the reported levels of motivations and benefits be higher to be considered successful? How do these findings compare to the motivations and benefits of firms with non-standardised innovation management systems? Do firms with SIMS generate as many radical innovations as firms operating under non-standardised systems? In what ways do SIMS differ structurally and functionally from non-standardised systems? Are the innovation capabilities of SIMS firms distinct, and if so, how? Do differences exist in the elements and relationships within the systems? Which system demonstrates faster innovation cycles? How do these differences explain variations in performance between SIMS and non-standardised systems? Are SIMS better equipped to deal with learning curves and knowledge management? How do SIMS-certified firms contribute to the innovation ecosystem in their regions compared to non-standardised counterparts? For firms that have decertified, what alternative strategies have they adopted, and how do they compare in terms of effectiveness and efficiency?

Addressing these questions is essential to advancing our understanding of innovation management systems. A significant portion of this inquiry should involve comparative studies between SIMS and non-standardised systems, employing diverse methodologies. Quantitative techniques such as factor analysis, discriminant analysis, analysis of regression, and structural equation modelling within groups (Hair *et al*., 2022:287), alongside event studies (e.g.,

Cândido et al., 2016, 2021), could provide empirical clarity. Additionally, qualitative methods would offer rich, contextual insights into these systems.

If significant differences are found between SIMS and non-standardised systems, this raises an additional important question: Are SIMS the culmination of the innovation management journey, or are they merely a foundational step toward more comprehensive innovation management systems? A parallel can be drawn with ISO 9001, which has often been viewed as a stepping stone toward the adoption of total quality management (TQM) systems (Najmi and Kehoe, 2001; Lakhal, 2014). This study uncovered that one of the main motivations for SIMS decertification is the availability of alternative standards or certifications that organisations perceive as superior. This finding suggests that SIMS might represent an initial or intermediate phase in the evolution of a more 'fully developed' ('total') innovation management system. Such a system could build upon the foundations provided by SIMS while addressing their limitations and integrating more advanced practices. Exploring whether SIMS serve as a stepping stone or a final solution for innovation management could be a promising direction for future research. It may also provide practical insights for organisations aiming to enhance their innovation systems beyond standardisation.

Besides theoretical contributions and suggestions for further research, this study offers practical implications for several stakeholder groups, including (1) certified and noncertified firms, (2) organisations responsible for the governance of national innovation systems, and (3) accredited certification bodies and consulting companies.

For noncertified firms driven by strong internal motivations, the findings suggest that adopting and certifying a SIMS could significantly enhance their innovation culture, innovation capability and economic-financial performance. This is particularly relevant for organisations with internal motivations aiming to integrate innovation more systematically into their operations. However, for organisations primarily motivated by external factors, the study suggests that these organisations can encounter greater obstacles, struggle to align their motivations with the CSFs, and consequently experience fewer benefits. Thus, for these companies, the study suggests setting realistic short-term goals and focusing on transforming external motivations into internal ones to maximise long-term benefits.

For organisations that are already certified, maintaining the SIMS certification yields long-term benefits, provided there is sustained alignment of the firms' motivations with the CSFs of certification maintenance. The study highlights the importance of continuously monitoring and realigning organisational practices to sustain and amplify these benefits over time.

Firms at various stages of the certification process, whether considering certification, maintaining it, or contemplating decertification, might also consider adapting the ISO 9001 strategies suggested by Cândido (2024) to better navigate challenges specific to SIMS.

Organisations overseeing the governance of national innovation systems have a pivotal role in fostering economic growth by increasing the number of certified organisations adopting standards such as NP 4457, UNE 166002, or the international ISO 56000 family. Certification enhances innovation capabilities, drives organisational performance, and cultivates a culture of innovation that can ripple through industries, stimulating broader economic benefits. To encourage this adoption of innovation standards, governance structures and governments could bolster incentives for certification. For example, offering tax benefits, financial subsidies, or grants for organisations undergoing the certification process could be viable strategies.

However, as this study highlights, there is a critical balance to maintain. Increasing external incentives may inadvertently shift the focus of newly certified organisations from internal motivations, which are associated with stronger internal benefits, to external motivations, potentially reducing the depth of engagement with the certification's principles and its resulting benefits. The current success of SIMS certification has been largely driven by

organisations with strong internal motivations. These organisations align their practices with the certification maintenance CSFs and derive significant internal benefits, such as enhanced innovation capabilities. To manage this potential challenge, certification bodies and consulting companies could adopt tailored strategies for guiding organisations with weaker internal motivations. For instance: (1) by setting realistic short-term objectives, encouraging organisations with predominantly external motivations to establish achievable goals during the early stages of certification; (2) fostering internal motivations, by providing training, workshops, and case studies to demonstrate how the principles of the certification standard can lead to tangible, intrinsic benefits; and (3) offering guidance for long-term integration, by developing frameworks for organisations to progressively integrate the standard into their operational and strategic frameworks, converting initial external drivers into sustained internal motivations.

The anticipated growth in certifications, driven by the new standards (e.g., ISO 56000 family; NP 4457:2021) and heightened external incentives, presents a unique opportunity for certification bodies and consulting companies to refine their approach. By addressing the diverse motivational profiles of organisations, they can ensure that the expansion of certified organisations continues to contribute positively to national innovation systems without diluting the core benefits of certification.

Lastly, certification bodies and governance structures within the national innovation system can benefit from understanding the reasons behind the decertification of some firms (12.7%, Section 2.4) to address these effectively. This study identifies as primary decertification motivations the existence of alternative standards, the perceived low value-added of the current standard, procedural formality, complexity, and cost (Table 7). These factors should be prioritised by governance and certification bodies to mitigate certification losses. Although the latest version of the standards (e.g., NP 4457:2021, ISO 56000 family) adopts the harmonised structure of ISO standards to ease integration with various management systems, and may have partially addressed some of these decertification motivations, ongoing monitoring is necessary to assess the effectiveness of these updates. Past revisions of ISO 9001 have not entirely eradicated decertification motivations; making it reasonable to anticipate that the revision of innovation management standards will face similar limitations. Certification bodies must judiciously handle the remaining issues. Moreover, certification bodies and consulting companies can play a crucial role in assisting decertified organisations with moderate or high internal motivations to transition to more advanced innovation management systems, whether certified according to more demanding standards or implemented as non-certified ‘fully developed systems’.

In addition to these practical implications, it is essential to recognise the evolving challenges faced by SIMS throughout the certification lifecycle. During the certification stage, managing motivations emerges as a key challenge, with a particular emphasis on converting external motivations into internal ones while simultaneously overcoming barriers to achieve certification. In the maintenance stage, organisations must persist in managing their motivations, ensuring the ongoing conversion of external motivation into internal ones, and maintaining alignment of motivations with critical success factors to sustain the SIMS and maximise it benefits. As the certification validity period nears its end, managers must face the added complexity of addressing both internal and external motivations for decertification. They must carefully assess the potential impacts of a certification withdrawal and make well-informed decisions regarding certification renewal or transition to alternative frameworks.

This study offers valuable insights to help managers anticipate and address these stage-specific challenges, equipping them to better navigate the complexities of the certification process. Certification bodies and consulting companies should also grasp how these challenges

evolve across different stages and adjust their support strategies accordingly. Additionally, individual organisations encounter unique challenges influenced by their specific contexts, which certification bodies and consultants must consider when providing guidance and tailored solutions.

This study has limitations that suggest additional directions for further research. First, the conclusions of the study may be context-dependent because the research centres on a national standard. Nevertheless, the NP 4457:2007 is very similar to the Spanish UNE 166002, and Portugal is a neighbouring country to Spain, sharing a long history of close ties and a similar Latin national culture, which might make the conclusions of this study relevant for those studying the Spanish standard or other national standards that were similarly based on the Spanish UNE 166002 (Franch, Brazilian and Mexican, according to Mir and Casadesús, 2011). Additionally, the NP 4457 incorporates several concepts from ISO standards, making it comparable to the international ISO 56000 family of innovation management standards. Consequently, the findings of this study could also be extended to organisations adopting these standards. Future studies could be conducted in more than one country and more than one standard to allow for comparative analyses. Integration of contingency and institutional variables may also contribute to explain any significant differences between standards and countries. Second, the study is exploratory and, as such, presents mostly descriptive statistics and binomial tests. So far, research has been essentially conceptual, based on case studies, or exploratory. Given the scarcity of research in this field, the methodologies employed in this research are justifiable. However, more advanced and sophisticated statistical methods should also be employed as more research is produced. Third, the research addresses only the population of certified firms. Future studies could also consider the population of decertified organisations to better understand the motivations of organisations that did decertify and the consequences of that decertification. Fourth, the data collected pertains to management perceptions, as is frequently the case when researching motivations, obstacles, and benefits of management initiatives. However, future research might also consider using objective measures to study, for instance, the economic-financial impact of SIMS certification, maintenance and decertification. Fifth and last, this survey does not address several issues which might stimulate future research, including the role of previous organisational innovation activities in the success of the certification, measures to overcome certification obstacles, difficulties faced during certification maintenance, standards being considered by firms as alternatives to replace the current standard, reasons for the replacement, role of external auditors and consultants in the certification, maintenance and replacement process, benefits of the replacement standard when compared with the previous standard, open innovation within SIMS, and others.

Acknowledgments

The authors gratefully acknowledge the participation of all survey respondents. Additionally, the authors extend their sincere thanks to the anonymous reviewers and the Editor for their constructive comments and suggestions, which have significantly enhanced the quality of this article. The first author also expresses gratitude for the kind support provided by CAGECE.

Funding

This research was supported by national funds from the Fundação para a Ciência e a Tecnologia (FCT) under the projects UIDB/04007/CEFAGE and UID/04020/CINTURS. FCT was not involved in the study's design, data collection, analysis, interpretation, manuscript writing, or the decision to submit this article for publication.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability statement

The data that has been used is confidential. Due to the sensitive nature of the questions asked in this study, survey respondents were assured that raw data would remain confidential and would not be shared.

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Appendix A: Measurement instrument

Table A1. Motivations, barriers and benefits of certification

Variable and indicators	Management system	Studies
Motivations	NP 4457	Santos *et al.*, 2019.
Items CM1 to CM8 [a]	UNE 166002 and other SSIM [b]	Correa *et al.*, 2007; Badrinas and Vilà, 2015; Mir *et al*., 2016; Araya and Paz, 2019.
	ISO 9001	Lo and Chang, 2007; Sampaio *et al.*, 2014; Djofack and Camacho, 2017; Kakouris and Sfakianaki, 2018; Ferreira and Cândido, 2021.
Barriers	NP 4457	Lopes *et al.*, 2012; Caetano, 2017; Santos *et al.*, 2019.
Items CBAR1 to CBAR10 [a]	UNE 166002 and other SSIM	Mir and Casadesús, 2011; Pellicer *et al*., 2012; Martínez Costa *et al.*, 2019.
	ISO 9001	Cândido and Santos, 2011; Sampaio *et al.*, 2014; Esgarrancho and Cândido, 2020; Sfakianaki and Kakouris, 2020; Ferreira and Cândido, 2021; Cândido and Ferreira, 2022, 2023.
Benefits	NP 4457	Lopes *et al.*, 2012; Caetano, 2017; Santos *et al.*, 2019.
Items CBEN1 to CBEN9 [a]	UNE 166002 and other SSIM	Correa *et al.*, 2007; Mir and Casadesús, 2011; Pellicer *et al.*, 2012; Mir *et al.*, 2016; Yepes *et al*., 2016; Garechana *et al*., 2017; Cerezo-Narváez *et al*., 2019; Martinez-Costa *et al.*, 2019; Idris and Durmuşoğlu, 2021; Khan *et al*., 2021.
	ISO 9001	Djofack and Camacho, 2017; Kakouris and Sfakianaki, 2018; Ferreira and Cândido, 2021; Cândido and Ferreira, 2022, 2023.

Notes: [a] Items' descriptions in Tables 1 to 3. [b] SSIM - systems or standards of innovation management.
Rating scale: very weak (1), weak (2), average (3), strong (4), very strong (5).

Table A2. Motivations, critical success factors and benefits of maintenance

Variable and indicators	Management system	Studies
Motivations Items MM1 to MM9 [a]	UNE 166002 and other SSIM [b]	AENOR, 2006; IPQ, 2007b; ISO, 2019.
	ISO 9001	Low and Omar, 1997; Water, 2000; Wahid *et al.*, 2011; Castka, 2018.
Critical success factors Items CSF1 to CSF10 [a]	UNE 166002 and other SSIM	AENOR, 2006; IPQ, 2007b; ISO, 2019.
	ISO 9001	Low and Omar, 1997; Wahid and Corner, 2009; Wahid *et al.*, 2011; Sanchez-Lizarraga *et al.*, 2020.
Benefits Items MB1 to MB9 [a]	ISO 9001	Lo and Chang, 2007; Wahid and Corner, 2009; Wahid *et al.*, 2011; Castka, 2018.

Notes: [a] Items' descriptions in Tables 4 to 6. [b] SSIM - systems or standards of innovation management.
Rating scale: very weak (1), weak (2), average (3), strong (4), very strong (5).

Table A3. Motivations, propensity and consequences of decertification

Variable and indicators	Management system	Studies
Motivations Items DM1 to DM11 [a]	ISO 9001	Kafel and Nowicki, 2014; Cândido *et al.*, 2016; Simon and Kafel, 2018; Chiarini, 2019; Cândido *et al.*, 2021; Ferreira and Cândido, 2021.
Propensity Items PRO1 to PRO4 [a]	ISO 9001	Ferreira and Cândido, 2021.
Consequences Items DC1 to DC7 [a]	ISO 9001	Alič, 2014; Kafel and Nowicki, 2014; Sansalvador and Brotons, 2015; Cândido *et al.*, 2016; Kafel and Simon, 2017.

Notes: [a] Items' descriptions in Tables 7 to 9.
Rating scale: very weak (1), weak (2), average (3), strong (4), very strong (5).

Appendix B

Table B1. Decline in the number of organisations with certified SIMS (NP 4457:2007)

Year	2015	2016	2017	2018	2019	2020	2021
Certified organisations	179	170	164	161	157	144	169
Decline in certified organisations *	-	9	6	3	4	13	-
Percentage ($decline_t/(certified_{t-1}/3)$) *		15.1%	10.6%	5.5%	7.5%	24.8%	-

Source: Portuguese Institute of Accreditation (IPAC, 2021)
Note: * Decertification numbers are higher than the 'decline', because the decertification is partially compensated by new certifications (first time certifications). Decertification data is currently not available for SIMS.