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Effects of the UNE 166.002 standards on the incremental and radical product innovation and organizational performance

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Abstract

Purpose – The purpose of the study has been to fill the gap detected in the literature and to analyze whether the application of management of R&D in accordance with UNE 166002:2021 allows companies to obtain higher product innovation and better performance, specifically incremental and radical product innovations.

Design/methodology/approach – The population used in this study included Spanish manufacturing organizations that were active, had more than 50 employees according to the SABI. The information was collected through a structured questionnaire previously tested using a company specializing in the sector under the supervision of the authors. A total of 1,154 companies were randomly contacted in order to reach an acceptable number of 225 valid questionnaires. The data analysis has been carried out with structural equation methodology.

Findings – The results obtained with a sample of 225 companies show that the application of this standard for innovation management promotes the development of new products with incremental and radical changes, and improves business performance. It has also been found that incremental and radical product innovations mediate the relationship between this standard and performance.

Research limitations/implications – Firstly, the survey is only addressed to the company's operations manager. Secondly, the sample used is cross-sectional, whereas innovation management implies a broad implementation process.

Practical implications – Managers must know that radical and incremental product innovation can improve the company's operational performance. And the most direct implication of this work is that, those companies that are committed to the development of innovations should seriously consider the application of the principles incorporated in Standard 166,002, as an instrument that improves the results of innovation in the organization. Since this SIMS promotes both types of innovations, it improves results directly and indirectly through these product innovations.

Originality/value – The existing literature indicates that no empirical study has focused on the benefits of this SIMSs for innovation and BP. This paper fills this gap detected in the literature and analyzes the results of the implementation of this standard on incremental and radical product innovations and business performance.

Keywords New products, Standardized innovation management system, UNE 166.000 standards, Radical and incremental innovation

Paper type Research paper

1. Introduction

In the last three decades, innovation has attracted the attention of many researchers, since technological innovations are widely recognized as an important driver of competitive advantage and resultant improvement of organizational performance (Hervás-Oliver *et al.*,

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2015, 2018, 2021; Rauter *et al.*, 2018; Omran *et al.*, 2019; Nieto *et al.*, 2022). Nowadays, events such as the health crisis caused by Covid-19 or the war in Ukraine show that organizations develop their activity in a highly volatile, uncertain, complex and ambiguous environment, in which innovation allows companies to differentiate from competitors and help them to be competitive, agile and flexible (Hull and Rothenberg, 2008; Psomas *et al.*, 2018; Wang *et al.*, 2022). Thus, an organization's ability to survive in competitive environments is based on its adaptation to turbulent markets, demands, and technological opportunities (Jansen *et al.*, 2006; Shipton *et al.*, 2006; Huesig and Endres, 2019). Therefore, it is important for companies to adopt innovative behavior by developing new and radical products in order to be competitive, faster and better than non-innovative enterprises (Brown and Eisenhardt, 1995; Mohammed *et al.*, 2017; Bodlaj and Čater, 2019).

The literature on product innovation uses similar justifications to emphasize the benefits of this process for the organization. In particular, the continuous changes that occur in customer needs force firms to develop new products to maintain their results and their competitive position in the markets (Schewe, 1996; Ali, 2000; Zhou, 2006; Hervás-Oliver *et al.*, 2018). So, in many companies the ability to successfully develop new products is the key to maintaining competitive advantage (Song and Thieme, 2006; Forés and Camisón, 2016; Popa *et al.*, 2017), and this depends on the ability to convert organizational competencies successfully into new product development (Atuahene Gima, 2005). However, there are doubts about how this innovation process should be managed so that the desired results are obtained, and the innovation process involves significant risks and capital investments (Tan, 2001; Shan *et al.*, 2016) and failures in the development of new products that can cost significant sums of money (Song and Noh, 2006). Despite this, many studies have found positive evidence between firm performance and the outcome of product innovations (Hult *et al.*, 2004; Zhou, 2006; Aragón-Correa *et al.*, 2007; Oke, 2007; Sawatani, 2022) or have demonstrated the positive effect of product innovation on performance (Ledwith and O'Dwyer, 2009; Calantone *et al.*, 2010; Rosenbusch *et al.*, 2011; Rubera and kirca, 2012). The company that manages to develop the new product, service or process will obtain "Schumpeterian" or innovation-derived rents from it, which, according to the approach of the present research, represent the company's competitive advantage.

Furthering this growing area of research, the term innovation system has attracted a great deal of interest. This refers to a planned innovation process that relies on several variables such as information, technology, people or institutions that establish norms related to innovation (Lundvall, 2010). The concept of innovation systems is a heuristic term, developed to analyze all societal subsystems, actors, and institutions contributing in one way or the other, intentionally or not, to the emergence or production of innovation (Freeman, 1987). In this case, the UNE standard has been developed by a private institution, the Spanish Association for Normalization (AENOR), with the aim of helping companies in their innovation process. The most basic function mentioned in many studies on innovation systems is activity learning or interactive learning. Edquist and Johnson (1997) mention three functions of institutions in innovation systems: the reduction of uncertainty by providing information, the management of problems and cooperation, and the provision of incentives for innovation. In this study, it is argued that thanks to the development of this standard, organizations have a favorable environment for the reduction of risks and doubts, the resolution of problems derived from the process of creating new products and, in short, the generation of innovations. However, the literature on innovation systems is not yet as mature and has not gone into sufficient depth in the study of this type of UNE standards.

This SIMS implies that companies systematize and formalize their procedures according to the area of management to which they refer, after which an independent third party will audit their correct implementation and issue a certificate that will be valid as proof of the existence of the management system in the organization. The aim of this SIMS is to enhance

R&D&I of companies. Moreover, in different sections of this standard it is indicated that organizations must generate new ideas or products, but they must also exploit those products already developed. It also establishes that companies must protect and exploit the results of R + D + I activities. Besides, throughout the standard, emphasis is placed on the fact that organizations must generate new ideas or products, but they must also exploit those already developed products. Likewise, companies must protect and exploit the results of R + D + I activities (sections 4.4.8.2 and 4.4.9). Therefore, the standard makes reference to the fact that companies must generate radical and incremental product innovations. Also, Xie *et al.* (2016) consider that efforts to standardize innovation lead to four types of innovation: modular, radical, incremental and architectural.

Nonetheless, the existing literature indicates that no empirical study has focused on the benefits of SIMSs for innovation and organizational performance. Therefore, given the importance of innovation for companies, in this study we intend to answer the following research question: Could product innovation help to explain how the implementation of Standardized Innovation Management Systems improves company performance?

Specifically, relying on the Innovation Systems Theory, this research aims to fill this gap detected in the literature, contributing in different ways: First, we analyze whether the SIMS of UNE 166.002:2021 has a positive effect on the innovation in companies, specifically on incremental and radical product innovations. Secondly, we verify the effect of these types of innovations as mechanisms to improve the organizational performance. Finally, we study if this SIMS has a positive effect on results. This study can also help managers who want to innovate by clarifying the important role and effects that this standard plays in managing product innovation.

The remainder of this article consists of four sections. In the first section, we describe the relationships between SIMS of UNE 166.002 and results, this standard and incremental and radical innovation and these types of innovation and results. In addition, we establish the research hypothesis. In the next section, we describe the methodology. Then, we discuss the data. Finally, we make some conclusions and discuss the contributions that the study may have for organizations. Also, we explain its limitations and future research that could be done.

2. Literature review

Innovation is a very complex process. To innovate, companies need to create new and different learning for developing innovative products, services, or new methods of production. In fact, many academic contributions link learning to innovation (Husain *et al.*, 2016). Consequently, innovation can be understood as a difficult process of learning, in which ideas are generated, assimilated, and applied (Hull and Covin, 2010).

For these reasons, different theories of innovation have been developed, such as Creative Destruction, Diffusion of Innovations, Open Innovation, Absorptive Capacity, User Innovation or Systems of Innovation. In this study, it is argued that the theory of innovation systems can help to understand that the generation of innovations works as a system, and that therefore, the interaction of different elements can contribute to generating new products (Nelson and Nelson, 2002). New laws, entry of new actors, and other events change the character of an innovation system over time. The main idea behind the innovation systems approach is that innovation and its diffusion is an act that any company can carry out individually or as a group and that the successful development of innovations implies the management of a complex system of different elements. This theory includes the dynamics of individual companies, public or private, their particular technological characteristics and adoption mechanisms, as well as technical or social variables that allow innovation (Hekkert *et al.*, 2007). Therefore, the determinants of technological change do not only occur within an individual company, but also within the innovation systems. In this theory, a norm, a process, a technology, etc. used by an organization could be used by another company contributing to the diffusion of that innovation (Nelson and Nelson, 2002). This theory has helped us to define the model that supports this paper, in which the institution that has created a useful standard to manage innovation is AENOR.

Accordingly, with this theory it is necessary to carry out a global management of innovation, as suggested by the normalization of innovation. The literature reports the benefits of techniques that promote the standardisation of procedures to achieve a more effective management, leading to the development of successful innovations. Mavroeidis and Tarnawska (2017) point out that efficient innovation management needs practices and routines that can be codified by a management standard, creating a formalized structure. Besides, according to Mir *et al.* (2016), innovation can be managed through Standardized Innovation Management Systems (SIMSs). These systems are sets of standards designed to help companies in the complex process of innovation, systematize their activities and enhance efficiency of its management. However, some studies that have examined innovation have found that standardizing the innovation process results in excessive and unnecessary bureaucratic burden (Jayawarna and Holt, 2009), although this has not deterred their rapid diffusion.

The aspect of this standard that is most widely debated in the literature is whether it is capable of performing its function. Specifically, if it has a positive effect on performance. Some managers argue that standardization can imply rigidity, but others believe that it is a mean and result for change and incremental innovation (Wright *et al.*, 2012).

For these reasons, both at global, European, national and regional levels, different support plans and policies to promote Research, Development and Innovation (R&D&I) have been developed, with the appearance of different regulatory bases, reference manuals, standards, etc. that aim to define and delimit the field of R&D and TI. Thus, in recent years, the normative paradigm has changed with the emergence of the first iterations of SIMSs in various countries such as Brazil, Colombia, Denmark, France, Ireland, Spain or the United Kingdom, among others (see Table 1).

Table 1. Standardized innovation management systems (SIMSs)

Location	Year	Standard
Spain	2006	UNE 166002:2006 – R&D&I Management: Requirements of the R&D&I management system (New version available in 2021)
Portugal	2007	NP4457:2007 – R&D&I Management: Requirements of the R&D&I management system
Mexico	2008	NMX-GT-003-IMNC-2008 – Technology management system - Requirements
Colombia	2008	NTC 5801:2008 – R&D&I Management: Requirements of the R&D&I management system
United Kingdom	2008	BS 7000–1:2008 – Design management systems – Part 1: Guide to managing innovation
Ireland	2009	NWA 1:2009 – Guide to good practice in innovation and product development processes
Denmark	2010	DS-hæfte 36:2010 – User oriented innovation management
Russia	2010	GOST R 54147:2010 – Strategic and innovation management. Terms and definitions
Brazil	2011	ABNT NBR 16501:2011 – Guidance for the research, development and Innovation (R&D&I) management system
France	2013	FD X50-271:2013 – Innovation management – Guide for innovation management implementation
Europe	2013	CEN-TS 16555-1:2013 – Innovation management: Innovation management system
International	2018	ISO 50501 – Innovation management system guidelines

Source(s): Authors' own construction

These SIMSs guidelines, regardless of the country or territorial scope of focus, share a common objective: to systematically and efficiently manage company innovation processes to improve innovative capability and organizational performance (BP) (Mir *et al.*, 2016). In Spain, the result of these plans and policies has been the development of the UNE 166.000 standard that includes the guidelines for R&D&I management.

The UNE 166.000 standards are relatively new. Unlike other business management standards (such as ISO 9000, ISO14000 in environmental management or OSHAS, 18000 in occupational risk prevention), there is still no debate in the literature that indicates the advantages of its implementation or has empirically verified its effect on innovation or results (Martínez-Costa *et al.*, 2019; Kihlander *et al.*, 2022). Except for case studies and papers that compare and combine standards, only two papers have dealt with this question empirically, these are the studies by Mir *et al.* (2016) and Martínez-Costa *et al.* (2019). The case studies were focused on sectors such as construction (Correa *et al.*, 2007; Pellicer *et al.*, 2008, 2010, 2012, 2014; Yepes *et al.*, 2016), manufacturing (Mir and Casadesús, 2008, 2011a, b) and nanotechnology (Law, 2010), among others. Other studies have made comparisons with other standards (Law, 2010; Mir and Casadesús, 2011a, b; Mir, 2012), proposed combining standards across systems (Law, 2010; Mir and Bernardo, 2012) and analyzed patterns of diffusion over time (Mir *et al.*, 2014).

What is clear from the limited existing literature is that the development of this type of standard is aimed at creating a framework for generating innovation and improving company performance. The following sections will analyze this axiom, starting with the controversial relationship between innovation and company performance.

2.1 Innovation and performance

Innovation has become one of the most important tools for the development of competitive advantage in companies. This is crucial at a time when companies face a variety of changes in the environment that force them to adapt and find new forms of business (Fernández, 1996; Jansen *et al.*, 2006; Prajogo, 2016).

The interest in innovation, and the different emphasis given to its components from different disciplines such as marketing, technology or organization, has led to the appearance of a variety of definitions of this concept depending on the context and theories (Chaharbaghi and Newman, 1996; Damanpour and Gopalakrishnan, 1998; Hekkert *et al.*, 2007). Regarding its concept, innovation is presented as the successful implementation of creative ideas within an organization (Popadiuk and Choo, 2006; Weerawardena *et al.*, 2006; Mahmoud *et al.*, 2016). This definition implies the conversion of knowledge and innovative ideas into a benefit for commercial use or for public well-being (Nasaj and Marri, 2020). In this line, Damanpour and Gopalakrishnan (1998) understand innovation as "*the adoption of a new idea or behaviour in an organization*", a definition that we consider appropriate for the purposes of this paper.

On the other hand, in order to explore the concept of innovation in greater depth, the literature has established different typologies of innovation. Frequently cited are those that differentiate various types of innovation according to the nature of the innovations (Ilmudeen *et al.*, 2021; Dewar and Dutton, 1986), business duality (Para-González *et al.*, 2021) or the radicalism of innovation (Damanpour and Evan, 1984; Urbinati *et al.*, 2022). The latter is considered in this study, dividing it into "incremental innovation" and "radical innovation" depending on the degree to which innovations replace previous technologies respectively (Lu and Chen, 2010; Saeed *et al.*, 2015; Sawatani, 2022). This duality of innovation is well known in the literature. Thus, product innovations can range from incremental adjustments to existing products, to radically new products that differ significantly from existing products (Brattström *et al.*, 2015).

Radical innovation is understood as an innovation that makes a novel and totally different contribution to what already exists. It is the set of new methods and materials (resulting from an entirely new knowledge base or from combinations of knowledge held by firms that give rise to other new knowledge) for existing firms (Hill and Rothaermel, 2003; Eroğlu, 2019), which is characterized by destroying the wealth of other firms, by being sources of competitive advantage and because it is increasing in frequency of occurrence (Chandy and Tellis, 1998). Radical innovations produce fundamental changes in the organizations' activities and represent a clear departure from existing practices (Agostini and Nosella, 2017). However, incremental (continuous, architectural) innovations introduce minor changes and simpler modifications to products (Tontini and Picolo, 2014). These innovations are more common, especially in larger firms that are less prone to radical innovations and more prone to incremental innovations (Stringer, 2000). Moreover, radical innovations require more resources, pose a serious challenge to the existing structure and affect the organization's activities more broadly than incremental innovations (Forés and Camisón, 2016). Besides, radical innovation is also more uncertain and more complex than incremental innovation, and its management requires a different set of practices (Slater *et al.*, 2014). As a result, radical innovations are, on average, more difficult to introduce than incremental innovations (Damanpour, 1996). However, both innovations are key drivers for the future and are necessary for excellent companies (Martínez-Costa and Martínez-Lorente, 2008). For this reason, Sharma and Salvato (2011) believe that family firms need to combine incremental and radical innovation together to achieve high firm performance.

Thus, the introduction of radical innovations often leads to fundamental changes in the organizations' usual practices, while incremental innovations lead to minor changes in existing practices (Ettlie *et al.*, 1984; Dewar and Dutton, 1986).

Regarding the impact of innovation in the organizational performance, the literature has indicated that it depends on another set of contextual aspects, such as the sector, the age of the company, the type of innovation and the cultural context (Deshpandé *et al.*, 1993; Damanpour *et al.*, 2009; Rosenbusch *et al.*, 2011). The relationship between these variables has raised some doubts, since innovation implies a series of investments, costs and risks that can reduce its attractiveness (Abetti, 2002; Robinson and Min, 2002; Xiao *et al.*, 2022). But it also has many benefits as will be stated below.

Oke (2007) and Sawatani (2022) consider that each type of innovation contributes in different ways to the achievement of competitive advantage. Considering product innovation, Henard and Szymanski (2001) point out that this is often linked to the sustainable success of business operations, because a new, unique and superior product should achieve competitive advantages for the company. Moreover, Mir *et al.* (2016) consider that from studies of the four types of innovation defined in the Oslo Manual (OECD, 2005), only product and process innovation positively and significantly affect firm performance (Calantone *et al.*, 2010). Furthermore, according to the degree of novelty, some authors suggest that the conditions and skills needed for radical product innovation are substantially different to incremental product innovation (Bouncken *et al.*, 2018; Colombo *et al.*, 2017; Slater *et al.*, 2014).

In the case of incremental innovations, some authors consider that the relationship between incremental product innovations and organizational performance is clear (He and Wong, 2004; Oke, 2007; Oerlemans *et al.*, 2022). These innovations are more predictable in terms of outcomes (Slater *et al.*, 2014), minimize costs (Wu *et al.*, 2019) and are the main source of income for many companies (Sorescu *et al.*, 2008). In this sense, the study by Bhaskaran (2006) carried out with a sample of 337 seafood retailers indicate that incremental product innovations offer competitive advantages to small and medium size companies, and these can be adopted rapidly and increase profitability and sales. Also, Varis and Littunen (2010) in their paper, based on a quantitative study of a sample of SMEs located in the Northern Savo region in Finland, conclude that the introduction of novel product, process and market innovations is positively associated with firms' growth. Other authors, such as Oerlemans *et al.* (2022), point out that, in the financial year 2012/2013 and in a sample of 497 manufacturing companies in South Africa, firms with exploitative/incremental product innovations generated on average about 37% of their sales with this type of innovations.

On the other hand, according with Coccia (2017) the development of radical product innovations allows firms to achieve the prospect of a (temporary) profit monopoly and competitive advantage in markets characterized by technological dynamisms. Also, this type of innovation can enable the organization to expand into new markets and secure long run competitiveness (Leifer *et al.*, 2000). However, radical innovations require more time, uncertainty increases with the degree of innovation (Abetti, 2002), and risks and cost are higher (Golder and Tellis, 1993; Robinson and Min, 2002; Xiao *et al.*, 2022), which are inherent to a higher degree of innovation (Danneels and Kleinschmidt, 2001). Still, many authors indicate that radical innovations have a positive impact on performance (Kleinschmidt and Cooper, 1991; Geroski *et al.*, 1993; Blundell *et al.*, 1999; He and Wong, 2004) and that the more innovative the products, the higher the organizational performance (Sorescu *et al.*, 2003). Moreover, radical innovation requires more creativity, greater exchange of information and knowledge, and more substantial coordination among team members (Leifer *et al.*, 2000; Slater *et al.*, 2014). Achieving these requirements has been shown to be strongly linked to trust among product innovation team members (e.g. Bertels *et al.*, 2011; de Clercq *et al.*, 2011). Also, Sorescu *et al.* (2008) carried out a study using data on more than 20,000 new products from consumer-packaged goods industries. The authors find that radical product innovation is associated with increases in both normal profits and economic rents and that, on average, each radical product innovation in the sample is associated with an increase in firm value of $4.2 million. Besides, Xiao *et al.* (2022) using the data of A-share listed China companies from 2012 to 2019 suggest that R&D tax credits have an incentive effect on enterprise innovation investment, new product sales revenue, and patent number, through radical and incremental innovation.

In this sense, Lyer *et al.* (2021) consider that organizations need to balance both innovation types to maximize their performance, both in the short and long term (organizational ambidexterity). In this business duality, exploratory innovation corresponds to radical innovation and exploitative innovation to incremental innovation (Ponsignon *et al.*, 2019). Therefore, innovation is also expected to develop exploitation and exploration knowledge in an organization and that organizations bet on both types of innovations (incremental and radical) to obtain the best results (Popadiuk, 2012; Zhang *et al.*, 2015).

Therefore, both types of product innovations are expected to show a positive effect on organizational performance. Consequently, the following hypotheses are proposed.

H1. The development of product innovations has a positive relationship with organizational performance.

H1a. The development of incremental product innovations is positively related to organizational performance.

H1b. The development of radical product innovations is positively related to organizational performance.

2.2 The standardized innovation management system (SIMS) of the UNE 166000 and the incremental and radical product innovation

In recent years, different management system standards have emerged that refer to the standardization of very diverse aspects of business activity, such as quality management (ISO 9000), environmental management (ISO 14000), occupational risk prevention and health and safety at work (OSHAS, 18000), or corporate social responsibility (ISO 26000). In 2002, the standardization body AENOR published the first standards of the ISO 166000 series on R&D&I Management, which includes the guidelines for their management. These systems have been studied deeply, and their benefits, limits and disadvantages have been discussed in the context of creativity and innovation (Prajogo and Hong, 2008; Jayawarna y Holt, 2009). However, with this standard there are very few studies on its advantages and disadvantages. Among the disadvantages, it is argued that standardization implies great control and limits the flexibility and creativity that innovation requires (Jayawarna y Holt, 2009).

Organizations that decide to implement R&D&I standards are expected to obtain the following advantages (Navarro Cabeza, 2005).

(1) The systemizing of R&D&I activities to make better use of resources and know-how.

(2) The promotion of R&D&I as a differentiating factor for competitiveness and corporate reputation.

(3) The encouraging of technology transfer and facilitate tax breaks.

(4) The improvement of employee involvement and motivation, as well as shareholder satisfaction.

Before the recent emergence of SIMSs, no specific standard for managing the corporate innovation process were available. This lack of resources was often addressed through the use of Total Quality Management (TQM) systems or through the application of the ISO 9001 standard for quality management. However, Zairi (1994) suggests that for most companies it is extremely difficult to apply TQM concepts and techniques in the area of innovation because the quality standards, such as ISO 9001, make standardizing the innovation process results in greater process control, which may disrupt the level of freedom necessary for creativity and R&D processes (Jayawarna and Holt, 2009). Thus, the adoption of a standard that standardizes R&D&I projects can be of great help both for the companies and entities that carry out projects and for the organizations that evaluate (and probably subsidize) the projects. Furthermore, the UNE 166000 standard is valued by the main national entities that evaluate projects (CDTI, MCYT, etc.). The UNE 166000 family consists of several standards, three of which are certifiable.

(1) UNE 166001:2006. R&D&I management: R&D&I project requirements. It aims to facilitate the systematization of research, development and innovation activities in the form of R&D&I projects and to help define, document, prepare, manage and communicate R&D&I projects.

(2) UNE 166002:2021. R&D&I Management: R&D&I Management System Requirements. Provides guidelines that help companies to develop an efficient and effective R&D&I system, improve the results of the system, improve internal procedures and optimize technological innovation processes.

(3) UNE 166006:2011. R&D&I Management: Technology Watch and Competitive Intelligence System.

The other standards of the family are not certifiable but help to implement the R&D&I management system. These are the following.

(1) UNE 166000:2006. R&D&I management: Terminology and definitions of R&D&I activities. This standard helps to understand the rest of the 166,000 family of standards.

(2) UNE 166005:2012 IN. R&D&I management: Guide for the application of the UNE 166002 standard to the capital goods sector.

(3) UNE 166007:2010 IN. Management of R&D&I: Guide for the application of the UNE 166002:2006 Standard.

(4) UNE 166008:2012. R&D&I management: Technology transfer.

These standards are intended to be a tool to support an organization to approach R&D&I tasks and to carry them out with increased efficiency and to develop innovation in an excellent way. This could suggest that the UNE standard should perhaps be included as one more component in the theory of innovation systems, since typical indicators to assess the structure of an innovation system are R&D efforts, patents and patent applications, qualities of educational systems, university–industry collaborations, and availability of venture capital (Hekkert *et al.*, 2007). Pellicer *et al.* (2008) consider that the systematization of innovation is something positive and that, standardization and innovation may be compatible concepts. Since innovation is a process, it can be standardized like any other process in the company. Mir and Casadesús (2008) also argue that the large amount of documentation, information and knowledge to be managed in relation to innovation and R&D fully justifies the need for a regulatory framework for organizations, and the establishing of guidelines and methodologies for the management of innovation (Heras-Saizarbitoria *et al.*, 2007).

Currently, the Spanish Government uses UNE 166.000 as a tool to measure organizational innovation and favors certified companies in competitions for public contracts (Pellicer *et al.*, 2008). As Pellicer *et al.* (2010) consider, many companies do not believe innovation as one of their competitive priorities, but the fact that it is recognized in public tenders forces companies to change their attitudes toward innovation and even to change their culture. However, while many studies that have focused on analyzing the benefits of other standards such as ISO 9000 for quality management, OHSAS 18000 for occupational risk prevention or ISO 14000 for environmental management, there are no generalizable scientific studies that have analyzed the effect of standard 166,002 on business activity and, in particular, on innovation performance. The literature on the standard is limited to theoretical reviews and some case studies (Caetano, 2017; Pellicer *et al.*, 2012). More specifically, given that, as stated above, companies can be certified by three standards, this study will focus on UNE 166002 (AENOR, 2021), a standard that specifically establishes the criteria to help companies develop an efficient and effective R&D&I system, improve the results of the system and improve internal procedures. The other two standards refer to R&D&I project requirements and technology watch.

According to the UNE 166002 standard, to establish a good model and management system for R&D&I activities should be identified and criteria and methods for monitoring, measuring and controlling these activities recognized. In addition, it is necessary that the company document the policy and objectives of R&D&I, the procedures and records required by this standard and the documents necessary to ensure effective R&D&I planning, operation and control. The innovation management system proposed in the UNE 166002 Standard leads to the analysis of a series of requirements, including the R&D&I management model and system, the responsibilities of senior management, resource management, the Research, Development and Innovation activities carried out by the company and, finally, the results obtained.

However, while many studies have focused on the benefits of other standards, there are no generalizable scientific studies that have analyzed the effect of standard 166,002 on business and on product innovation (Martinez-Costa *et al.*, 2019). For example, Manders *et al.* (2016) consider that the standardization of innovation through the ISO 9001 standard generates radical and incremental products innovations, but the relationship between both variables may be influenced by factors such as the extent to which the standard has been adopted, the extent of signaling, the motivation of the company to implement the ISO 9001 standard, the sector and the region in which the company operates, the size of the company, and the standard version (1987, 1994/2000, 2008/2015). Also, Foucart and Li (2021) study the role of technology standards in firms' product innovation in terms of both incremental innovation (within a technology life cycle) and radical innovation (beyond the present technology cycle). They develop a theoretical model which predicts that technology standards can be used by firms as an "insurance" hedging against the risky process of developing new products. This insurance mechanism fosters incremental innovation and product growth especially for those further away from the technological frontier.

Therefore, it is to be assumed, that if companies must develop procedures for its implementation, establish objectives and responsibilities and even, as previously stated, modify their culture, the implementation of this SIMS will have a positive influence on innovation. As an example, the standard itself, in section 4.4.4, states that the portfolio of projects to be undertaken must be planned, monitored and controlled in a methodical manner to optimize the mix of projects under development. There should also be a structured transfer of relevant in-house or external technologies (4.4.5). In general, the standard recommends the use of tools such as technology watch, technology foresight, creativity techniques and internal and external analysis. The problems and opportunities detected (4.4.2 and 4.4.3) through the above tools should be dealt with in a systematic way in order to conclude in a systematic process of analysis and selection of innovation project ideas.

Martinez-Costa *et al.* (2019) confirm the effectiveness of a SIMS base on the UNE 166002:2014 standard on the development of product innovations. This is because this SIMS supplies information for innovation, accelerates the diffusion of innovation, and reduces risks and the time needed to market innovation (Zoo *et al.*, 2017). Moreover, the UNE 166002 can facilitate different types of innovation, promoting an innovative culture, strengthening cooperation and alliances, involving management, providing resources, favoring the creation of new knowledge and lead to changes in products, processes and systems of organization that can be incremental or radical. Also, Mir and Casadesús (2011a, b) consider that the UNE 166002:2006 standard allows better planning, documentation, management and monitoring of R&D&I projects, increases the innovative capacity of the company and further product innovation (Kim and Hwang, 2014).

Other studies, such as Xie *et al.* (2016) consider that efforts to standardize innovation need different types of knowledge and lead to four types of innovation: modular, radical, incremental and architectural (Narayanana and Chen, 2012; Viardot, 2010; Viardot *et al.*, 2016). In this sense, Narayanana and Chen (2012) reveal, implicitly, that knowledge complexity in standardization has the potential to influence architectural innovation at the community level (i.e. competing firms and their technological platforms) and modular innovation within the product offerings. Besides, throughout the standard, emphasis is placed on the fact that organizations must generate new ideas or products, but they must also exploit those already developed products. Likewise, companies must protect and exploit the results of R + D + i activities (sections 4.4.8.2 and 4.4.9). Therefore, the standard indicates that companies must generate radical and incremental product innovations. So, it can be expected that the application of this type of Standard in the company will contribute decisively to an improvement in the management of the innovation process and, consequently, in obtaining both radical and incremental product innovations.

Therefore, we propose to test the following working hypothesis.

H2. The SIMS of the UNE 166002 is positively related to product innovation.

H2a. The SIMS of the UNE 166002 is positively related to incremental product innovation.

H2b. The SIMS of the UNE 166002 is positively related to radical product innovation.

2.3 The standardized innovation management system (SIMS) of the UNE 166000 and performance

The SIMS of the UNE 166002 is configured as a tool aimed at improving company performance. Most of the principles addressed under this Standard are similar to those established in the EFQM Excellence model and are configured as tools for improving results. According to AENOR (2021), "*a system of this type allows organizations to be more innovative and to promote the success of their innovations in products, services, processes, organizational designs or business models, thereby contributing to the improvement of their results, their value and their competitiveness*". More precisely, the implementation of an R&D&I management system provides the organization numerous benefits, for example.

(1) Improves growth, revenues and profits from innovations (Mir and Casadesús, 2011a, b; Pellicer *et al.*, 2012, 2014; Yepes *et al.*, 2016).

(2) Brings new ideas and values to the organization (Kim *et al.*, 2017).

(3) Proactively derives value from a better understanding of future market needs and possibilities (Staudenmayer *et al.*, 2005; Foucart and Li, 2021).

(4) Helps to identify and reduce risks (Zoo *et al.*, 2017).

(5) Harnesses the creativity and collective intelligence of the organization (Viardot *et al.*, 2021).

(6) Derives value from collaboration with other partners for R&D&I activities (Ranganathan *et al.*, 2018; Wen *et al.*, 2020).

(7) Stimulates the involvement of the members of the organization and encourages teamwork and collaboration (Viardot *et al.*, 2021).

It is clear, for example, how important certain aspects such as management responsibility (point 4.2) or resource management (point 4.3) are for the success of the company. It is therefore reasonable to assume that the implementation of this standard will lead to an improvement in organizational performance, either directly or through the development of innovations. In this line, Caetano (2017) demonstrates the importance of standardization to contribute to organizational innovation and to increase competitiveness and realization of value. The author considers that standardization can enhance organizational capabilities in order to be aligned with national and international best practices as well as to develop internal competences, routines and processes that can leverage an innovation journey toward excellent results. Also, Naidoo (2020) suggests that standardization improves the bottom line of an organization, then this offers benefits that have a positive effect on organizational efficiency by improving process performance and ultimately improving market success (Featherston *et al.*, 2016).

In this sense, Mir *et al.* (2016) establish that the implementation of a SIMS, for example under the UNE 166002 standard, improves innovative capability and BP as seen in previous case studies (Correa *et al.*, 2007; Pellicer *et al.*, 2008, 2012, 2014; Law, 2010; Mir and Casadesús, 2011a, b; Yepes *et al.*, 2016). Moreover, Mir and Casadesús (2011a, b) believe that the UNE 166002:2006 standard facilitates relations with government agencies in order to receive subsidies, soft credit or to justify tax deductions for R&D&I projects. So, Companies with this certificate get higher evaluations. Based on these previous reflections, we propose the following positive relationship between the SIMS and organizational performance.

H3. The SIMS of the UNE 166002 is positively related to organizational performance.

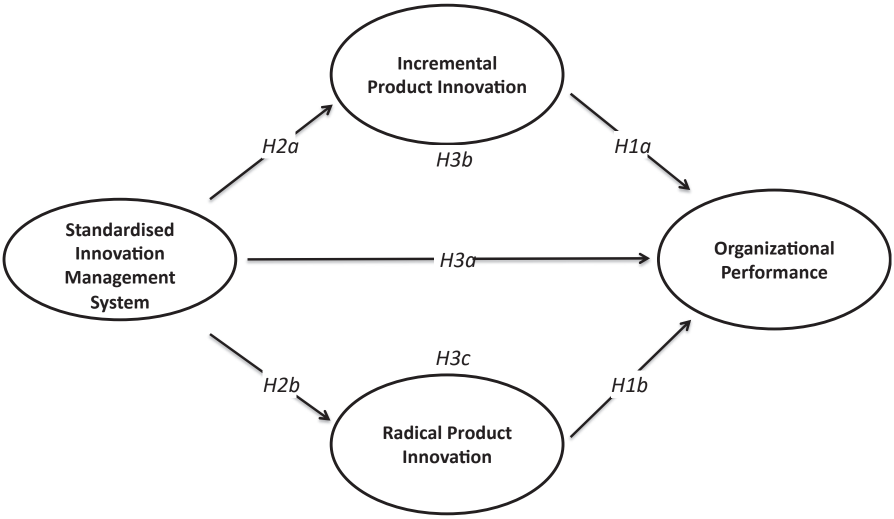
H3a. The SIMS of UNE 166002 is positively and directly related to organizational performance.

However, and according to the literature review, both incremental and radical product innovations could mediate this relationship, what could also suggest the existence of indirect effects. Correspondingly, we hypothesize that.

H3b. Incremental product innovation mediates the relationship between SIMS of the UNE 166002 and organizational performance.

H3c. Radical product innovation mediates the relationship between SIMS of the UNE 166002 and organizational performance.

The following graph shows the model that includes the hypotheses raised in this study (see Figure 1).



Source(s): Authors' own construction

Figure 1.
Theoretical model

3. Methodology

3.1 Population and sample

The population used in this study included Spanish international manufacturing organizations that were active (eliminating those in receivership or bankruptcy proceedings), had more than 50 employees according to the SABI (Sistema de Análisis de Balances Ibéricos) database and were at least 5 years old. This resulted in a population of 4,265 companies. We chose this country to carry out the research because we can obtain data from international companies from this country that belongs to the European Union. The sample is composed of organizations that operate in many markets. Spain's macroeconomic performance has remained remarkable: the country has experienced a 13th consecutive year of strong growth. This economic vitality has had the effect of narrowing the gap in per capita GDP with the euro area average from 20% to under 12% over the past decade. GDP growth is projected to slow to 2.1% in 2023 and 1.9% in 2024, after two years of strong post-COVID growth of 5.5%. Lower inflation and a resilient labor market will support households' consumption. Stronger external demand will underpin export growth. Besides, today the economy of Spain is the fifth largest in Europe, accounting for around 8% of EU output (OECD, 2023).

The information was collected through a structured questionnaire previously tested using a company specialized in the sector under the supervision of the authors. Starting with a telephone contact, the operations manager or, failing that, the company's general manager was contacted. Subsequently, via a website, e-mail or even a telephone interview, the manager answered the questionnaire. A total of 1,154 companies were randomly contacted in order to reach an acceptable number of 225 valid questionnaires. 169 companies expressly declined to participate in the study, 675 companies were not contacted, and the remaining 85 companies did not answer the telephone or had an answering machine. This represents a response rate of 19.5% of the companies contacted.

A series of precautionary measures were established before the collection phase. First, the questionnaire was developed based on the recommendations of the literature and was reviewed by five academics from different universities. Second, a pretest was conducted in ten companies from different sectors to refine the questionnaire and checked that all concepts were understood. The participants reported that there were no misunderstandings about the content of the questionnaire, which implied that the definitions of the different constructs were clear.

We focused on a sample of 225 companies since it is suitable for the use of the structural equation methodology (Cook and Forzani, 2023; Hair *et al.*, 2006) and even more when the number of observations is less than 250 (Reinartz *et al.*, 2009). In addition, this study complies with the commonly used pattern of the "rule of ten", where the simple size requirement would be 10 times the most complex regression relationship in the model (Chin, 1998). Moreover, and although PLS packages do not include Monte Carlo simulation features that can be used for power analyses, several authors state that a sample size of at least 200 would be enough to ensure sufficient statistical power (Felipe *et al.*, 2017; Hoyle, 1995).

The representativeness of the sample with respect to the composition by sectors was verified through Pearson's correlation coefficient (0.767 significant at 1%), which correlates the variable for organizations in the population with the same variable in the sample companies. This means that the sample can be considered a good representation of the population regarding the distribution across industries (see Table 2).

	Mean	25th percentile	50th percentile	75th percentile
Company age	35.17	22.25	34.00	47.00
Employees	189.69	93.00	139.50	243.75
Operating income (million €)	81.23	31.08	47.96	96.08
Profit for the year (millions €)	1.60	0.24	1.14	3.21
Total assets (million €)	64.61	23.88	39.84	72.81
Economic profitability (%)	2.93	0.72	3.75	9.29
Financial profitability (%)	12.28	2.23	9.96	19.99
Net sales turnover (%)	6.64	−4.35	3.60	12.92
Sample sectors	26.0% Food and beverage industry; 4.5% Textile industry; 2.5% Wood and cork industry; 4.5% Paper and printing industry; 11.0% Chemical industry; 3.0% Manufacture of pharmaceutical products; 8.0% Manufacture of rubber and plastic products; 4.5% Manufacture of non-metallic mineral products; 8.0% Manufacture of iron, steel and ferro-alloy products; 8.5% Manufacture of metal products; 3.5% Manufacture of electrical material and equipment; 5.0% Manufacture of machinery; 11.0% Manufacture of motor vehicles, trailers and semi-trailers Total: 225			

Source(s): Authors' own construction

Table 2.
Sample characteristics

In the same way, representativeness in terms of size was also analyzed, through an analysis of variance using the measure of the number of employees of each company. This analysis has shown that the population and the sample are not significantly different in size ($F = 0.034$, $p = 0.854$). Also, the results of the ANOVA analysis did not show that the companies in the population and the sample were different in terms of the financial results variables (ROA) of the company ($F = 0.724$, $p = 0.395$). Therefore, generally, it can be concluded that no evidence of differences between the sample and the population were found, which is consistent with the purpose of this research.

3.2 Measures

The design of the questionnaire was based on the literature review. In the research model, all variables correspond to first-order factors with multi-item scales using a five-point Likert scale (1 = "Strongly Disagree"; 5 = "Strongly agree") for management perception. The variables used are as follows:

3.2.1 Innovation management system. Following the methodology used in the application of Standard 166,002 on innovation management, we have processed this system as a formative construct, created from 15 indicators that form the main requirements of the company for proper innovation management. These indicators are taken directly from AENOR Standard 166,002 (AENOR, 2021), as has been done in other previous studies (Martínez-Costa *et al.*, 2019).

3.2.2 Radicality of innovation. In this research four indicators have been used to measure both incremental and radical product innovation. These scales are taken from the study of Jansen *et al.* (2006). These measures have been treated as reflective.

3.2.3 Organizational performance. Four final measures have been collected, after scale refinement, referring to the company's operational performance based on the scale proposed in the study of Peng *et al.* (2008). The respondents were asked about their organizational performance in aspects such as unit cost of manufacturing, customer satisfaction, or flexibility to change product mix.

3.2.4 Control variables. Two control variables have been included. Firm size has been measured as the number of workers in the sample. The age of the company has been measured as the number of years since its incorporation. Both variables have been recoded to the same scale as the rest of the variables.

The impact of common method bias was assessed using post hoc approaches. This potential problem was tested with the Harman single-factor test (Podsakoff and Organ, 1986). The results of the analysis of unrotated principal component indicated that common method variance of the common method was not a serious problem in our research because there were several factors with an eigenvalue greater than 1.

3.3 Analysis

Partial Least Squares through structural equation methodology using the statistical program SmartPLS 4 (Ringle *et al.*, 2005) was used to perform the hypothesis testing. PLS is a regression-based structural equation modeling (SEM) technique that makes no assumptions about data distributions. Structural equation modelling employs a principal component-based estimation approach (Chin, 1998; Hair *et al.*, 2020; Sarstedt *et al.*, 2023). In this method, sample size plays an important role in the estimation and interpretation of results. Some researchers have established that 200 observations allow estimates to be made with adequate sensitivity. It is the so-called "critical sample size" (Hair *et al.*, 2006). In addition, this technique is recommended when the number of observations is below 250 (Reinartz *et al.*, 2009), when model uses formative indicators and data is non-normal (Henseler, 2017). The composite model is based on the assumption that the construct is composed of indicators or elements as a linear combination of them. The relationships between indicators and the construct are not cause effect. In fact, PLS-SEM always uses the modelling of variables as compounds.

To ensure adequate quality in the measures used in the study, several criteria were evaluated for reflective and formative constructs. Firstly, and for the reflective scales, all the loading from items of the reflective constructs are below 0.7 (see Table 3), what ensures individual reliability in the measurement model.

Moreover, the reliability of the measurement scales was verified with Cronbach's alpha coefficient, obtaining in all cases a value above 0.7, considered adequate by the literature.

Items	Coef	Std Des	*T*-value	*p*-value
Standardized innovation management system[(a)]				
Actively promotes the R&D&I policy	0.122	0.147	0.830	0.203
It tries to continuously improve its R&D&I policy	0.178	0.183	0.969	0.166
Collects the needs and expectations of the interested parties in the R&D&I process	0.082	0.150	0.547	0.292
Establishes the R&D&I objectives and the plans to meet them	0.220	0.172	1.278	0.101
Try to ensure that the entire organization is aware of the company's R&D&I policy	−0.324	0.175	1.854	0.032
There is an area in charge of managing R&D&I	−0.104	0.150	0.694	0.244
Provides sufficient resources to manage R&D&I	0.348	0.195	1.787	0.037
It has the necessary infrastructure to carry out R&D&I activities	0.131	0.166	0.790	0.215
Provides training to personnel involved in R&D&I activities	0.012	0.173	0.072	0.471
Motivates and excites the personnel involved in R&D&I activities	0.262	0.164	1.596	0.055
It has a system that captures useful technological information for the company	−0.104	0.132	0.790	0.215
The results of R&D&I projects and activities are adequately protected and exploited	0.145	0.149	0.974	0.165
Tools are available for the protection and exploitation of the results of R&D&I activities	0.096	0.158	0.606	0.272
Control systems or audits of R&D&I activities are carried out	0.048	0.170	0.285	0.388
Each of its R&D&I activities is documented	0.073	0.175	0.415	0.339
Radical innovation[(b)]				
We invent new products and services	0.771	0.040	19.115	0.000
We experiment with new products and services in our local market	0.720	0.073	9.925	0.000
We commercialize products and services that are completely new to our unit	0.759	0.046	16.560	0.000
We frequently utilize new opportunities in new markets	0.709	0.052	13.638	0.000
Incremental innovation[(b)]				
We frequently refine the provision of existing products and services	0.891	0.016	54.431	0.000
We regularly implement small adaptations to existing products and services	0.873	0.020	44.637	0.000
We introduce improved, but existing products and services for our local market	0.838	0.032	26.000	0.000
Our unit expands services for existing clients	0.718	0.047	15.114	0.000
Performance[(b)]				
Conformance to product specifications	0.836	0.026	32.347	0.000
Flexibility to change volume	0.883	0.020	43.215	0.000
Flexibility to change product mix	0.855	0.027	31.791	0.000
Speed of new product introduction into the plant (development lead time)	0.888	0.017	53.398	0.000

Note(s): Coef. show weights for formative constructs[(a)] or loading for reflective constructs[(b)]
Source(s): Authors' own construction

Table 3.
Measurement model

Composite reliability ranged from 0.726 to 0.890, above the threshold of 0.7 (Nunnally, 1978). An examination of the average variance extracted (AVE) revealed that all constructs exceeded the 0.50 cut-off set by the literature (Fornell and Larcker, 1981).

Moreover, the R^2 value for the endogenous constructs exceeds the recommended minimum value of 0.1, which shows that the developed model is suitable for hypothesis testing. Next, the discriminant validity of the measures was assessed. As Fornell and Larcker (1981) suggested, the AVE for each construct should be greater than the squared latent factor correlations between pairs of constructs (see Table 4). Consequently, all variables were found to show satisfactory discriminant validity. In summary, our model has good reliability, convergent validity and discriminant validity.

Secondly, the innovation management system variable has been configured as a formative scale. The analysis of the measurement model in this case would include the analysis of the weights of each dimension (see Table 3), as well as an analysis of the absence of multicollinearity, in order to avoid redundant dimensions or dimensions that measure similar aspects of effectiveness (Cheah *et al.*, 2018). To this end, we assessed the weights of each of the 15 items that make up this construct, which indicate the degree of contribution of the formative indicators to the construct to which they are linked, testing their significance for $p < 0.05$ of the two-tailed t-statistic (Urbach and Ahlemann, 2010). However, although several items had a low significance, their elimination is not recommended as it would drop part of the value of the exogenous construct (Roberts and Thatcher, 2009). Furthermore, the absence of multicollinearity among the formative indicators was tested by analyzing the variance inflation factor (VIF) (range between 2.103 and 3.244) below the recommended values of 5 (Belsley, 1991; Roberts and Thatcher, 2009).

4. Results

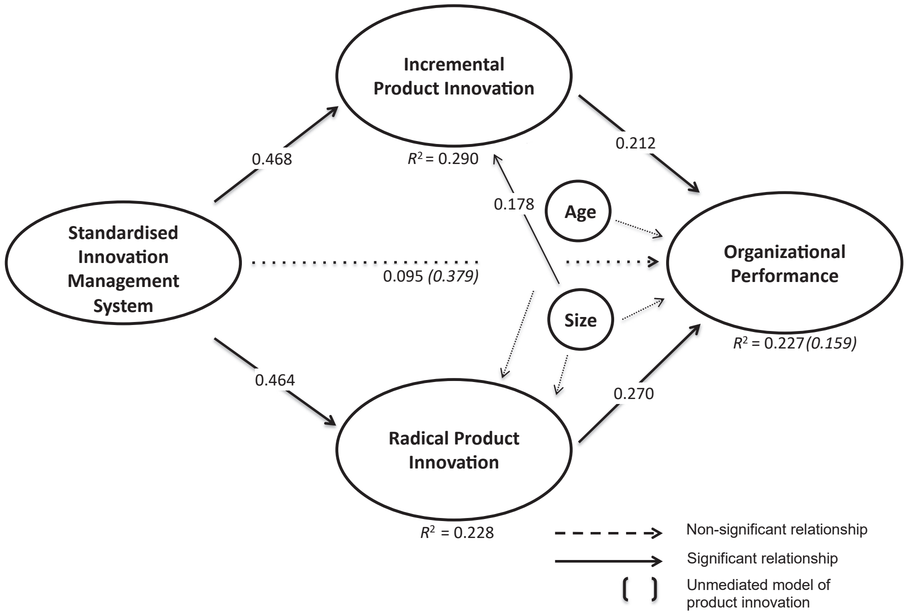
To test our hypotheses, SmartPLS 4 has been used with the bootstrap resampling method (Chin, 1998). According to Podsakoff and Organ (1986), PLS avoids many of the restrictive assumptions underlying maximum likelihood techniques. Also, PLS is insensitive to sample size considerations, dealing with very small or very large samples more easily than a structural equation model does. This is why it is recommended when the number of observations is less than 250 (Reinartz *et al.*, 2009). In addition, PLS handles both reflective and formative constructs (Hair *et al.*, 2006), as is the case in this research. Figure 2 shows the results of the proposed model after the literature review.

As shown in Table 5, most of the hypotheses proposed in this research are accepted. Thanks to the resampling process with 5,000 subsamples, the importance of interaction effects can be observed (Chin, 1998). Besides, first, to confirm the measurement model, several tests have been

	Statistics				Correlations				
	AVE	C_R	α	R^2	1	2	3	4	5
1. Increm. Prodt Innv	0.548	0.829	0.724	0.254	*0.740*	0.654	0.504	0.143	0.296
2. Radical Prodt Innv	0.693	0.900	0.851	0.226	0.515	*0.833*	0.485	0.086	0.182
3. Org. Performance	0.749	0.923	0.888	0.227	0.408	0.429	*0,866*	0.033	0.177
4. Size		[a]			−0.121	−0.083	0.009	*−0.124*	−0.083
5. Age					0.668	0.301	0.272	0.346	*0.194*

Note(s): AVE = Average extracted variance; CR=Composite Reliability; α = Cronbach's alpha; The diagonal of the covariances (in italic) captures the square root of the variance shared between the constructs and their measures. Below diagonal elements are the correlations between constructs. Above diagonal elements are the Heterotrait–Monotrait Ratio (HTMT) values; [a] = One indicator only
Source(s): Authors' own construction

Table 4.
Psychometric properties and correlation matrix of the reflective constructs



Source(s): Authors' own construction

Figure 2. Results of the proposed model

developed (Henseler *et al.*, 2016). Specifically, these analyses (saturated model) provided standardized root mean squared residual (SRMR = 0.044), unweighted minimum squares discrepancy (dULS = 0.854), geodetic discrepancy (dG = 0.389) and non-normed fit index (NNFI = 0.886) values within acceptable limits (values less than the percentile levels based on 95% bootstrapping). This implies that the model has an acceptable adjustment in PLS-SEM (Albort-Morant *et al.*, 2018).

The results of the first hypothesis indicate that both incremental ($\beta = 0.212, p < 0.05$) and radical product innovation ($\beta = 0.270, p < 0.05$) influences firm performance. This reaffirms innovation as a powerful tool to improve the profitability of the company. This strengthens previous literature in this field.

Secondly, the effectiveness of an integrated innovation management system based on the UNE 166002 standard on the development of innovations with different degrees of radicality has been tested. The results provide strong evidence of a positive relationship between this system and incremental ($\beta = 0.468, p < 0.001$) and radical innovations ($\beta = 0.464, p < 0.001$). This allows us to accept the hypothesis put forward and to understand that this system constitutes a strong dynamizer of product innovation in the company. Therefore, the results indicate that Standard 166,002:2021 should be considered as a subsystem or element of innovation systems theory, since the norm facilitates the incremental and radical innovations to the organizations.

Thirdly, the results do not show a direct effect of the innovation management system on operational performance in the model where mediation exists ($\beta = 0.095, p > 0.10$). However, when the model excludes the innovation variables and confronts the innovation management system with the results directly, a clear positive effect does appear ($\beta = 0.379, p < 0.001$), although there is a loss of explanation of the variance depending on it (going from an R^2 of 0.227 to 0.156).

Finally, these data show the existence of a total mediation by innovation in the relationship between the application of the Standard and the results. Consequently, it can be stated that the Standard facilitates the improvement of performance indirectly through the

Model relationships	Path value	St-Dev	T-value	p-values	LL	UL	Empirical evidence
Main hypothesis							
H1a: Incremental Prodt Innv → O. Performance	0.212	0.116	1.836	0.033	0.022	0.406	Yes
H1b: Radical Prodt Innv → O. Performance	0.270	0.112	2.415	0.008	0.068	0.433	Yes
H2a: SIMS → Incremental Prodt Innv	0.468	0.075	6.262	0.000	0.363	0.608	Yes
H2b: SIMS → Radical Prodt Innv	0.464	0.067	6.958	0.000	0.383	0.601	Yes
H3a: SIMS → O. Performance	0.095	0.121	0.787	0.216	−0.077	0.318	No
Control variables							
Age → Incremental Prodt Innv	−0.082	0.062	1.318	0.094	−0.181	0.025	
Age → Radical Prodt Innv	−0.063	0.065	0.979	0.164	−0.166	0.046	
Age → O. Performance	0.071	0.069	1.027	0.152	−0.053	0.177	
Size → Incremental Prodt Innv	0.178	0.055	3.268	0.001	0.080	0.258	
Size → Radical Prodt Innv	0.069	0.062	1.115	0.132	−0.043	0.163	
Size → O. Performance	0.060	0.069	0.866	0.193	−0.056	0.170	
Indirect effects							
H3b: SIMS → Incremental Prodt Innv → O. Performance	0.125	0.053	2.363	0.009	0.035	0.210	Yes
H3c: SIMS → Radical Prodt Innv → O. Performance	0.099	0.066	1.497	0.067	0.010	0.227	Yes
Unmediated model							
SIMS → O. Performance	0.379	0.064	5.956	0.000	0.345	0.551	Yes
Age → O. Performance	0.108	0.060	1.792	0.037	0.003	0.199	
Size → O. Performance	0.031	0.069	0.453	0.325	−0.086	0.141	

Note(s): LL = Lower level confidence interval; UL = Upper level confidence interval
Source(s): Authors' own construction

Table 5.
Structural model

development of incremental or radical product innovations. Table 5 shows the indirect effects of SIMS on organizational performance through both incremental ($\beta = 0.195$, $p < 0.01$) and radical ($\beta = 0.099$, $p = 0.067$) product innovation. These results indicate that hypothesis three is fulfilled but this mediation occurs mainly through incremental product innovation, since the mediating effect of radical innovation is weaker.

5. Discussion, implications, and conclusions

5.1 Discussion and implications

Product innovation PI is a fundamental element for companies immersed in dynamic environments or turbulent markets that constantly need to incorporate improvements to their products so that they do not quickly become obsolete. This is why innovation facilitates the exploration of new competencies that ensure the future survival of the company and a defence mechanism against competitors (Huesig and Endres, 2019). Therefore, it is important that companies adopt innovative behaviour, to adapt to continuous changes that occur in customer needs and force them to develop new and radical products to maintain their results and their competitive position (Hervás-Oliver *et al.*, 2018; Bodlaj and Čater, 2019).

The literature on product innovation highlights its benefits for the organization. In many companies, the ability to successfully develop new products is the key to maintaining competitive advantage (Forés and Camisón, 2016; Popa *et al.*, 2017). Many studies have found positive evidence between firm performance and the outcome of product innovations (Zhou, 2006; Aragón-Correa *et al.*, 2007; Oke, 2007; Sawatani, 2022) or have demonstrated the positive effect of product innovation on performance (Roberts, 1999; Schulz, 2001; Oke, 2007; Ledwith and O'Dwyer, 2009; Calantone *et al.*, 2010; Rosenbusch *et al.*, 2011; Rubera and kirca, 2012). However, there are doubts about how this innovation process should be managed so that the desired results are obtained (Shan *et al.*, 2016). In this sense, Mavroeidis and Tarnawska (2017) and Mir *et al.* (2016) point out that efficient innovation can be managed through SIMSs. These SIMSs are sets of standards designed to help organizations in the complex process of innovation, systematize their activities and enhance efficiency of its management. Thus, in recent years, the normative paradigm has changed with the emergence of the first iterations of SIMSs in various countries such as Brazil, Colombia, Denmark, France, Ireland, Spain or the United Kingdom, among others (Martínez-Costa *et al.*, 2019; Mir *et al.*, 2016).

The UNE 166000 Standards pursue the objective of "*guiding organizations in the development, implementation and maintenance of a systematic framework for their R&D&I management practices, all of which are integrated into an R&D&I management system*". According to this standard, companies must generate new ideas or products, but they must also exploit those already developed products (sections 4.4.8.2 and 4.4.9). Therefore, the standard indicates that organizations must generate radical and incremental product innovations. In this sense, Xie *et al.* (2016) believe that efforts to standardize innovation lead to develop incremental and radical innovations, among others. This empirical study has been based on these assumptions, with the aim of analyzing whether the management system suggested with the application of the UNE 166002 Standard contributes to explaining the development of the different types of innovation and the results in the company.

The results obtained have important theoretical and managerial implications. First, this study indicates that both incremental and radical product innovation influence firm performance. Therefore, managers must know that radical and incremental product innovation may improve the company's operational performance. Second, and the most direct implication of this study, is that those companies that are committed to the development of innovations should seriously consider the application of the principles incorporated in Standard 166,002:2021, as an instrument that improves the results of innovation in the organization. Since this SIMS promotes both types of innovations, it improves results directly and indirectly through these product innovations. In this way, managers committed to innovation should know that this standard may provide them a guide that standardizes and facilitates the innovative process. Besides, if they want to improve their results through product innovations using this SIMS, the most appropriate innovations for this are the incremental ones.

Thirdly, the important role of AENOR as the institution that has developed this standard should be highlighted. Norm that could be included in studies that use the theory of innovation systems. Managers interested in innovation should be familiar with this institution and the standards it has created.

Finally, given the characteristics of the sample, Spanish international manufacturing organizations that operate in many markets, it is possible that the results of this study can be extrapolated to other countries.

5.2 Conclusions, limitations, and future research

This research reveals the importance of Standard 166,002:2021 and incremental and radical product innovations. Firstly, the findings show that the development of innovations is a clear dynamizer of the company's operating results, which configures innovation as a source of competitive advantages. These results are supported by both incremental and radical product innovations and, therefore, open up different ways to improve the company's profitability. This finding is consistent with other previous studies. For example, Bhaskaran (2006) points out that incremental product innovations offer competitive advantages to small and medium size companies, and these can be adopted rapidly and increase profitability and sales. Other authors consider that these innovations are more predictable in terms of outcomes (Slater *et al.*, 2014), minimizes costs (Wu *et al.*, 2019) and are the main source of income for many companies (Leifer *et al.*, 2000; Sorescu *et al.*, 2008; Oerlemans *et al.*, 2022). Besides, radical product innovations allow firms to earn monopoly profit, a competitive advantage and expand into new markets (Leifer *et al.*, 2000; Coccia, 2017).

Secondly, the Standard 166,002:2021 becomes a strong driver for both types of innovation. This means that the application of the principles suggested in the Standard has a global influence on innovation, both in the case of small improvements in the company's products and in the development of more profound changes that break with the existing trend. The study of Martinez-Costa *et al.* (2019) confirms the effectiveness of a SIMS base on the UNE 166002:2014 standard on the development of product innovations, but not on the radical and incremental innovation of products. In fact, the UNE 166002:2021 standard indicates in its sections 4.4.8.2 and 4.4.9 that organizations must generate new ideas or products and they must also exploit those already developed products. Moreover, according to Zoo *et al.* (2017) this SIMS supplies information for innovation, accelerates the diffusion of innovation, and reduces risks and the time needed to market innovation. In this sense, Mir and Casadesús (2011b) point out that the UNE 166002:2006 standard allows better planning, documentation, management and monitoring of R&D&I projects, increases the product innovation capacity (Kim and Hwang, 2014). Also, many studies consider that efforts to standardize innovation lead to different types of innovation, among them radical and incremental products innovation (Narayanana and Chen, 2012; Viardot, 2010; Viardot *et al.*, 2016).

Thirdly, an indirect benefit of the application of the Standard has been found. In this case, although it does not have a direct impact on the results, when using the full proposed model, the advantages of implementing the Standard on the creation of new products that will ultimately improve the company's performance are clear. In fact, SIMS has an indirect effect on organizational performance mainly through incremental product innovation, since the mediating effect of radical innovation is weaker.

Moreover, when the model excludes the innovation variables and confronts the innovation management system with the results directly, a clear positive effect does appear. This result is consistent with some previous research that has highlighted the importance of standardization to improve BP (Featherston *et al.*, 2016; Mir *et al.*, 2016; Caetano, 2017; Naidoo, 2020).

Finally, these results reveal the importance of this standard, so researchers should include it when proposing models to study innovation from the point of view of innovation systems theory.

The study is not without limitations. Firstly, the survey is addressed to the company's operations manager. Although this manager has a comprehensive view of this area of the company, biases may arise from the point of view of the existence of a single source of information or biased toward his or her field. Secondly, the instrument used to measure the Standard was a series of questions that would never capture all the richness of the practices that an in-depth analysis would entail, although they do provide a clear picture of the principles followed by the company. Finally, the sample used is cross-sectional, whereas innovation management implies a broad implementation process, while the principles suggested in the Standard require continuous implementation.

For this reason, the following lines are proposed for future research. Firstly, longitudinal studies should be carried out in order to analyze the changes in the practices adopted by the company as a result of the Standard, the process of developing innovations and their results. Secondly, it would be appropriate to send the questionnaire to different sources within the same organization, i.e. different managers from different areas of the company. Finally, it would be convenient to include different variables that could help to understand how the complementarities derived from the joint application of the different types of innovation influence the results, but at the same time conditioned by contextual variables that may act as moderators in this relationship.

References

Abetti, P.A. (2002), "From science to technology to products and profits: superconductivity at general electric and intermagnetics general (1960-1990)", *Journal of Business Venturing*, Vol. 17 No. 1, pp. 83-98, doi: 10.1016/S0883-9026(00)00049-5.

AENOR (2021), *R&D&I Management: Requirements of the R&D&I Management System. Une 166002*, AENOR, Madrid.

Agostini, L. and Nosella, A. (2017), "Enhancing radical innovation performance through intellectual capital components", *Journal of Intellectual Capital*, Vol. 18 No. 4, pp. 789-806, doi: 10.1108/JIC-10-2016-0103.

Albort-Morant, G., Henseler, J., Cepeda-Carrión, G. and Leal-Rodríguez, A.L. (2018), "Potential and realized absorptive capacity as complementary drivers of green product and process innovation performance", *Sustainability*, Vol. 10 No. 2, pp. 381-400, doi: 10.3390/su11010223.

Ali, A. (2000), "The impact of innovativeness and development time on new product performance for small firms", *Marketing Letters*, Vol. 11 No. 2, pp. 151-163, doi: 10.1023/A:1008142823872.

Aragón-Correa, J.A., García-Morales, V.J. and Cordón-pozo, E. (2007), "Leadership and organisational learning's role on innovation and performance: lessons from Spain", *Industrial Marketing Management*, Vol. 36 No. 3, pp. 349-359, doi: 10.1016/j.indmarman.2005.09.006.

Atuahene-Gima, K. (2005), "Resolving the capability-rigidity paradox in new product innovation", *Journal of Marketing*, Vol. 69 No. 4, pp. 61-83, doi: 10.1509/jmkg.2005.69.4.61.

Belsley, D.A. (1991), *Conditioning Diagnostics: Collinearity and Weak Data in Regression*, Wiley & Sons, New York, doi: 10.1080/00401706.1993.10484997.

Bertels, H.M.J., Kleinschmidt, E.J. and Koen, P.A. (2011), "Communities of practice versus organizational climate: which one matters more to dispersed collaboration in the front end of innovation?", *Journal of Product Innovation Management*, Vol. 28 No. 5, pp. 757-772, doi: 10.1111/j.1540-5885.2011.00836.x.

Bhaskaran, S. (2006), "Incremental innovation and business performance: small and mediumsize food enterprises in a concentrated industry environment", *Journal of Small Business Management*, Vol. 44 No. 1, pp. 64-80, doi: 10.1111/j.1540-627X.2006.00154.x.

Blundell, R.W., Griffith, R. and Van Reenen, J. (1999), "Market share, market value, and innovation in a panel of British manufacturing firms", *Review of Economic Studies*, Vol. 66 No. 3, pp. 529-554, available at: http://hdl.handle.net/10.1111/1467-937X.00097

Bodlaj, M. and Čater, B. (2019), "The impact of environmental turbulence on the perceived importance of innovation and innovativeness in SMEs", *Journal of Small Business Management*, Vol. 57 No. sup2, pp. 417-435, doi: 10.1111/jsbm.12482.

Bouncken, R., Fredrich, V., Ritala, P. and Kraus, S. (2018), "Coopetition in new production development alliances: advantages and tensions for incremental and radical innovation", *British Journal of Management*, Vol. 29 No. 3, pp. 391-410, doi: 10.1111/1467-8551.12213.

Brattstrom, A., Lofsten, H. and Richtner, A. (2015), "Similar, yet different: a comparative analysis of the role of trust in radical and incremental product innovation", *International Journal of Innovation Management*, Vol. 19 No. 4, pp. 1-33, doi: 10.1142/S1363919615500437.

Brown, S.L. and Eisenhardt, K.M. (1995), "Product development: past research, present findings, and future directions", *Academy of Management Review*, Vol. 20 No. 2, pp. 343-378, available at: https://www.jstor.org/stable/258850

Caetano, I. (2017), "Standardization and innovation management", *Journal of Innovation Management*, Vol. 5 No. 2, pp. 8-14, available at: http://hdl.handle.net/10216/105431

Calantone, R.J., Harmancioglu, N. and Droge, C. (2010), "Inconclusive innovation "returns": a meta-analysis of research on innovation in new product development", *Journal of Product Innovation Management*, Vol. 27 No. 7, pp. 1065-1081, doi: 10.1111/j.1540-5885.2010.00771.x.

Chaharbaghi, K. and Newman, V. (1996), "Innovating: towards an integrated learning model", *Management Decision*, Vol. 34 No. 4, pp. 5-13, doi: 10.1108/00251749610115107.

Chandy, R.K. and Tellis, G.J. (1998), "Organizing for radical product innovation: the overlooked role of willingness to cannibalize", *Journal of Marketing Research*, Vol. 35 No. 4, pp. 474-487, available at: https://www.jstor.org/stable/3152166

Cheah, J.-H., Sarstedt, M., Ringle, C.M., Ramayah, T. and Ting, H. (2018), "Convergent validity assessment of formatively measured constructs in PLS-SEM: on using single-item versus multi-item measures in redundancy analyses", *International Journal of Contemporary Hospitality Management*, Vol. 30 No. 11, pp. 3192-3210, doi: 10.1108/IJCHM-10-2017-0649.

Chin, W.W. (1998), "The partial least squares approach to structural equation modeling", in Marcoulides, G.A. (Ed.), Lawrence Erlbaum Associate, Mahwah, NJ.

Coccia, M. (2017), "Sources of technological innovation: radical and incremental innovation problem-driven to support competitive advantage of firms", *Technology Analysis & Strategic Management*, Vol. 29 No. 9, pp. 1048-1061, doi: 10.1080/09537325.2016.1268682.

Colombo, M.G., Von Krogh, G., Rossi-Lamastra, C. and Stephan, P. (2017), "Organizing for radical innovation: exploring novel insights", *Journal of Product Innovation Management*, Vol. 34 No. 4, pp. 394-405, doi: 10.1111/jpim.12391.

Cook, R.D. and Forzani, L. (2023), "On the role of partial least squares in path analysis for the social sciences", *Journal of Business Research*, Vol. 167, doi: 10.1016/j.jbusres.2023.114132.

Correa, L.C., Yepes, V. and Pellicer, E. (2007), "Factores determinantes y propuestas para la gestión de la innovación en las empresas constructoras", *Revista ingeniería de construcción*, Vol. 22 No. 1, pp. 5-14, doi: 10.4067/S0718-50732007000100001.

Damanpour, F. (1996), "Bureaucracy and innovation revisited: effects of contingency factors, industrial sectors, and innovation characteristics", *Journal of High Technology Management Research*, Vol. 7 No. 2, pp. 150-175, doi: 10.1016/S1047-8310(96)90002-4.

Damanpour, F. and Evan, W. (1984), "Organizational innovation and performance: the problem of organizational lag", *Administrative Science Quarterly*, Vol. 29 No. 3, pp. 392-409, doi: 10.2307/2393031.

Damanpour, F. and Gopalakrishnan, S. (1998), "Theories of organizational structure and innovation adoption: the role of environmental change", *Journal of Engineering and Technology Management*, Vol. 15 No. 1, pp. 1-24, doi: 10.1016/S0923-4748(97)00029-5.

Damanpour, F., Walter, R.M. and Avellaneda, C.N. (2009), "Combinative effects of innovation types and organizational performance: a longitudinal study of service organizations", *Journal of Management Studies*, Vol. 46 No. 4, pp. 650-675, doi: 10.1111/j.1467-6486.2008.00814.x.

Danneels, E. and Kleinschmidt, E.J. (2001), "Product innovativeness from the firm's perspective: its dimensions and their relation with project selection and performance", *Journal of Product Innovation Management*, Vol. 18 No. 6, pp. 357-373, doi: 10.1016/S0737-6782(01)00109-6.

de Clercq, D., Thongpapanl, N. and Dimov, D. (2011), "A closer look at cross-functional collaboration and product innovativeness: contingency effects of structural and relational context", *Journal of Product Innovation Management*, Vol. 28 No. 5, pp. 680-697, doi: 10.1111/j.1540-5885.2011.00830.x.

Deshpandé, R., Farley, J.U. and Webster, F.E. (1993), "Corporate culture. Customer orientation, and innovativeness in Japanese firms: a quadrad analysis", *Journal of Marketing*, Vol. 57 No. 1, pp. 23-37, doi: 10.2307/1252055.

Dewar, R.D. and Dutton, J.E. (1986), "The adoption of radical and incremental innovations: an empirical analysis", *Management Science*, Vol. 32 No. 11, pp. 1422-1433, available at: https://www.jstor.org/stable/2631501

Edquist, C. and Johnson, B. (1997), "Institutions and organisations in systems of innovation", in Edquist, C. (Ed.), *Systems of Innovation-Technologies, Institutions and Organizations*, Pinter Publisher, London.

Eroğlu, I. (2019), "Effects of innovation types on product identities: does radical innovation lead to a more integrated product identity?", *International Journal of Innovation*, Vol. 7 No. 2, pp. 252-272, doi: 10.5585/iji.v7i2.376.

Ettlie, J.E., Bridges, W.P. and O'keefe, R.D. (1984), "Organization strategy and structural differences for radical versus incremental innovation", *Management Science*, Vol. 30 No. 6, pp. 682-695, available at: https://www.jstor.org/stable/2631748

Featherston, C.R., Ho, J.Y., Brévignon-Dodin, L. and Eoin O'Sullivan, E. (2016), "Mediating and catalysing innovation: a framework for anticipating the standardisation needs of emerging technologies", *Technovation*, Vol. 48 No. 49, pp. 25-40, doi: 10.1016/j.technovation.2015.11.003.

Felipe, C.M., Roldán, J.L. and Leal-Rodríguez, A.L. (2017), "Impact of Organizational Culture values on organizational agility", *Sustainability*, Vol. 9 No. 12, pp. 2-23, doi: 10.3390/su9122354.

Fernández, E. (1996), *Innovación, tecnología y alianzas estratégicas: factores claves de la competencia*, Civitas, Madrid.

Forés, B. and Camisón, C. (2016), "Does incremental and radical innovation performance depend on different types of knowledge accumulation capabilities and organizational size?", *Journal of Business Research*, Vol. 69 No. 2, pp. 831-848, doi: 10.1016/j.jbusres.2015.07.006.

Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. XXVII No. 1, pp. 39-50, doi: 10.2307/3151312.

Foucart, R. and Li, Q.C. (2021), "The role of technology standards in product innovation: theory and evidence from UK manufacturing firms", *Research Policy*, Vol. 50 No. 2, pp. 1-14, doi: 10.1016/j.respol.2020.104157.

Freeman, C. (1987), *Technology Policy and Economic Performance: Lessons from Japan*, Pinter Publishers, London.

Geroski, P., Machin, S. and Van Reenen, J. (1993), "The profitability of innovating firms", *RAND Journal of Economics*, Vol. 24 No. 2, pp. 198-212, doi: 10.2307/2555757.

Golder, P.N. and Tellis, G.J. (1993), "Pioneer advantage: marketing logic or marketing legend?", *Journal of Marketing Research*, Vol. 30 May, pp. 158-171, doi: 10.2307/3172825.

Hair, J.F., Anderson, R.L. and Tatham, W.C. (2006), *Multivariate Data Analysis*, Pearson Ed, Upper Saddle River, NJ.

Hair, J.F., Oward, M.C. and Nitzl, C. (2020), "Assessing measurement model quality in PLS-SEM using confirmatory composite analysis", *Journal of Business Research*, Vol. 109, pp. 101-110, doi: 10.1016/j.jbusres.2019.11.069.

He, Z.-L. and Wong, P.K. (2004), "Exploration vs Exploitation: an empirical test of the ambidexterity hypothesis", *Organization Science*, Vol. 15 No. 4, pp. 481-494, doi: 10.1287/orsc.1040.0078.

Hekkert, M.P., Suurs, R.A.A., Negro, S.O., Kuhlmann, S. and Smits, R.E.H.M. (2007), "Functions of innovation systems: a new approach for analysing technological change", *Technological Forecasting and Social Change*, Vol. 74 No. 4, pp. 413-432, doi: 10.1016/j.techfore.2006.03.002.

Henard, D.H. and Szymanski, D.M. (2001), "Why some new products are more successful than others?", *Journal of Marketing Research*, Vol. 38 No. 3, pp. 362-375, available at: https://www.jstor.org/stable/1558530

Henseler, J. (2017), "Bridging desing and behavioral research with variance-based structural equation modeling", *Journal of Advertising*, Vol. 46 No. 1, pp. 178-192, doi: 10.1080/00913367.2017.1281780.

Henseler, J., Hubona, G. and Ray, P.A. (2016), "Using PLS path modeling in new technology research: updated guidelines", *Industrial Management & Data Systems*, Vol. 116 No. 1, pp. 2-20, doi: 10.1108/IMDS-09-2015-0382.

Heras-Saizarbitoria, I., Bernardo, M. and Casadesús Fa, M. (2007), "La integración de sistemas de gestión basados en estándares internacionales: resultados de un estudio empírico realizado en la capv", *Revista de Dirección y Administración de Empresas*, Vol. 14, pp. 155-174, available at: http://hdl.handle.net/10810/9913

Hervás-Oliver, J.L. and Sempere-Ripoll, F. (2015), "Disentangling the influence of technological process and product innovations", *Journal of Business Research*, Vol. 68 No. 1, doi: 10.1016/j.jbusres.2014.04.010.

Hervás-Oliver, J.L., Albors-Garrigos, J., Estelles-Miguel, S. and Boronat-Moll, C. (2018), "Radical innovation in Marshallian industrial districts", *Regional Studies*, Vol. 10 No. 52, doi: 10.1080/00343404.2017.1390311.

Hervás-Oliver, J.L., Parrilli, M.D., Rodríguez-Pose, A. and Sempere-Ripoll, F. (2021), "The drivers of SME innovation in the regions of the EU", *Research Policy*, Vol. 9 No. 50, doi: 10.1016/j.respol.2021.104316.

Hill, C.W.L. and Rothaermel, F.T. (2003), "The performance of incumbent firms in the face of radical technological innovation", *Academy of Management Journal*, Vol. 28 No. 2, pp. 257-274, doi: 10.2307/30040712.

Hoyle, R. (1995), *The Structural Equation Modeling: Concepts, Issues and Applications*, Sage Publications, Thousand Oaks, CA.

Huesig, S. and Endres, H. (2019), "Exploring the digital innovation process: the role of functionality for the adoption of innovation management software by innovation managers European", *Journal of Innovation Management*, Vol. 22, pp. 302-314, doi: 10.1108/EJIM-02-2018-0051.

Hull, C.E. and Covin, J.G. (2010), "Learning capability, technological parity, and innovation mode use", *Journal of Product Innovation Management*, Vol. 27 No. 1, pp. 97-114, doi: 10.1111/j.1540-5885.2009.00702.x.

Hull, C.E. and Rothenberg, S. (2008), "Firm performance: the interactions of corporate social performance with innovation and industry differentiation", *Strategic Management Journal*, Vol. 29 No. 7, pp. 781-789, doi: 10.1002/smj.675.

Hult, G.T.M., Hurley, R.F. and Knight, G.A. (2004), "Innovativeness: its antecedents and impact on business performance", *Industrial Marketing Management*, Vol. 33 No. 5, pp. 429-438, doi: 10.1016/j.indmarman.2003.08.015.

Husain, Z., Dayan, M. and Di Benedetto, C.A. (2016), "The impact of networking on competitiveness via organizational learning, employee innovativeness, and innovation process: a mediation model", *Journal of Engineering and Technology Management*, Vol. 40, pp. 15-28, doi: 10.1016/j.jengtecman.2016.03.001.

Ilmudeen, A., Bao, Y., Alharbi, I.M. and Zubair, N. (2021), "Revisiting dynamic capability for organizations' innovation types: does it matter for organizational performance in China?", *European Journal of Innovation Management*, Vol. 24 No. 2, pp. 507-532, doi: 10.1108/EJIM-06-2019-0144.

Jansen, J.J.P., Van Den Bosch, F.A.J. and Volberda, H.W. (2006), "Exploratory innovation, exploitative innovation, and performance: effects of organizational antecedents and environmental moderatos", *Management Science*, Vol. 52 No. 11, pp. 1661-1674, doi: 10.1287/mnsc.1060.0576.

Jayawarna, D. and Holt, R. (2009), "Knowledge and quality management: an R&D perspective", *Technovation*, Vol. 29 No. 11, pp. 775-785, doi: 10.1016/j.technovation.2009.04.004.

Kihlander, I., Magnusson, M. and Karlsson, M. (2022), "Certification of innovation management professionals: reasons for and results from acquiring certification", *Journal of Innovation Management*, Vol. 10 No. 1, pp. 58-75, doi: 10.24840/2183-0606_010.001_0004.

Kim, D.Y. and Hwang, Y.H. (2014), "Self-certification framework for technological innovation: a case study", *International Journal of Quality & Reliability Management*, Vol. 31 No. 7, pp. 751-763, doi: 10.1108/IJQRM-10-2012-0139.

Kim, D.H., Lee, H. and Kwak, J. (2017), "Standards as a driving force that influences emerging technological trajectories in the converging world of the Internet and things: an investigation of the M2M/IoT patent network", *Research Policy*, Vol. 46 No. 7, pp. 1234-1254, doi: 10.1016/j.respol.2017.05.008.

Kleinschmidt, E.J. and Cooper, R.G. (1991), "The impact of product innovativeness on performance", *Journal of Product Innovation Management*, Vol. 8 No. 4, pp. 240-251, doi: 10.1016/0737-6782(91)90046-2.

Law, N. (2010), *Application of the IUMSS Methodology in an R&D-oriented Nanotechnology Setting*, Master Thesis. Department of Mechanical Engineering. University of Alberta, Alberta, doi: 10.7939/R3V97C.

Ledwith, A. and O'Dwyer, M. (2009), "Market orientation, npd performance, and organisational performance in small firms", *Journal of Product Innovation Management*, Vol. 26 No. 6, pp. 652-661, doi: 10.1111/j.1540-5885.2009.00690.x.

Leifer, R., McDermott, C.M., O'Connor, G.C., Peters, L.S., Rice, M. and Veryzer, R.W. (2000), *Radical Innovation: How Mature Companies Can Outsmart Upstarts*, Harvard Business School Press, Boston, doi: 10.1016/S0148-2963(01)00266-1.

Lu, T.T. and Chen, J.C. (2010), "Incremental or radical? A study of organizational innovation: an artificial world approach", *Expert Systems with Applications*, Vol. 37 No. 12, pp. 8193-8200, doi: 10.1016/j.eswa.2010.05.067.

Lundvall, B.Å. (2010), "In national systems of innovation: toward a theory of innovation and interactive learning", Anthem Press, available at: http://www.jstor.org/stable/j.ctt1gxp7cs.1

Lyer, P., Davari, A., Zolfagharian, M. and Paswan, A. (2021), "Organizational ambidexterity, brand management capability and brand performance", *Journal of Business and Industrial Marketing*, Vol. 36 No. 6, pp. 946-961, doi: 10.1108/JBIM-12-2019-0522.

Mahmoud, M.A., Blankson, C., Owusu-Frimpong, N., Nwankwo, S. and Trang, T.P. (2016), "Market orientation, learning orientation and business performance: the mediating role of innovation", *International Journal of Bank Marketing*, Vol. 34 No. 5, pp. 623-648, doi: 10.1108/IJBM-04-2015-0057.

Manders, B., de Vries, H.J. and Blind, K. (2016), "ISO 9001 and product innovation: a literature review and research framework", *Technovation*, Vol. 48, pp. 41-55, doi: 10.1016/j.technovation.2015.11.004.

Martínez-Costa, M. and Martínez-Lorente, A.R. (2008), "Does quality management foster or hinder innovation? An empirical study of Spanish companies", *Total Quality Management & Business Excellence*, Vol. 19 No. 3, pp. 209-221, doi: 10.1080/14783360701600639.

Martínez-Costa, M., Jiménez-Jiménez, D., Castro-del-Rosario and Yolanda del Pilar (2019), "The performance implications of the UNE 166.000 standardised innovation management system", *European Journal of Innovation Management*, Vol. 22 No. 2, pp. 281-301, doi: 10.1108/EJIM-02-2018-0028.

Mavroeidis, V. and Tarnawska, K. (2017), "Toward a new innovation management standard incorporation of the knowledge triangle concept and quadruple innovation helix model into innovation management standard", *Journal of the Knowledge Economy*, Vol. 8 No. 2, pp. 653-671, doi: 10.1007/s13132-016-0414-4.

Mir, M. (2012), "Gestión de la Innovación y la calidad: rumbo hacia un binomio excelente", *Forum Calidad*, Vol. 235 No. 12, pp. 36-43.

Mir, M. and Bernardo, M. (2012), "Integration of innovation management system standards within existing management systems: a proposed guideline", in Bernardo, M. (Ed.), *Quality Management and beyond: The Current Situation and Future Perspectives. UdG Publicacions. GITASP 8*, Documenta Universitaria, Girona, pp. 121-134.

Mir, M. and Casadesús, M. (2008), "UNE 166002:2006: estandarizar y sistematizar la I+D+i. La norma y la importancia de las TIC en su implementación", *Dyna Ingeniería e Industria*, Vol. 83 No. 6, pp. 325-331, doi: 10.6036/1479.

Mir, M. and Casadesús, M. (2011a), "Normas para la gestión de la innovación: un análisis comparativo", *Dyna Ingeniería e Industria*, Vol. 86 No. 1, pp. 49-58, doi: 10.6036/3857.

Mir, M. and Casadesús, M. (2011b), "Standardised innovation management systems: a case study of the Spanish standard UNE 166002:2006", *Innovar*, Vol. 21 No. 40, pp. 171-187, available at: https://www.redalyc.org/articulo.oa?id=81822453013

Mir, M., Casadesús, M. and Petnji, L.H. (2016), "The impact of standardized innovation management systems on innovation capability and business performance: an empirical study", *Journal of Engineering and Technology Management*, Vol. 41, pp. 26-44, doi: 10.1016/j.jengtecman.2016.06.002.

Mir, M., Llach, J. and Marimon, F. (2014), "Diffusion of the UNE 166002 innovation management standard: a forecast model approach towards internationalization", *TMQ – Techniques, Methodologies and Quality*, Vol. 1 No. 5, pp. 106-125.

Mohammed, Y.M., Mohd, M.S.S., Rahim, O.A. and Yaty, S. (2017), "Does interaction between TQM practices and knowledge management processes enhance the innovation performance?", *International Journal of Quality & Reliability Management*, Vol. 34 No. 7, pp. 955-974, doi: 10.1108/IJQRM-09-2014-0138.

Naidoo, S. (2020), "The mediating effect of standardisation effort on standardisation and innovation to improve organisational efficiency post COVID-19", *International Journal of Business Innovation and Research*, Vol. 28 No. 4, pp. 525-541, doi: 10.1504/IJBIR.2022.124888.

Narayanana, V.K. and Chen, T. (2012), "Research on technology standards: accomplishment and challenges", *Research Policy*, Vol. 41 No. 8, pp. 1375-1406, doi: 10.1016/j.respol.2012.02.006.

Nasaj, M. and Marri, K. (2020), "The influence of soft and hard quality management on innovation performance in UAE service sector", in Abu-Tair, A., Lahrech, A., Al Marri, K. and Abu-Hijleh, B. (Eds), *Proceedings of the II International Triple Helix Summit. THS 2018. Lecture Notes in Civil Engineering*, Springer, Cham, Vol. 43, doi: 10.1007/978-3-030-23898-8_22.

Navarro Cabeza, I.M. (2005), "Normalización y certificación de proyectos y sistemas de gestión de la i+d+i", *Técnica Industrial*, Vol. 256, pp. 38-45.

Nelson, R.R. and Nelson, K. (2002), "Technology, institutions, and innovation systems", *Research Policy*, Vol. 31 No. 2, pp. 265-272, doi: 10.1016/S0048-7333(01)00140-8.

Nieto, M., Alonso-Martínez, D. and González-Álvarez, N. (2022), "Industry and country effects on innovation effort", *European Journal of Innovation Management*, Vol. 25 No. 1, pp. 271-298, doi: 10.1108/EJIM-06-2020-0240.

Nunnally, J.C. (1978), *Psychometric Theory*, McGraw-Hill, New York, doi: 10.1177/014662167900300.

OECD (2005), *Oslo Manual, the Measurement of Scientific and Technological Activities. Proposed Guidelines for Collecting and Interpreting Technological Innovation Data*, OECD EUROSTAT, Paris.

OECD (2023), available at: https://www.oecd.org/economy/spain-economic-snapshot/

Oerlemans, L., Chan, K.Y., Knoben, J. and Vermeulen, P. (2022), "Keep it simple: external resource utilisation and incremental product innovation in resource-challenged South African manufacturing firms", *Industry and Innovation*, Vol. 29 No. 1, pp. 102-130, doi: 10.1080/13662716.2021.1997724.

Oke, A. (2007), "Innovation types and innovation management practices in service companies", *International Journal of Operations & Production Management*, Vol. 27 No. 6, pp. 564-587, doi: 10.1108/01443570710750268.

Omran, M., Khallaf, A., Gleason, K. and Tahat, Y. (2019), "Non-financial performance measures disclosure, quality strategy, and organizational financial performance: a mediating model", *Total Quality Management & Business Excellence*, Vol. 32 No. 7, pp. 1-24, doi: 10.1080/14783363.2019.1625708.

Para-Gonzalez, L., Jiménez Jiménez, D. and Martínez-Lorente, A.R. (2021), "The link between people and performance under the EFQM excellence model umbrella", *Total Quality Management and Business Excellence*, Vol. 32 Nos 3-4, pp. 410-430, doi: 10.1080/14783363.2018.1552516.

Pellicer, E., Yepes, V. and Martínez, G. (2008), "Enhancing R&D&I through standardisation and certification: the case of the Spanish construction industry", *Revista ingeniería de construcción*, Vol. 23 No. 2, pp. 112-121, available at: http://hdl.handle.net/10251/150670

Pellicer, E., Yepes, V. and Rojas, R.J. (2010), "Innovation and competitiveness in construction companies", *Journal of Management Research*, Vol. 10 No. 2, pp. 103-115, available at: http://hdl.handle.net/10251/95402

Pellicer, E., Correa, C.L., Yepes, V. and Alarcón, L.F. (2012), "Organizational improvement through standardization of the innovation process in construction firms", *Engineering Management Journal*, Vol. 24 No. 2, pp. 40-53, doi: 10.1080/10429247.2012.11431935.

Pellicer, E., Yepes, V., Correa, C.L. and Alarcon, L.F. (2014), "Model for systematic innovation in construction companies", *Journal of Construction Engineering and Management*, Vol. 140 No. 4, doi: 10.1061/(ASCE)CO.1943-7862.0000700.

Peng, D.X., Schroeder, R.G. and Shah, R. (2008), "Linking routines to operations capabilities: a new perspective", *Journal of Operations Management*, Vol. 26 No. 6, pp. 730-748, doi: 10.1016/j.jom.2007.11.001.

Podsakoff, P.M. and Organ, D. (1986), "Reports in organizational research: problems and prospects", *Journal of Management*, Vol. 12 No. 4, pp. 531-545, doi: 10.1177/014920638601200408.

Ponsignon, F., Kleinhans, S. and Bressolles, G. (2019), "The contribution of quality management to an organisation's digital transformation: a qualitative study", *Total Quality Management & Business Excellence*, Vol. 30 No. sup1, pp. S17-S34, doi: 10.1080/14783363.2019.1665770.

Popa, S., Soto-Acosta, P. and Martínez-Conesa, I.M. (2017), "Antecedents, moderators, and outcomes of innovation climate and open innovation: an empirical study in SMEs", *Technological Forecasting & Social Change*, Vol. 118, pp. 134-142, doi: 10.1016/j.techfore.2017.02.014.

Popadiuk, S. (2012), "Scale for classifying organizations as explorers, exploiters or ambidextrous", *International Journal of Information Management*, Vol. 32 No. 1, pp. 75-87, doi: 10.1016/j.ijinfomgt.2011.07.001.

Popadiuk, S. and Choo, S.W. (2006), "Innovation and knowledge creation: how are these concepts related?", *International Journal of Information Management*, Vol. 26 No. 4, doi: 10.1016/j.ijinfomgt.2006.03.011.

Prajogo, D.I. (2016), "The strategic fit between innovation strategies and business environment in delivering business performance", *International Journal of Production Economics*, Vol. 171 January, pp. 241-249, doi: 10.1016/j.ijpe.2015.07.037.

Prajogo, D.I. and Hong, S.W. (2008), "The effect of TQM on performance in R&D environments: a perspective from South Korean firms", *Technovation*, Vol. 28 No. 12, pp. 855-863, doi: 10.1155/2014/537605.

Psomas, E., Kafetzopoulos, D. and Gotzamani, K. (2018), "Determinants of company innovation and market performance", *The TQM Journal*, Vol. 30 No. 1, pp. 54-73, doi: 10.1108/TQM-07-2017-0074.

Ranganathan, A.G. and Rosenkopf, L. (2018), "Competition–cooperation interplay during multiform technology coordination: the effect of firm heterogeneity on conflict and consensus in a technology standards organization", *Strategic Manage. J.*, Vol. 39 No. 12, pp. 3193-3221, doi: 10.1002/smj.2786.

Rauter, R., Globocnik, D., Perl-Vorbach, E. and Baumgartner, R.J. (2018), "Open innovation and its effects on economic and sustainability innovation performance", *Journal of Innovation & Knowledge*, Vol. 4 No.4, pp. 226-233, doi: 10.1016/j.jik.2018.03.004.

Reinartz, W., Haenlein, M. and Henseler, J. (2009), "An empirical comparison of the efficacy of covariance-based and variance-based sem", *International Journal of Research in Marketing*, Vol. 26 No. 4, pp. 332-344, doi: 10.1016/j.ijresmar.2009.08.001.

Ringle, C.M., Wende, S. and Will, A. (2005), "Smartpls 2.0 (M3) Beta", University of Hamburg, Hamburg, available at: www.smartpls.de

Roberts, P.W. (1999), "Product innovation, product-market competition and persistent profitability in the U.S. Pharmaceutical industry", *Strategic Management Journal*, Vol. 20 No. 7, pp. 655-670, available at: https://www.jstor.org/stable/3094134

Roberts, N. and Thatcher, J. (2009), "Conceptualizing and testing formative constructs: tutorial and annotated example", *Data Base for Advances in Information Systems*, Vol. 40 No. 3, pp. 9-39, doi: 10.1145/1592401.1592405.

Robinson, W.T. and Min, S. (2002), "Is the first to market the first to fail? Empirical evidence for industrial goods businesses", *Journal of Marketing Research*, Vol. 39, pp. 120-128, doi: 10.1509/jmkr.39.1.120.18938.

Rosenbusch, N., Brinckmann, J. and Bausch, A. (2011), "Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs", *Journal of Business Venturing*, Vol. 26 No. 4, pp. 441-457, doi: 10.1016/j.jbusvent.2009.12.002.

Rubera, G. and Kirca, A.K. (2012), "Firm innovativeness and its performance outcomes: a meta-analytic review and theoretical integration", *Journal of Marketing*, Vol. 76, pp. 130-147, doi: 10.1509/jm.10.0494.

Saeed, S., Yousafzai, S., Paladino, A. and De Luca, L.M. (2015), "Inside-out and outside-in orientations: a meta-analysis of orientation's effects on innovation and firm performance", *Industrial Marketing Management*, Vol. 47, pp. 121-133, doi: 10.1016/j.indmarman.2015.02.037.

Sarstedt, M., Hair, J.F. and Ringle, C.M. (2023), "PLS-SEM: indeed a silver bullet retrospective observations and recent advances", *Journal of Marketing Theory and Practice*, Vol. 31 No. 3, pp. 261-275, doi: 10.1080/10696679.2022.2056488.

Sawatani, Y. (2022), "Knowledge resources and design activities impact on innovation types", *Journal of Innovation Management*, Vol. 10 No. 2, pp. 47-73, doi: 10.24840/2183-0606_010.002_0003.

Schewe, G. (1996), "Imitation as a strategic option for external acquisition of technology", *Journal of Engineering and Technology Management*, Vol. 13 No. 1, pp. 55-82, doi: 10.1016/0923-4748(96)00005-7.

Schulz, M. (2001), "The uncertain relevance of newness: organizational learning and knowledge flows", *Academy of Management Journal*, Vol. 44 No. 4, pp. 661-681, available at: https://www.jstor.org/stable/3069409

Shan, P., Song, M. and Ju, X. (2016), "Entrepreneurial orientation and performance: is innovation speed a missing link?", *Journal of Business Research*, Vol. 69 No. 2, pp. 683-690, doi: 10.1016/j.jbusres.2015.08.032.

Sharma, P. and Salvato, C. (2011), "Commentary: exploiting and exploring new opportunities over life cycle stages of family firms", *Entrepreneurship Theory and Practice*, Vol. 35 No. 6, pp. 1199-1205, doi: 10.1111/j.1540-6520.2011.00498.x.

Shipton, H., West, M.A., Dawson, J., Birdi, K. and Patterson, M. (2006), "Hrm as a predictor of innovation", *Human Resource Management Journal*, Vol. 16 No. 1, pp. 3-27, doi: 10.1111/j.1748-8583.2006.00002.x.

Slater, S., Mohr, J. and Sengupta, S. (2014), "Radical product innovation capabilities: literature review, synthesis, and illustrative research propositions", *Journal of Product Innovation Management*, Vol. 31 No. 3, pp. 552-566, doi: 10.1111/jpim.12113.

Song, M. and Noh, J. (2006), "Best new product development and management practices in the Korean high-tech industry", *Industrial Marketing Management*, Vol. 35 No. 3, pp. 262-278, doi: 10.1016/j.indmarman.2005.04.007.

Song, X. and Thieme, R. (2006), "A cross-national investigation of the r&d-marketing interface in the product innovation process", *Industrial Marketing Management*, Vol. 35 No. 3, pp. 308-322, doi: 10.1016/j.indmarman.2004.09.024.

Sorescu, A.B. and Spanjol, J. (2008), "Innovation's effect on firm value and risk: insights from consumer packaged goods", *Journal of Marketing*, Vol. 72 No. 2, pp. 114-132, doi: 10.1509/jmkg.72.2.114.

Sorescu, A.B., Chandy, R.K. and Prabhu, J. (2003), "Sources and financial consequences of radical innovation: insights from pharmaceuticals", *Journal of Marketing*, Vol. 67 No. 4, pp. 82-102, available at: https://www.jstor.org/stable/30040551

Staudenmayer, N., Tripsas, M. and Tucci, C.L. (2005), "Interfirm modularity and its implications for product development", *Journal of Product Innovation Management*, Vol. 22 No. 4, pp. 303-321, doi: 10.1111/j.0737-6782.2005.00128.x.

Stringer, R. (2000), "How to manage radical innovation", *California Management Review*, Vol. 42 No. 4, pp. 70-88, available at: https://www.proquest.com/scholarly-journals/how-manage-radical-innovation/docview/216150649/se-2

Tan, K.C. (2001), "A structural equation model of new product design and development", *Decision Sciences*, Vol. 32 No. 2, pp. 195-226, doi: 10.1111/j.1540-5915.2001.tb00958.x.

Tontini, G. and Picolo, J.D. (2014), "Identifying the impact of incremental innovations on customer satisfaction using a fusion method between importance-performance analysis and Kano model", *International Journal of Quality & Reliability Management*, Vol. 31 No. 1, pp. 32-52, doi: 10.1108/IJQRM-05-2012-0062.

Urbach, N. and Ahlemann, F. (2010), "Structural equation equation modeling in information systems research using partial least squares", *Journal of Information Technology Theory and Application*, Vol. 11 No. 2, pp. 5-40.

Urbinati, A., Manzini, R., Piacentini, D. and Carretti, C. (2022), "Implementing open innovation for radical innovation: three successful cases in the SAES group", *European Journal of Innovation Management*, Vol. 25 No. 2, pp. 501-522, doi: 10.1108/EJIM-04-2020-0116.

Varis, M. and Littunen, H. (2010), "Types of innovation, sources of information and performance in entrepreneurial SMEs", *European Journal of Innovation Management*, Vol. 13 No. 2, pp. 128-154, doi: 10.1108/14601061011040221.

Viardot, E. (2010), "Achieving market leadership: the next challenge for technology firms from growing countries", *Journal of Technology Management for Growing Economies*, Vol. 1 No. 2, pp. 9-28, doi: 10.15415/jtmge.2010.12010.

Viardot, E., Hashem, M.S. and Chen, J. (2016), "Managing innovation with standardization: an introduction to recent trends and new challenges", *Technovation*, Vols 48-49, pp. 1-3, doi: 10.1016/j.technovation.2016.01.006.

Viardot, E., McCarthy, I. and Chen, J. (2021), "Editorial: standardization in a digital and global world: state-of- the-art and future perspectives", *IEEE Transactions on Engineering Management*, Vol. 68 No. 1, pp. 11-17, doi: 10.1109/TEM.2020.3006302.

Wang, C., Qureshi, I., Guo, F. and Zhang, Q. (2022), "Corporate social responsibility and disruptive innovation: the moderating effects of environmental turbulence", *Journal of Business Research*, Vol. 139, pp. 1435-1450, doi: 10.1016/j.jbusres.2021.10.046.

Weerawardena, J., O'Cass, A. and Julian, C. (2006), "Does industry matter? Examining the role of industry structure and organizational learning in innovation and brand performance", *Journal of Business Research*, Vol. 59 No. 1, pp. 37-45, doi: 10.1016/j.jbusres.2005.02.004.

Wen, J., Qualls, W.J. and Zeng, D. (2020), "Standardization alliance networks, standard-setting influence, and new product outcomes", *Journal of Product Innovation Management*, Vol. 37 No. 2, pp. 138-157, doi: 10.1111/jpim.12520.

Wright, C., Sturdy, A. and Wyliec, N. (2012), "Management innovation through standardization: consultants as standardizers of organizational practice", *Research Policy*, Vol. 41 No. 3, pp. 652-662, doi: 10.1016/j.respol.2011.12.004.

Wu, J., Harrigan, K.R., Ang, S.H. and Wu, Z. (2019), "The impact of imitation strategy and R&D resources on incremental and radical innovation: evidence from Chinese manufacturing firms", *The Journal of Technology Transfer*, Vol. 44, pp. 210-230, doi: 10.1007/s10961-017-9621-9.

Xiao, C. and Zhuang, Z. (2022), "Do R&D tax credits incentivize radical or incremental innovation? Evidence from China", *Sustainability*, Vol. 14 No. 14, pp. 1-17, doi: 10.3390/su14148238.

Xie, Z., Hall, J., McCarthy, I.P., Skitmore, M. and Shen, L. (2016), "Standardization efforts: the relationship between knowledge dimensions, search processes and innovation outcomes", *Technovation*, Vols 48-49, pp. 69-78, doi: 10.1016/j.technovation.2015.12.002.

Yepes, V., Pellicer, E., Alarcon, L.F. and Correa, C.L. (2016), "Creative innovation in Spanish construction firms", *Journal of Professional Issues in Engineering Education and Practice*, Vol. 142 No. 1, pp. 1-10, doi: 10.1061/(ASCE)EI.1943-5541.0000251.

Zairi, M. (1994), "Innovation or innovativeness? Results of a benchmarking study", *Total Quality Management*, Vol. 5 No. 3, pp. 27-43, doi: 10.1080/09544129400000023.

Zhang, H., Wu, F. and Cui, A.S. (2015), "Balancing market exploration and market exploitation in product innovation: a contingency perspective", *International Journal of Research in Marketing*, Vol. 32 No. 3, pp. 297-308, doi: 10.1016/j.ijresmar.2015.03.004.

Zhou, K.Z. (2006), "Innovation, imitation, and new product performance: the case of China", *Industrial Marketing Management*, Vol. 35 No. 3, pp. 394-402, doi: 10.1016/j.indmarman.2005.10.006.

Zoo, H., De Vries, H.J. and Lee, H. (2017), "Interplay of innovation and standardization: exploring the relevance in developing countries", *Technological Forecasting and Social Change*, Vol. 118 Supplement C, pp. 334-348, doi: 10.1016/j.techfore.2017.02.033.

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