ISO 9001 and product innovation: A literature review and research framework

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Abstract

The ISO 9001 standard has been implemented by more than one million organizations in 187 countries, and a substantial number of these organizations aim at achieving product innovation. However, it is still not clear whether ISO 9001 fosters or hinders product innovation, because so far there has been little scientific discussion. Moreover, the conclusions of the studies about the influence of ISO 9001 on product innovation are partly contradictory. This paper aims to solve this controversy and to contribute to the theory by reviewing the literature about the impact of ISO 9001 on product innovation and by developing a framework which can guide future research. This paper also aims to contribute to practice by helping managers understand the relationship between ISO 9001 and product innovation better. We propose that the relationship between ISO 9001 and radical and incremental product innovation performance is influenced by 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).

Keywords: Quality management ISO 9001 Radical product innovation Incremental product innovation Literature review

1. Introduction

This special issue on standardization and innovation deserves to have a study on how the most commonly used standard, the ISO 9001 standard for quality management, affects innovation. The International Organization for Standardization (ISO) published the ISO 9000 series of standards, including ISO 9001, in 1987. This set of standards provided a framework for quality management from manufacturing to delivery. For many firms, the ISO 9001 standard provided the method they were looking for to meet the demands of global competition. Obtaining ISO 9001 certification can be quite expensive, but many firms see it as a worthwhile investment and ISO 9001 has been implemented by over one million organizations in 187 countries (ISO, 2013). A new version of ISO 9001 has been published in the autumn of 2015. However, quality management alone is not enough for the competitiveness and survival of organizations. Innovation has received considerable attention from researchers as it brings competitive advantage to organizations. Nowadays, quality is considered as more of an order qualifier, whereas innovation is considered as an order winner (Prajogo et al., 2007). Therefore, companies aim to achieve both high quality and high innovation performance at the same time in order to increase productivity (e.g. Legros and Galia, 2012) or profit.

Companies implement different quality management practices to increase quality. ISO 9001 being the most commonly used. Companies also expect to increase their innovation performance by implementing ISO 9001. As stated by the chairman of Guardsmark, one of the world largest security service companies (PRNewswire, 2014): “For the last 15 years, we have been committed to the ISO standards program… It recognizes innovation and improvement. That is our goal”.

However, it is not yet clear whether ISO 9001 fosters or hinders product innovation. When companies started to implement ISO 9001, researchers also started to examine its impact. Some research has been conducted on the relationship between ISO 9001 and other quality initiatives such as Total Quality Management (TQM) (Sadikoglu and Zehir, 2010), Malcolm Baldrige National Quality Award (Perdomo-Ortiz et al., 2006; Prajogo and Sohal, 2004), and the European Foundation for Quality Management excellence model (EFQM) (Bayo-Moriones et al., 2011; Santos-Vijande and Alvarez-Gonzales, 2007), but only a limited number of studies which focus specifically on the impact of ISO 9001 on innovation.

The results of existing studies are contradictory. Some studies claim that ISO 9001 has a positive impact on product innovation.
For example, Pekovic and Galia (2009) conducted a survey study among 1146 manufacturing companies in France and show that ISO 9001 has a significantly positive impact on product innovation. However, other studies claim that ISO 9001 has a negative impact and hinders innovation. For example, Benner and Tushman (2002) conducted a longitudinal study in the USA with a sample of 98 firms from the photography industry and 17 firms from the paint industry. They find that process management activities like ISO 9001 hinder radical product innovation, because they focus on mapping processes and incremental improvements.

This research examines how ISO 9001 implementation influences product innovation. In other words, it investigates whether ISO 9001 fosters or hinders product innovation, but does not consider the implementation of ISO 9001 as innovation itself (e.g. Bernardo, 2014). We aim to contribute to theory and practice in several ways. We provide a systematic review of ISO 9001 product innovation literature, discuss the possible impact of ISO 9001 on innovation based on the existing studies, and provide a framework for future research.

Examining the relationship between ISO 9001 and product innovation is also important for managers for several reasons. As mentioned, ISO 9001 has been implemented by over a million companies worldwide. Every year more and more companies jump on the bandwagon and implement ISO 9001 to increase their quality. However, besides having high quality, companies need be innovative to win orders. Therefore, managers need to know if they can achieve better quality and innovation performance at the same time. They need to know whether ISO 9001 hinders product innovation and if so, under what conditions, so that they can take the necessary actions to ensure that their innovation performance is not negatively impacted by ISO 9001 implementation. They also need to know whether ISO 9001 can function as an antecedent for product innovation and if so, under what conditions, so that they can ensure those conditions exist while implementing ISO 9001, and gain both quality and innovation benefits. Managers can get some insights about this relationship from existing studies, but research about the impact of ISO 9001 on product innovation is limited and has reported contradictory results. It is therefore important to explore how these two variables interact and what other factors impact this relationship. We develop a framework to guide both managers and researchers.

The remainder of this paper is organized as follows. Section 2 gives a general introduction to ISO 9001 and product innovation. Section 3 summarizes the literature on the impact of ISO 9001 on product innovation. Section 4 discusses lessons learned from the literature, examines how ISO 9001 impacts product innovation, and explains the factors which influence this relationship. The last section provides the framework that can help managers and researchers to understand the relationship between ISO 9001 and innovation.

2. Theoretical background

2.1. ISO 9001

The ISO 9000 family of standards includes ISO 9000, ISO 9001, ISO 9004, and ISO 19011. ISO 9000 describes the basic concepts and the language used to help organizations to adopt ISO 9001. ISO 9001 specifies the basic requirements for a quality management system and ISO 9004 describes a wider range of objectives for managing the long-term success of the organization. ISO 19011 focuses on auditing quality management systems and environmental management systems (ISO, 2009).

The 1987 version of the ISO 9000 series of standards included three standards for quality assurance: ISO 9001, ISO 9002 and ISO 9003. ISO 9001:1987 was the model for quality assurance in design, development, production, installation, and servicing. ISO 9002:1987 was the model for quality assurance in production, installation, and servicing. It was almost the same as ISO 9001:1987, but it did not cover the development of new products. ISO 9003:1987 was the model for quality assurance in final inspection and testing, but was hardly used. The second version of the ISO 9000 series was released in 1994. It stressed the importance of preventive actions. The third version combined ISO 9001, 9002 and 9003 into one standard, ISO 9001:2000. This version used a broader concept of quality management, and improving customer satisfaction became one of the performance measurements. Additionally, it focused on the process approach and on the active involvement of management. ISO 9001:2008 is basically the same as the previous version. It aims to explain the existing requirements more clearly. ISO has published a new version of ISO 9001 in the autumn of 2015. The 2015 version focuses on the identification and control of risks. Moreover, it requires top management to take a more active role in aligning quality policies with business needs (ISO, 2014). In this study, we focus on ISO 9001, and also include ISO 9002.

2.2. Innovation

As yet, there is no common definition of innovation in the management literature, which makes it difficult to define the borders of the research topic and to compare the results across studies. To overcome these difficulties, the Oslo Manual (OECD and EUROSTAT, 2005) provides guidelines for collecting and interpreting innovation data. We use their definition and the classifications in this research: “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations”. The Oslo Manual describes product, process, organizational, and marketing innovation. In this paper, we will focus only on product innovation: “The introduction of a good or service that is new or significantly improved in terms of its characteristics or intended uses”.

Additionally, we distinguish between incremental and radical innovation. Incremental innovations are based on the firm’s current technical capabilities and are characterized by small changes in a technological trajectory of the firm. Radical innovations change the firm’s current technical trajectory and organizational competencies fundamentally (Schumpeter, 1934). In this research, we address both radical and incremental product innovations.

3. General findings from the literature review

We performed a systematic and rigorous review of the existing literature. First, we conducted a detailed search of ABI/INFORM Global, Business Source Premier, Emerald, Jstor, Science Direct, Scopus, and Wiley databases for journal articles, working papers, conference proceedings, and dissertations in the English language. The data search period was from 1987 to February 2015. We searched for the terms (“ISO 9000” OR “ISO 9001”) AND innovation in the titles, keywords, or abstracts of the articles. We also looked at the literature review studies about the impact of ISO 9001 (Boiral, 2012; Manders, 2015; Psmosas and Fotopoulos, 2009; Rusjan and Alic, 2010; Sampaio et al., 2009). This resulted in 207 papers.

Second, we read titles and abstracts of the studies to identify the relevant ones. A study had to be empirical and report a relationship between ISO 9001 and innovation performance for inclusion. Seven papers missed a full text. Consequently, we tried to
identify their authors. Eventually, we managed to contact four authors, but received only two papers. The second step resulted in 55 studies.

Third, we examined each paper carefully and excluded papers that did not fit the previously mentioned criteria. If there was more than one paper based on the same dataset, we only included one to assure independence. We also examined the backward and forward references of the relevant papers, which resulted in the inclusion of two previously not identified, but relevant papers. Overall, these efforts resulted in 29 studies which are listed in Table 1 in the Annex.

The review of these 29 papers shows that the research findings in this area are conflicting (see Table A1 in the Annex). Some studies (i.e. Kafetzopoulos et al., 2013; Pekovic and Galić, 2009; Wu and Chen, 2011) find that ISO 9001 has positive effect on product innovation in general, on time-to-market, and on new product development process in particular, which illustrates the heterogeneity of the innovation dimension. Significantly more studies (i.e. Benner, 2009; Magd and Curry, 2003; Naveh and Erez, 2004; Prajogo, 2009; Nair and Prajogo, 2009; Sandholtz, 2012). Kafetzopoulos et al. (2013) and Najmi and Kehoe (2001) are the only studies which take adoption into account. Kafetzopoulos et al. (2013) measure the effectiveness of ISO 9001 implementation in a survey and show that effective ISO 9001 implementation has a positive effect on innovation. Najmi and Kehoe (2001) show that companies that are committed to post ISO 9001 quality development gain more benefits than companies that have no progress beyond ISO 9001. This indicates that the extent to which companies adopt ISO 9001 might explain why companies gain different innovation benefits from the standard. Therefore, we now discuss the impact of ISO 9001 on product innovation performance in terms of adopting quality management principles.

The ISO 9001 standard is based on eight quality management principles: customer focus, leadership, involvement of people, process approach, system approach to management, continual improvement, factual approach to decision making, and mutually beneficial supplier relationships (ISO, 2005, 2012). These principles displayed in Table 1 form a framework for senior managers to guide their organizations. Other quality management approaches like TQM and EFQM use similar principles and there are some discussions in the TQM and EFQM literature about how these principles interact with innovation. We discuss how the principles underlying ISO 9001 may impact product innovation by relying on

4. Lessons learned from the literature review

This section derives the lessons learned from the literature review. In the following, we differentiate between the impacts of the more general concept of adoption of ISO 9001 following the eight quality management principles and ISO 9001 certification in particular. We conclude the chapter by separating the factors which have an influence on the relationship between ISO 9001 and product innovation.

4.1. Adoption of ISO 9001

The review of the literature shows that almost all of the studies focus on the impact of ISO 9001 certification rather than on ISO 9001 adoption. They use a binary variable to represent whether a company is certified or not. Apparently, they assume homogeneous adoption. However, having a certificate is not the same as adopting the ISO 9001 standard. A company might obtain ISO 9001 certification without adopting the standard properly or using it regularly in its daily operations. This phenomenon is called decoupling (Aravind and Christmann, 2011). Some studies confirm that companies adopt ISO 9001 at different levels (Beck and Walgenbach, 2005; Boiral, 2011; Heras-Saizarbitoria, 2011; Nair and Prajogo, 2009; Sandholtz, 2012). Kafetzopoulos et al. (2013) and Najmi and Kehoe (2001) are the only studies which take adoption into account. Kafetzopoulos et al. (2013) measure the effectiveness of ISO 9001 implementation in a survey and show that effective ISO 9001 implementation has a positive effect on innovation. Najmi and Kehoe (2001) show that companies that are committed to post ISO 9001 quality development gain more benefits than companies that have no progress beyond ISO 9001. This indicates that the extent to which companies adopt ISO 9001 might explain why companies gain different innovation benefits from the standard. Therefore, we now discuss the impact of ISO 9001 on product innovation performance in terms of adopting quality management principles.

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| Customer focus | “Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.” |
| Leadership | “Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization objectives.” |
| Involvement of people | “People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization benefit.” |
| Process approach | “A desired result is achieved more efficiently when activities and related resources are managed as a process.” |
| System approach to management | “Identifying, understanding and managing interrelated processes as a system contributes to the organization effectiveness and efficiency in achieving its objectives.” |
| Continual improvement | “Continual improvement of the organization overall performance should be a permanent objective of the organization.” |
| Factual approach to decision making | “Effective decisions are based on the analysis of data and information.” |
| Mutually beneficial supplier relationships | “An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value.” |

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the existing literature on quality management, ISO 9001, TQM, EFQM, and innovation.

4.1.1. Customer focus

The customer focus principle states that organizations are dependent on their customers and should therefore understand and meet the needs of current and future customers and should try to exceed their expectations. Organizations need to research and understand the needs and preferences of their customers so that they can develop new products and services and guide their innovation efforts (Martínez-Costa and Martínez-Lorente, 2008). Additionally, knowing the needs in the market allows firms to align their strategy with their technological capabilities (Perdomo-Ortiz et al., 2006) and to channelize their resources into innovative ideas which could satisfy customer demand (Perdomo-Ortiz et al., 2006). To sum up, these arguments show that the customer focus principle can foster product innovation in organizations.

However, other arguments claim that customer focus promotes incremental innovation, but hinders radical innovation. It could lead the organization to focus only on current customers. In this case, the innovations resulting from customer needs are likely to be incremental (Cole and Matsumiya, 2007). Customer focus could also cause companies to be reactive in the short term, which would prevent them from recognizing the needs of unserved markets, potential new customers, and potential new functionalities (Cole and Matsumiya, 2007). As a result, managers could be trapped in the "tyranny of the served market" where they see the world only through their current customers' eyes (Prajogo and Sohal, 2001). Furthermore, focusing on current customer needs may alter the thinking of the organization. In more detail, adaptive learning that is based on exploitation of previous knowledge may overcome generative learning. Adaptive learning alone leads to organizations which are based on a pre-established view of what the firm is or does, and therefore to organizations which focus on their current markets. This could limit radical innovation, which generally arises from alternative responses to known demands (Santos-Vijande and Alvarez-Gonzales, 2007).

The customer focus principle ensures that customer needs and expectations are communicated throughout the organization. The organization measures customer satisfaction and acts according to the results. Consequently, organizations would focus on incremental innovations to satisfy their customers and to beat their competitors in a competitive environment (Martínez-Costa and Martínez-Lorente, 2008). On top of that, organizations would go beyond conformance and focus on radical innovations to exceed customer needs and expectations (Prajogo and Sohal, 2001). However, focusing on customer satisfaction may hinder radical innovation. Firms may adopt a "no bug" culture and be risk averse (Cole and Matsumiya, 2007). The organization may be scared to disturb their relationships with existing customers by producing new innovations. Risk of losing existing customers could lead them to neglect prospective market research and proactive strategies and thus, because of the fear of disturbing existing customers, companies may start to focus on conformance at the expense of innovativeness (Prajogo and Sohal, 2001; Santos-Vijande and Alvarez-Gonzales, 2007).

Nevertheless, there are several theoretical arguments that challenge the previous reasoning about how customer focus hinders radical innovation. First of all, a well-interpreted customer focus principle indicates that the organization should take into account both current and future customer needs and the environment that shapes expectations, which would lead to innovative, novel products (Prajogo and Sohal, 2001; Santos-Vijande and Alvarez-Gonzales, 2007). In addition, the customer focus principle demonstrates the importance of understanding lead users who are able to experience future demands and anticipate developing markets. Understanding the expectations of lead users would advocate successful radical innovations (Santos-Vijande and Alvarez-Gonzales, 2007). Furthermore, focusing on customer needs and expectations gives rise to a new culture in which ideas are accepted easily (Santos-Vijande and Alvarez-Gonzales, 2007). Because of this openness, the organization's capability to create novel ideas increases. Finally, customer focus promotes proactiveness (Santos-Vijande and Alvarez-Gonzales, 2007) in continuously searching for new markets. Proactive behavior indicates an organization in which the beliefs are questioned and the learning is generative. This would allow organizations to develop new markets and encourage radical innovations (Santos-Vijande and Alvarez-Gonzales, 2007).

4.1.2. Leadership

The leadership principle states that the leader of an organization should establish unity of purpose and direction for the organization. Applying this principle leads to establishing a clear vision of the organization's future. The leader sets challenging goals and targets which match the vision of the organization. Thus, if the organization wants to foster innovation, the goals will be formulated to achieve better capabilities for the adoption of change (Perdomo-Ortiz et al., 2006), and the leader will communicate these goals and set targets. As a result, an innovation culture, which is expected to increase both incremental and radical innovations, should develop in the organization.

The leadership principle also requires inspiring, encouraging and recognizing employees' ideas and contributions. This involves creating an environment of trust so that employees feel free to share ideas and to contribute. Such an environment will lead to more employee contributions, as they feel that their ideas are appreciated (Prajogo and Sohal, 2004). In other words, the leadership principle is expected to stimulate idea generation in organizations and therefore to increase both incremental and radical innovation.

Additionally, the leadership principle states that the employees should be given the necessary resources and training. Training should be effective and in accordance with the goals of the organization. If the organization's vision and goals are to achieve higher levels of innovation, company training should empower employees to reach these goals. Training programs will enable employees to generate more ideas which may be valuable to the organization. Thus, the leadership principle is expected to increase incremental and radical innovation.

4.1.3. Involvement of people

The principle of involvement of people states that people at all levels of the organization are the essence of the organization. Therefore, the organization should involve these people and use their abilities for its benefit. This principle leads to empowering people in the organization by giving them more responsibility and a sense of ownership so that they understand that their contribution and their role in the organization is important. If the goal of the organization is to be innovative, this greater degree of autonomy and responsibility enables people to be more innovative. They will generate and screen ideas more freely as they know that their ideas and efforts are valued (Perdomo-Ortiz et al., 2006; Santos-Vijande and Alvarez-Gonzales, 2007). Hence, empowering people is expected to increase both incremental and radical innovation.

Following this principle leads to employees evaluating their own performance in terms of their personal goals and objectives. This together with autonomy makes people less bounded by existing rules and more self-efficient, which can foster and develop innovative behavior (Prajogo and Sohal, 2004). If the goals and objectives of the employees are consistent with having high
innovation performance, this would allow them to be more innovative. This is why autonomy and self-measurement fosters both incremental and radical innovations.

According to this principle, employees themselves identify the constraints which keep them from reaching their goals and openly discuss these with their leaders. They are also encouraged to actively seek opportunities to enhance their competence, knowledge, and experience. First of all, if the goal of the organization is to increase product innovation performance and if this goal cannot be reached, the organization may find out the reasons from the first source, its employees, and take action. Second, any action taken by the organization to eliminate the problem would be accepted more easily by employees, since they were involved in helping the organization and themselves to achieve their goals. In other words, this principle builds an effective two-way communication where employees identify and share their problems and the organization helps them to solve these problems. In the long run, this is expected to increase both radical and incremental product innovation levels in the organization.

The involvement of people principle also leads to employees freely sharing knowledge and experience. This allows information to flow and increases technical communication. As a consequence, employees have the necessary knowledge to formulate innovation projects (Perdomo-Ortiz et al., 2006). This is expected to increase radical and incremental innovation performance. It also induces a communication flow among departments, including the R&D unit. In this way, the R&D unit can be closer to the rest of the organization. ISO 9001 also supports sharing knowledge across industries which is expected to speed up the learning process (Prajogo and Hong, 2008), and therefore innovation.

4.1.4. Process approach

The process principle promotes a process approach and ensures that activities and resources are handled as processes. Applying this principle leads to systematically identifying, managing, and controlling the processes that make up the organization, the interactions between these processes, and the inputs and outputs that connect the processes. However, identifying, managing, and controlling processes may lead to process standardization, which can inhibit innovation, especially radical innovation, for several reasons. First, process standardization decreases ambiguity in the design of tasks and limits the creativity of employees, and is therefore likely to discourage any type of innovation (Santos-Vijande and Alvarez-Gonzales, 2007). Second, process standardization results in a compliance culture in which employees may be afraid to deviate from routines, and might even be punished for proposing alternatives. The system will produce law-abiding and obedient employees (Prajogo and Sohal, 2001; Santos-Vijande and Alvarez-Gonzales, 2007) who cannot or do not want to come up with radical ideas. Third, standardization leads to lower flexibility and openness to change that is caused by devotion to routines (Santos-Vijande and Alvarez-Gonzales, 2007). The organization could get stuck to the same routines and thus not explore new ways of doing things (Prajogo and Sohal, 2001). Moreover, routines may make employees believe that the current solution is the best one (Benner and Tushman, 2002; Prajogo and Sohal, 2001) and as a result, employees will not be willing to generate ideas for further developments. Activities such as brainstorming and improvisation may be excluded from existing processes as they may be inconsistent with increased efficiency measures (Benner and Tushman, 2002). Eliminating creative activities is expected to hinder both incremental and radical innovations.

Applying the process principle also leads to analyzing and measuring the capabilities of key activities and focusing on how these activities can be improved with the help of sources, methods, and materials. This is expected to hamper radical innovation for two reasons. First, process management is based on the plan-do-check-act cycle and requires that the changes are implemented as controlled experiments that involve repetition of practices and measurement prior to making testable, small changes. Organizations collect data on efficiency and quality, and then act according to these data (Benner and Tushman, 2002). This approach promotes incremental improvements, since radical improvements are risky and more difficult to measure (Sethi and Sethi, 2009). Second, repeating established best practices would lead to further incremental changes through an experimental learning process (Benner and Tushman, 2002). In other words, through repetition the organization’s culture would change and only incremental innovations would be possible. Besides changes in the culture, the knowledge base of the organization would also change. If an organization does not explore knowledge in one period, it may not be able to produce exploratory innovations in the next period because of lack of relevant knowledge (Benner and Tushman, 2002).

4.1.5. System approach to management

The principle of a system approach to management indicates that identifying, understanding, and managing interrelated processes as a system enables the organization to be more effective and efficient in achieving its goals. This requires understanding the relationship between different processes, harmonizing and integrating these processes, and ensuring that employees understand their roles and responsibilities in the system. The expected impact of the system approach on product innovation performance is twofold. First, it may hinder radical innovation performance due to the shift in culture from downstream inspection to upstream prevention (Cole and Matsumiya, 2007). In other words, organizations already start to consider the quality of their products in the development phase. Treating processes as a system increases the linkages between different functions of the organization. Departments like business planning and quality become connected to R&D, which gives them the opportunity to be involved early in the development process. This may shift project focus from developing innovative products to meeting customer demands or producing high quality products (Cole and Matsumiya, 2007). Pressure from other departments can cause the organization to be risk averse and focus more on incremental innovations. However, the system approach may also promote radical innovation. Involving other departments, especially the marketing department more intensively, may increase the knowledge base of the R&D department about current and future customers’ needs and expectations. As a result, the level of both incremental and radical innovations might increase.

4.1.6. Continual improvement

According to the principle of continual improvement, the long-lasting objective of the organization should be to continuously improve overall performance. Organizations should employ an organization-wide approach, and focus on the continual improvement of products, processes, and systems should become the objective of every individual in the organization. Continuous improvement is expected to increase the level of product innovation in the organization, as it encourages change and creative thinking (Prajogo and Sohal, 2001) which, in turn, will lead to development of new services, products, and processes (Martinez-Costa and Martinez-Lorente, 2008).

However, some arguments in the literature suggest that continual improvement promotes incremental innovations, but hinders radical innovations. First of all, the continuous improvement philosophy emphasizes analytical, structural, and linear thinking, whereas synthetic, unstructured, and non-linear thinking is needed for creating innovations (Prajogo and Sohal, 2001). Because of this altered thinking, people in the organization may not
be able to produce the ideas needed for radical innovations. Second, continuous improvement supports a planned systematic approach of improvements, whereas trial and error is necessary for radical innovation. Employees are encouraged to search for solutions in the neighborhood of their existing skills and knowledge. This is likely to initiate incremental innovations that exploit existing knowledge (Benner and Tushman, 2002). Third, emphasis on continual, incremental changes may change the climate in the organization. Organizations may start to focus more on compliance than on innovation. That is, they may focus on maintaining the competitive balance and lose their ambition to become innovative (Santos-Vijande and Alvarez-Gonzales, 2007). When people work on unambitious goals, they are not likely to come up with novel solutions (Prajogo and Sohal, 2001). Finally, repeatedly focusing on best practices, incremental changes, and therefore incremental innovations may create a pattern in the organization (Benner and Tushman, 2002) that changes always start to occur in an incremental way. To sum up, previous arguments show that the continuous improvement principle may prevent radical innovations.

The continual improvement principle ensures that measurements are established to track improvements. However, this may create a risk aversion culture in which people try to avoid failures (Santos-Vijande and Alvarez-Gonzales, 2007). As mentioned before, trial and error processes are crucial in any innovation process, especially in radical ones. Hence, risk aversion resulting from continuous improvement measurements may hinder radical innovations.

Finally, this principle states that employees should be provided the necessary training and tools for continual improvement. First, this increases employees’ ability to come up with innovative ideas. Second, know-how enables employees to formulate critical and more relevant questions (Perdomo-Ortiz et al., 2006) which are expected to induce both incremental and radical innovations.

4.1.7. Factual approach to decision making

The principle of a factual approach to decision making specifies that effective decisions are built on the analysis of data and information. In other words, it is important to analyze data and information by using valid methods, and making decisions and taking actions based on these analyses. ISO 9001 stimulates organizations to measure the impact of improved manufacturing or distribution processes on existing customer satisfaction. However, emerging markets and customers are harder to measure (Benner and Tushman, 2002). Additionally, the results of incremental innovations are often tangible and can be seen in the short term, whereas the results of the radical innovations are uncertain and may not be seen for a long period of time (Benner and Tushman, 2002). Increased importance of innovation efficiency and effectiveness measures and the perceived returns of competing innovation projects may impact the innovation selection process in companies (Benner and Tushman, 2002). This could mean that firms prefer incremental innovations to radical ones. Moreover, the process approach is based on reducing waste and increasing efficiency. The factual approach to decision-making forces companies to make decisions based on efficiency. For this reason, companies may decrease or eliminate their slack resources, which has been found to be influential in innovation (Prajogo and Sohal, 2001). In other words, lack of resources may decrease a company’s innovation capability. Cost efficiency measures on innovation projects could limit the capacity and opportunity for innovation (Prajogo and Sohal, 2001). These arguments demonstrate that a factual approach to decision making in companies may hinder both incremental and radical innovations.

4.1.8. Mutually beneficial supplier relationships

This principle states that an organization depends on its suppliers and the suppliers depend on the organization. A mutual relationship enhances the value creation ability of both the main organization and its suppliers. Applying this principle will lead to sharing expertise, resources, information, and future plans with partners, clear and open communication between the organization and its suppliers, and inspiring and recognizing the successes of suppliers. Even if the internal R&D is the main source of innovation in many companies, external sources may enhance the innovation process as well (Singh and Smith, 2004). If suppliers share their ideas and innovations developed in their organization freely with the main firm, the product innovation performance in the main firm is expected to increase. In other words, the existing knowledge base of the organization increases as a result of this shared information. In a similar way, if an organization shares its expectations, resources, and information with its suppliers, the product innovation performance of the suppliers is expected to increase. Some suppliers may be able to produce innovative ideas, but may not be able to implement them due to financial reasons. In the case of a mutual relationship, the main organization may support the innovation projects of its suppliers. Additionally, the expectations and the knowledge transferred from the organization would increase the knowledge base of the suppliers, and consequently the innovation levels. This innovation at the supplier side could then generate innovation in the organization.

4.1.9. Overview

The main influences of the eight quality management principles on product innovation are summarized in Table 2. Overall, they push product innovation, but especially incremental innovation. However, some principles may also hinder product innovation. Consequently, we have identified some explanations for the ambiguous findings in the literature about the impact of ISO 9001 on product innovation.

4.2. ISO 9001 certification

The effects of ISO 9001 certification on organizations’ performance may stem from both internal and external improvements (Sharma, 2005). Internally, practices in the organization change through the guidelines and principles underlying the ISO 9001 standard. The possible impacts of these changes have been explained in the previous sections. However, external improvements can be achieved by the quality management system as such, but also by the signal certification gives to the market. This can be further explained by market signaling theory (Spence, 1973). There is an information asymmetry in the market in the sense that customers often do not have complete knowledge about the characteristics of the product and its supplier. Standards can partly solve the problem of information asymmetry. Product quality standards enable customers to distinguish high quality products from low quality ones, and quality management standards help to distinguish companies that assure a stable product quality from companies that might be less reliable in this sense.

Signaling may also change the innovation processes in the organization and subsequently affect product innovation performance. Therefore, its impact on product innovation needs to be studied separately. As mentioned in the previous section, standards can create a quality compliance culture in which any risks of disturbing existing customers are eliminated. However, the signaling effect of standards can compensate this negative effect on radical product innovations. The organization may be willing to produce more radical innovations and take more risks since customers will be still confident of product quality because of certification. Moreover, because certification signals the quality of the...
Table 2
The influence of ISO 9001 quality management principles on product innovation.

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<th>Principle</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Customer focus</td>
<td>Promotes an understanding of customers’ needs and expectation, facilitating product innovation</td>
</tr>
<tr>
<td>Leadership</td>
<td>Promotes innovation culture, facilitating incremental and radical innovation</td>
</tr>
<tr>
<td>Involvement of people</td>
<td>Supports company training to empower employees, leading to higher levels of innovation</td>
</tr>
<tr>
<td>Process approach</td>
<td>Leads to process standardization, hindering innovation, especially radical innovation</td>
</tr>
<tr>
<td>System approach to management</td>
<td>Causes a shift in culture from downstream inspection to upstream prevention, hindering radical innovation</td>
</tr>
<tr>
<td>Continual improvement</td>
<td>Promotes shared knowledge and experience among employees, facilitating innovation</td>
</tr>
<tr>
<td>System approach to management</td>
<td>Causes the involvement of other departments and increases the knowledge base about current and future customers’ needs and expectations, facilitating incremental and radical innovation</td>
</tr>
<tr>
<td>Factual approach to decision making</td>
<td>Promotes innovation efficiency, facilitating incremental rather than radical innovation</td>
</tr>
<tr>
<td>Mutually beneficial supplier relationships</td>
<td>Promotes sharing expectations, resources, and information with suppliers, increasing product innovation performance</td>
</tr>
</tbody>
</table>

new products, sales may increase, improving innovation performance. For these reasons, ISO 9001 certification is expected to increase both incremental and radical innovations.

4.3. Influencing factors

The review of the empirical studies about the relationship between ISO 9001 and product innovation shows inconsistent results. The explanation of ISO 9001 adoption and the signaling effect of certification give arguments for both positive and negative results. However, other factors are expected to influence the relationship between ISO 9001 and product innovation performance. The literature examining the impact of ISO 9001 on product innovation suggests that the following factors may influence this relationship: motivation for implementing ISO 9001, the region and the sector in which the firm operates, firm size, and the version of the standard. These factors will be discussed in the following sections.

4.3.1. Motivation for implementing ISO 9001

Motivation for implementing the ISO 9001 standards is expected to have an influence on product innovation. Organizations may want to implement ISO 9001 standards for two reasons. They may want to obtain the certification for external reasons, for example, because of pressure from customers, the market, or the government. They may also be motivated for internal reasons, for example, to improve their productivity and efficiency (Martínez-Costa et al., 2008). These motivational factors may impact innovation performance in several ways. As external motivation may steer organizations to focus on customer expectations and needs, it may increase the innovation level. On the other hand, internal motivation prompts organizations to focus more on productivity and efficiency. Implementing the principles effectively is also expected to increase the innovation level in organizations. Therefore, both internal and external motivations are believed to increase innovation, but for different reasons.

Yahya and Goh (2001) is the only study that has examined the impact of reasons for certification on the relationship between ISO 9001 and performance. The authors distinguish three types of reasons for certification. Developmental reasons are the company’s desire to improve internal performance and enhance overall competitive performance. These are the same as internal motivations. Non-developmental reasons are the company’s desire to meet customers’ requirements and to not be excluded from tenders. These are the same as external motivations. The third category is the combination of developmental and non-developmental reasons. They show that companies with developmental reasons gain more innovation benefits than companies with non-developmental reasons. Although this difference is not statistically significant, it indicates that the motivation of companies to implement ISO 9001 can partially explain the mixed results reported in the literature.

4.3.2. Region

The region in which the firm operates is believed to have an effect on the innovation benefits gained from ISO 9001. Existence of public research institutions, large dynamic firms, industry clusters, venture capital, and a strong entrepreneurial environment in a specific region may influence product innovation performance (OECD and EUROSTAT, 2005). Implementing ISO 9001 stimulates forming mutually beneficial relationships with other parties. As a result, implementing ISO 9001 in such regions is expected to increase innovation performance, because it would allow organizations to work with customers, competitors, suppliers, and public research institutions more easily.

The level of economic development in a country may influence the innovation benefits gained from ISO 9001. In highly developed countries, organizations often already have sophisticated management systems in place. They have more formal approaches for managing quality and customer satisfaction (Prasad and Tata, 2003), and they are more experienced in implementing and using quality management approaches like TQM, Six Sigma, and Lean. Because of this, ISO 9001 may not improve their existing practices much. On the other hand, in developing countries, organizations may have less sophisticated management systems in place, and as a result will have little experience with quality management practices (Lakhe and Mohanty, 1994). As a result, implementing ISO 9001 may lead to substantial changes in the organization and therefore to more innovation benefits.

4.3.3. Sector

The sector in which the firm operates may explain why the conflicting relationship between the ISO 9001 standard and product innovation. First of all, legislation may differ from one sector
to another. This could impact the motivation of the organizations to be certified and therefore the innovation level. Innovation processes vary in different sectors regarding development, technological change rate, connections between organizations, and access to knowledge. In high-technology sectors, changes occur rapidly and R&D plays an important role in innovation, whereas in low and medium technology industries (LMTs) the changes are small and slow (OECD and EUROSTAT, 2005). Because of this, customer expectations are likely to be different in high-technology sectors than in LMTs. This could affect the motivation of the organizations to be certified and to what extent they implement the standard, and consequently influence innovation levels. Finally, service and manufacturing sectors are expected to gain different innovation benefits from ISO 9001. As service firms usually do not perform formal R&D (Arundel et al., 2007), ISO 9001 could help them to formalize the innovation process and consequently increase innovation levels. Mangiarotti and Riillo (2014) is the only study that differentiates manufacturing and service sectors. They show that ISO 9001 facilitates technological innovation in manufacturing firms and non-technological innovation in service firms.

4.3.4. Firm size

The size of the organization may also influence the relationship between certification and product innovation (Briscoe et al., 2005). Small and medium-sized enterprises (SMEs) often lack internal funds to conduct innovation projects and cannot easily obtain external funds (OECD and EUROSTAT, 2005). As implementing ISO 9001 standards and acquiring certification is costly (Gunlaugsdóttir, 2002), SMEs may have to reduce the number of their innovation projects after certification. Moreover, SMEs are often more specialized in their activities and do not have a dedicated department for R&D activities. They mostly communicate with other firms and research institutions for R&D and exchange of knowledge (OECD and EUROSTAT, 2005). After the certification, SMEs might have to limit their interactions with external parties due to efficiency or financial reasons. This could lead to decreased innovation levels. On the other hand, because small firms usually do not perform formal R&D (Rammer et al., 2009), ISO 9001 may help them to formalize the innovation process and consequently increase innovation levels. Huarng (1998) and Mangiarotti and Riillo (2014) are the only studies that have examined the impact of company size on the relationship between ISO 9001 and innovation. Huarng (1998) shows that SMEs obtain more benefits than large enterprises in terms of speeding new product introduction, and Mangiarotti and Riillo (2014) show that the impact of ISO 9001 on innovation is greater for smaller firms.

4.3.5. Standard version

The version of the standard may also influence the relationship between ISO 9001 and product innovation. ISO 9001 standards have been updated several times and there is an important difference between the 1994 and 2000 versions. Customer focus, process approach, and the continual improvement principles gained importance. In other words, ISO 9001:1994 focused more on quality assurance, whereas the newer version pointed to the importance of continuous improvements, especially related to customer satisfaction (Bergenhenegouwen et al., 2002). The 2000 and 2008 versions have a higher impact on innovation than the older ones. Furthermore, the upcoming 2015 version requires higher management responsibility and risk management, and focuses even more on continuous improvement. Prajogo (2009) is the only study that has examined the impact of standard version. He shows that the version of the standard does not moderate the relationship between ISO 9001 and speed of new product development. However, the impact of the version of the standard needs to be studied in more detail to reach more generalizable conclusions.

4.3.6. Overview

In Table 3, we summarize the major arguments of the five factors moderating the influence of ISO 9001 on product innovation. The overview reveals that it is crucial to take all these factors into account in order to explain the inconsistent and even contradictory insights from studies on the impact of ISO 9001 on product innovation.

5. Discussion

This paper has shown that the current literature about the impact of ISO 9001 certification on product innovation is contradictory. We discussed the lessons learned from the literature and explained how ISO 9001 adoption and certification can impact both radical and incremental innovation. We also examined the factors that can explain the different results of the studies. This indicates that there is not enough theoretical support to accept or reject a clear-cut hypothesis about the positive effect of ISO 9001 certification on product innovation. For this reason, it is important to conduct new research to answer the following questions:

Table 3
Factors influencing the relationship between ISO 9001 and product innovation.

<table>
<thead>
<tr>
<th>Motivation for implementing ISO 9001</th>
<th>Region</th>
<th>Sector</th>
<th>Firm size</th>
<th>Standard version</th>
</tr>
</thead>
<tbody>
<tr>
<td>- External reasons, e.g. pressure from customers, the market, or the government, leading to more innovation</td>
<td>- A strong entrepreneurial environment positively influences innovation</td>
<td>- Legislation has an influence on adoption of ISO 9001 and consequently on innovation</td>
<td>- Innovation in services with low level of R&amp;D may benefit more from ISO 9001 than innovation in manufacturing companies</td>
<td>- Newer versions place more importance on customer focus, process approach, and the continuous improvement principles and facilitate innovation more than older versions</td>
</tr>
<tr>
<td>- Internal reasons directs focus on productivity and efficiency, leading to more innovation</td>
<td>- In developing countries, ISO 9001 adoption may lead to substantial changes and therefore to more innovation</td>
<td>- Different levels of technology and R&amp;D have an influence on the adoption and efficiency of ISO 9001 and consequently innovation</td>
<td>- ISO 9001 may help SMEs to formalize their innovation process and consequently increase innovation levels</td>
<td></td>
</tr>
<tr>
<td>- An increasing importance of continuous and consequently in-</td>
<td>- Legislation has an influence on adoption of ISO 9001 and consequently on innovation</td>
<td>- Legislation has an influence on adoption of ISO 9001 and consequently on innovation</td>
<td>- ISO 9001 may help SMEs to formalize their innovation process and consequently increase innovation levels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Legislation has an influence on adoption of ISO 9001 and consequently on innovation</td>
<td>- Legislation has an influence on adoption of ISO 9001 and consequently on innovation</td>
<td>- ISO 9001 may help SMEs to formalize their innovation process and consequently increase innovation levels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Legislation has an influence on adoption of ISO 9001 and consequently on innovation</td>
<td>- Legislation has an influence on adoption of ISO 9001 and consequently on innovation</td>
<td>- ISO 9001 may help SMEs to formalize their innovation process and consequently increase innovation levels</td>
<td></td>
</tr>
</tbody>
</table>

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Table A1
Studies about the relationship between ISO 9001 and product innovation.

<table>
<thead>
<tr>
<th>Paper</th>
<th>Independent variables</th>
<th>Moderators/ Mediators</th>
<th>Dependent variables</th>
<th>Country</th>
<th>Sector</th>
<th>Comp. size</th>
<th>Standard version</th>
<th>Data collection method</th>
<th>Smpl. size</th>
<th>Impact of ISO 9001 on product innovation (N=neutral, + =positive, − =negative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Khaled (2014)</td>
<td>TQM practices</td>
<td>ISO 9001 certification</td>
<td>Innovation (new products)</td>
<td>Saudi Arabia</td>
<td>Manufacturing</td>
<td>Mixed</td>
<td>N/A</td>
<td>Survey</td>
<td>88</td>
<td>N TQM practices have a significant positive effect on innovation. ISO 9001 does not have much explanatory power on innovation performance.</td>
</tr>
<tr>
<td>Bayo-Moriones et al. (2011)</td>
<td>– ISO 9001 certification – EFQM model</td>
<td>Flexible work practices: – % of workers who take part in groups set up to solve specific problems – % of workers who belong to autonomous work teams to perform ordinary tasks – % of workers who participate in autonomous work teams to develop new projects</td>
<td>Spain</td>
<td>Mixed</td>
<td>At least 20 empl.</td>
<td>N/A</td>
<td>Survey</td>
<td>665</td>
<td>+/− ISO 9001 has a positive and significant impact on improvement groups but does not have a significant impact on ordinary autonomous and autonomous new project teams.</td>
<td></td>
</tr>
<tr>
<td>Benner and Tushman (2002)</td>
<td>Process management (measured by ISO 9001 certification)</td>
<td></td>
<td>Exploitative and exploratory technological innovations</td>
<td>USA</td>
<td>Photography, paint</td>
<td>N/A</td>
<td>N/A</td>
<td>Longitudinal (database)</td>
<td>115</td>
<td>+/− ISO 9001 has a positive impact on exploitative and a negative impact on exploratory innovations. Increases in process management activities also trigger a shift toward more exploitative innovations.</td>
</tr>
<tr>
<td>Benner (2009)</td>
<td>Process management (measured by ISO 9001 certification)</td>
<td>Incumbents and other entrants</td>
<td>Responsiveness to change through new products</td>
<td>USA</td>
<td>Digital camera</td>
<td>Large</td>
<td>N/A</td>
<td>Longitudinal (database)</td>
<td>19</td>
<td>− Increases in process management activities have a negative effect on responsiveness to the ongoing technology change. ISO 9001 practices dampen response for all the firms in the sample but the negative effect is stronger for the incumbent firm's responsiveness.</td>
</tr>
<tr>
<td>Chandrasekaran and Karthikeyaan (2013)</td>
<td>ISO 9001 certification</td>
<td></td>
<td>Product innovation</td>
<td>India</td>
<td>Pump sets manufacturing</td>
<td>N/A</td>
<td>9001:2000</td>
<td>Survey</td>
<td>69</td>
<td>N ISO 9001 does not have a significant impact on product innovation.</td>
</tr>
<tr>
<td>Paper</td>
<td>Independent variables</td>
<td>Moderators/ Mediators</td>
<td>Dependent variables</td>
<td>Country</td>
<td>Sector</td>
<td>Comp. size</td>
<td>Standard version</td>
<td>Data collection method</td>
<td>Smp. size</td>
<td>Impact of ISO 9001 on product innovation (N = neutral, + = positive, − = negative)</td>
</tr>
<tr>
<td>-------</td>
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<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Delic et al. (2014)</td>
<td>ISO 9001 certification</td>
<td>− Investments in new products/services, − Adopted suggestions and improvement proposals, − Competence developing costs per employee, − Share of a new products/services in the overall organization’s assortment</td>
<td>Serbia</td>
<td>Manufacturing, service</td>
<td>Mixed</td>
<td>N/A</td>
<td>Survey</td>
<td>160</td>
<td>N ISO 9001 does not have a significant impact on innovation.</td>
<td></td>
</tr>
<tr>
<td>Huarng (1998)</td>
<td>ISO 9001 certification</td>
<td>Size</td>
<td>Speeding up new product introduction</td>
<td>Taiwan</td>
<td>N/A</td>
<td>Mixed</td>
<td>N/A</td>
<td>Survey</td>
<td>370</td>
<td>N ISO 9001 does not have a significant impact on speeding new product introduction. SMEs get more benefits than large-enterprises in terms of speeding up new product introduction.</td>
</tr>
<tr>
<td>Kafetzopoulos et al. (2013)</td>
<td>− Effective implementation of ISO 9001 and ISO 22000</td>
<td>− Flexibility in responding to the market rapidly within a short period, − Introducing new products faster than major competitors</td>
<td>Greece</td>
<td>Food manufacturing</td>
<td>Mixed (mostly SMEs)</td>
<td>9001:2000/2008</td>
<td>Survey</td>
<td>169</td>
<td>+ ISO 9001 has a significant positive impact on innovation.</td>
<td></td>
</tr>
<tr>
<td>Magd and Curry (2003)</td>
<td>ISO 9001 certification</td>
<td>Product development tool</td>
<td>Egypt</td>
<td>Manufacturing, service, construction</td>
<td>Mixed</td>
<td>9001:2000</td>
<td>Survey</td>
<td>38</td>
<td>− Respondents disagreed that ISO 9001 can be beneficial as a product development tool (significance values are not reported).</td>
<td></td>
</tr>
<tr>
<td>Magd et al. (2003)</td>
<td>ISO 9001 certification</td>
<td>Improved product design</td>
<td>Saudi Arabia</td>
<td>Manufacturing</td>
<td>Mixed</td>
<td>9001, 9002</td>
<td>Survey</td>
<td>83</td>
<td>N ISO 9001 has little effect on improved product design.</td>
<td></td>
</tr>
<tr>
<td>Mangiarotti and Riillo (2014)</td>
<td>ISO 9001 certification</td>
<td>Size, sector</td>
<td>Firm that introduced product or process innovation: − With positive expenditures in formal internal and external R&amp;D, acquisition of machinery, equipment, software and external knowledge, − Engaged in at least one innovation activity, − Regardless of innovation expenditures or activities, − Or organizational or marketing innovation, regardless of innovation expenditures or activities.</td>
<td>Luxemburg</td>
<td>Manufacturing, service</td>
<td>Mixed</td>
<td>N/A</td>
<td>Survey</td>
<td>1140</td>
<td>N ISO 9001 has no impact on the first three definitions. When organizational and marketing innovations are included, a positive and significant impact is detected. Impact of ISO 9001 on innovation is greater for smaller firms. Certification increases technological innovation in manufacturing and non-technological innovation in services.</td>
</tr>
<tr>
<td>Reference</td>
<td>Certification</td>
<td>Practices</td>
<td>Innovation Area</td>
<td>Country</td>
<td>Industry Type</td>
<td>Sample Size</td>
<td>Methodology</td>
<td>Findings</td>
<td></td>
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</tr>
<tr>
<td>Najmi and Kehoe (2001)</td>
<td>ISO 9001 certification</td>
<td>Quality development beyond ISO 9001</td>
<td>Product development timescale</td>
<td>UK</td>
<td>Manufacturing, Mixed</td>
<td>N/A</td>
<td>Survey</td>
<td>Managers interviewed were not concerned that ISO 9001 would stifle innovation. ISO 9001 has none to small impact on product development timescale. Companies that are committed to post-ISO 9001 quality development gain more benefits than companies that have no progress beyond ISO 9001 (significance values are not reported)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pekovic and Galka (2009)</td>
<td>ISO 9001 certification</td>
<td>Quality levels</td>
<td>Effect on product - New or improved products for the firm - Turnover due to new or improved products - New or improved products on the market - Share of new or improved products to the market</td>
<td>France</td>
<td>Manufacturing</td>
<td>At least 20 empl.</td>
<td>N/A</td>
<td>Survey</td>
<td>ISO 9001 has a positive and significant impact on products (for all indicators), processes (technologically new process) and innovation activities (for both indicators).</td>
<td></td>
</tr>
<tr>
<td>Paper</td>
<td>Independent variables</td>
<td>Moderators/ Mediators</td>
<td>Dependent variables</td>
<td>Country</td>
<td>Sector</td>
<td>Comp. size</td>
<td>Standard version</td>
<td>Data collection method</td>
<td>Smp. size</td>
<td>Impact of ISO 9001 on product innovation (N− neutral, +− positive, −− negative)</td>
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<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ratnasingam et al. (2013)</td>
<td>ISO 9001 certification</td>
<td>materials and not just changing packaging, Generate revenues from new products</td>
<td>Process innovation, Product innovation, Raw material innovation, Technology innovation, Design innovation, Market innovation</td>
<td>Malaysia</td>
<td>Furniture manufacturing</td>
<td>N/A</td>
<td>N/A</td>
<td>Survey</td>
<td>36</td>
<td>influences new product launches. ISO 9001 negatively influences revenues from radically new products. ISO 9001 has a positive impact on process, raw material, technology and market innovations but negative effect on product and design innovations.</td>
</tr>
<tr>
<td>Terziovski and Guerrero (2014)</td>
<td>The degree of ISO 9001 certification</td>
<td>Product innovation performance, Time of innovation adoption, Time to Market (TTM), Ecological efficiency, Process innovation performance, Restructuring, Internal customer concept</td>
<td>Australia</td>
<td>Manufacturing, service</td>
<td>Mixed</td>
<td>N/A</td>
<td>Survey</td>
<td>220</td>
<td>+ / −</td>
<td>ISO 9001 has a significant negative impact on time of innovation adoption and time-to-market of new products. ISO 9001 has a significant positive impact on ecological efficiency. ISO 9001 has a significant positive impact on process innovation performance measures.</td>
</tr>
<tr>
<td>Terziovski and Samson (1999)</td>
<td>TQM practices, ISO 9001 certification</td>
<td>Innovation (new products)</td>
<td>Australia, New Zealand</td>
<td>Manufacturing</td>
<td>Mixed</td>
<td>N/A</td>
<td>Survey</td>
<td>1341</td>
<td>N</td>
<td>ISO 9001 certification does not affect innovation in the presence or absence of TQM environment.</td>
</tr>
<tr>
<td>Wang (2014)</td>
<td>R&amp;D expenses, Product innovation, Process innovation</td>
<td>Firm performance: Return on assets</td>
<td>Taiwan</td>
<td>High-tech</td>
<td>N/A</td>
<td>N/A</td>
<td>Longitudinal (database)</td>
<td>607</td>
<td>+ / N</td>
<td>ISO 9001 enhances the influence of R&amp;D activity on firm performance. ISO 9001 has no significant impact on the relationship between product innovation and firm performance, and process innovation and firm performance.</td>
</tr>
<tr>
<td>Wei (2010)</td>
<td>ISO 9001 certification, Knowledge integration mechanisms</td>
<td>Product innovation performance</td>
<td>Taiwan</td>
<td>Bicycle, automobile, manufacturing, insurance, financial</td>
<td>N/A</td>
<td>N/A</td>
<td>Survey</td>
<td>467</td>
<td>−</td>
<td>ISO 9001 negatively affects product innovation via knowledge integration mechanisms.</td>
</tr>
<tr>
<td>Wu and Chen (2011)</td>
<td>ISO 9001 certification</td>
<td>Innovation process, Improving the ability of new product development, Attracting and recruiting new employees</td>
<td>Taiwan</td>
<td>Manufacturing</td>
<td>N/A</td>
<td>N/A</td>
<td>Survey</td>
<td>407</td>
<td>+</td>
<td>ISO 9001 has a significant positive impact on innovation process.</td>
</tr>
</tbody>
</table>
To what extent do ISO 9001 adoption and adherence to the underlying quality management principles affect radical and incremental product innovation performance? How does this relationship work?

To what extent does ISO 9001 certification affect radical and incremental product innovation performance and how does this relationship work?

To what extent is the relationship between ISO 9001 and product innovation performance affected by factors such as motivation of the company to implement the ISO 9001 standard, firm size, ISO 9001 standard version (1987, 1994/2000, 2008/2015), and the sector and the region in which the company operates? Can these factors explain the different outcomes of product innovation performance resulting from ISO 9001 implementation?

The literature on the relationship between ISO 9001 and product innovation performance shows that the research questions given above have not been addressed thoroughly in past studies. Thus, there is a gap in the literature on ISO 9001 certification and product innovation. To fill this gap, we have developed a research framework as shown in Fig. 1.

This figure illustrates that there is a probable relationship between implementing the ISO 9001 standard and radical and incremental product innovation performance. However, this relationship may be influenced by other factors such as the motivation of the company to implement ISO 9001 standards, the sector and the region in which the company operates, the size of the company, and the ISO 9001 standard version (1987, 1994/2000, 2008/2015), which are represented as moderators in the given framework.

Basically, the main proposition is that implementation of ISO 9001 is related to product innovation performance and that this relationship is influenced by some factors. Future research could examine the appropriateness of the model given above. First, it could examine how ISO 9001 standards foster or hinder product innovation. Prajogo and Sohal (2001) claim that TQM is a multidimensional model and the principles of TQM can be categorized into two groups as mechanical and organic elements. They state that the organic elements of TQM support innovation, whereas the mechanical elements of TQM hinder innovation. A similar analysis could be conducted to identify which aspects of adopting the ISO 9001 standard promote or hinder product innovation. Second, future research could investigate how the signaling effect of certification affects product innovation performance. This can be studied by comparing the innovation performance of the companies that have implemented the ISO 9001 standard but are not certified and companies that have implemented the standard and are certified. By comparing these two types of companies, researchers can identify the effect of certification alone. Finally, more research should be conducted to test the impact of region, size, sector, standard version, and the motivation of the company. Since the new version of ISO 9001 is planned to be introduced in the autumn of 2015, it is important to examine whether the improved version of the standard has a more positive impact on the innovation performance.

Overall, the impact of ISO 9001 on product innovation is still not clear and more research is needed on this topic. In the meantime, companies that are planning to implement or maintain ISO 9001 can take this research framework into consideration to ensure that their product innovation level increases with ISO 9001 adoption. Managers should first make sure that they seek both internal and external motivation. Next, they should properly adopt the ISO 9001 standard and its principles and should use the standards requirements in daily operations. Finally, they should be aware of the impact of region, sector, size and standard version and may have to take action to reduce or eliminate the negative impacts of these factors.
6. Conclusion

The systematic review of the existing literature about the influence of ISO 9001 on product innovation reveals a contradictory picture. However, it provides us with a list of factors such as company size, sector, country, ISO 9001 version, and company motivation, which might have an influence on the direction and strength of the influence. Based on these insights, we propose a framework to guide future research by addressing the various factors that might have an influence on impact of ISO 9001 on product innovation. The paper also aims to contribute to practice by helping managers to understand the relationship between ISO 9001 and product innovation better along the principles of quality management.

Annex

See Table A1

References

Al-Khaled, A., 2014. Establishing a Logical Nexus Between the Application of Total Quality Management (TQM) and Organisational Performance. Available at SSRN 2399677.


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