Perspectives on the interplay between process improvement approaches and product innovation. A literature review and research agenda

Rima Al Hasan (phd14ra@mail.wbs.ac.uk)
Doctoral researcher, Operations management group
Warwick business school

Pietro Micheli
Professor of business performance and innovation
Warwick business school

Abstract
This paper systematically reviews the literature on the interplay between process improvement (PI) approaches - such as lean, six sigma and total quality management - and product innovation. Findings show that two main views exist: control-oriented and learning-oriented. The former finds a mainly negative relationship, whereas the latter identifies a positive one. This review shows that these perspectives differ along seven main dimensions- capabilities, customer orientation, formalization, attitude toward risk, availability of slack resources, continuous improvement, and employees' involvement. Despite such contradictory views, the findings also indicate that a certain level of standardization through PI approaches is required for innovation.

Keywords: process improvement, product innovation, lean.

Introduction
Tensions and paradoxes – such as 'exploitation and exploration' (Andriopoulos and Lewis, 2009), 'alignment and adaptability' (Gibson and Birkinshaw, 2004), 'incremental and radical innovation' (Cardinal, 2001, Dewar and Dutton, 1986), 'standardization and creativity' (Gilson et al., 2005) and 'efficiency and flexibility' (Adler et al., 1999) – have attracted the attention of management scholars for a long time (Schad et al., 2016). Managing these tensions is a fundamental challenge in organizations whereby "the strengths of thriving firms can become weaknesses" (Adler et al., 2009: 107) and hinder their capacity to survive.

In 1978 Abernathy introduced the notion of the "productivity dilemma", highlighting the importance, but at the same time the downsides of gaining efficiency through productivity improvement activities, as these can "hinder learning and innovation, leaving organizations rigid and inflexible" (Adler et al., 2009: 99). More recently, innovation management and strategy scholars have questioned the benefits of PI approaches such as lean, six sigma, theory of constraints (TOC), and total quality management (TQM), as they may enable incremental product innovation, but hinder radical innovation (Benner and Tushman, 2003, 2015, Abernathy, 1978).

On the other hand, a considerable amount of research has been undertaken on different PI approaches in the operations management literature (Modig and Ahlstrom, 2012, Sousa and Voss, 2002). This research highlights the benefits these bring to organizations, not only in term of increasing

efficiency, improving product quality, eliminating constraints, and improving throughput and productivity, but also in creating customer value, increasing customer satisfaction and innovating products and services (Kim et al., 2012). Nonetheless, there is inconclusive evidence regarding the relationship between different PI approaches and incremental and radical product innovation (see, e.g., Benner and Tushman, 2002, Kim et al., 2012).

Overall, the literature on the interplay between different PI approaches on product innovation appears fragmented. While reviews of the literature have been conducted, these have mainly focused either on the impact of TQM on innovation performance or on innovation in general without considering either different PI approaches or various degrees of product innovation (e.g. Prajogo and Sohal, 2001). To better understand the interplay between PI and product innovation, a systematic review of the literature (Tranfield et al., 2003) was undertaken. As a result, two main perspectives over PI approaches were identified - control-oriented and learning-oriented. The former conceptualizes PI approaches mainly as a collection of efficiency-oriented practices and finds a negative relationship between different PI approaches and product innovation. The latter considers PI approaches as means for creating an environment that facilitates learning, collaboration and knowledge sharing, which are positively associated with various degrees of innovation. Also, despite divergent conceptualizations, most empirical studies indicate that a certain level of formalization and standardization, attained through PI approaches, is required for product innovation – both incremental and radical.

This study makes three main contributions. First, previous research has identified various contingent factors that might affect the impact of PI approaches on innovation, including organizational culture, business environment, organizational strategy, and organizational form (Prajogo and Sohal, 2001, Benner and Tushman, 2003). This study shows that conflicting empirical findings are not only due to contextual factors, but also to fundamentally different perspectives on PI approaches. Second, several operations management scholars have suggested that PI approaches consists of two contradicting dimensions; for example, Schroeder et al. (2008) argued that "Six Sigma can be viewed from two different structural dimensions: structural control and structural exploration" (p. 544). Also, Sitkin et al. (1994) identified two distinct approaches for TQM such as total quality control and total quality learning. This paper contributes to this research by identifying the control-oriented and learning-oriented conceptualizations of different PI approaches and clarifies the outcome of these different conceptualizations on product innovation. Third, this review highlights areas of tension and agreement on the link between PI approaches and innovation, and outlines an agenda for future studies.

Methodology

This paper examines the effects of PI approaches on product innovation, both incremental and radical. In particular, we conducted a systematic literature review following the process suggested by Tranfield et al. (2003): planning, executing and reporting.

Step 1: Planning the review: The review started by defining the research focus and the main concepts. PI approaches encompass lean, six sigma, TQM, and TOC. A radically innovative product is defined as a product that incorporates a new technology and / or new knowledge, and which serves a new customer need in comparison to existing products in the same category (Chandy and Tellis, 2000, Dewar and Dutton, 1986). An incrementally innovative product is "a product that provides new features, benefits, or improvements to existing technology in the existing market" (Garcia and Calantone, 2002: 123).

Step 2: Conducting the search: The literature search was conducted in two stages: first, we investigated the literature using two electronic databases: ISI web of knowledge and EBSCO. We used two different databases in order to increase the reliability of the research findings (Franco-Santos

et al., 2012). Second, we conducted a sense-check search by going through every issue published over the last five years in three highly ranked journals in operations management and innovation that have traditionally published articles in this area of research (*Journal of Operations Management*, *Journal of Product Innovation Management*, and *International Journal of Operations & Production Management*).

A comprehensive list of search terms was used to identify the most relevant articles. We used two sets of terms; the first one consisted of: lean, "six sigma", "quality management", "theory of constraints", TQM, TOC, "process management", "process improvement", and "quality improv*", "continuous improv*", "business process reengineer*", "just in time", BPR, JIT. The second one included a broad search term – innov* - which encompasses "product innovation", "incremental innovation", "radical innovation", etc. We then limited the search to the articles that mentioned at least one keyword from both sets in the title, abstract or keywords. Also, the search was limited to business and management research. As a result, we obtained a sample of 3,740 articles.

Step 3: Applying the inclusion and exclusion criteria: At this stage, the exclusion criteria were applied. First, to preserve the quality of the review findings, articles that were published in journals either ranked "1" or not featuring on the UK ABS (2015) academic journal quality guide were excluded (see also (Franco-Santos et al., 2012). This reduced the total number to 1,259 papers. Subsequently, all titles and abstracts were extracted by using referencing software. We read the abstracts of all extracted articles and excluded the ones that focused either on PI approaches or product innovation alone. This process resulted in the identification of 57 articles[1].

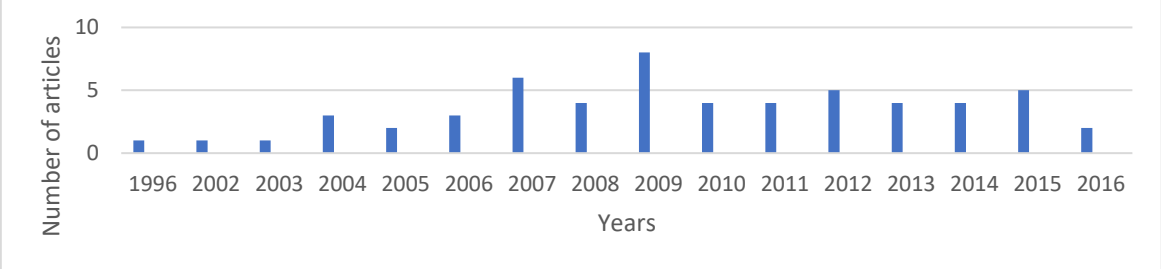
Analysis

Data analysis for the selected 57 articles was conducted in two stages: first a descriptive analysis and then coding and categorization of concepts using the NVivo software.

Descriptive Analysis

As shown in Figure 1, the number of articles that studied the interaction between PI approaches and product innovation has remained fairly stable, mildly increasing over the last decade. Figures 2 and 3 categorize the articles according to the PI approaches and the research methods used. About half of the reviewed articles (51%) studied the impact of TQM / quality management on innovation, 16% considered the impact of lean, and 7% and 2% of the articles focused on six sigma and TOC respectively. Some scholars did not focus on specific approaches and used other terms such as "process management", "quality orientation" and "quality improvement": these represent 24% of the sample. In terms of methodology, 61% of the articles used quantitative methods (mostly surveys), and 21% used qualitative methods, and 18% were theoretical.

Figure 1



[1] Because of space constraints, a full summary of the reviewed articles is not included in this manuscript, but it is available from the authors.

Figure 2

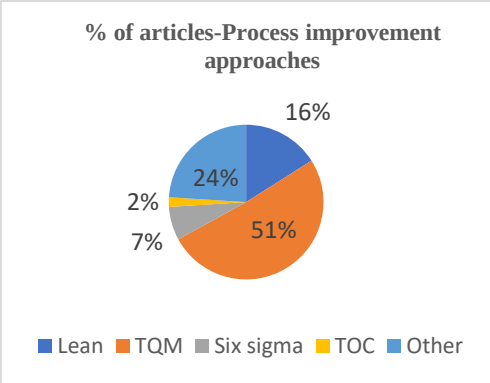
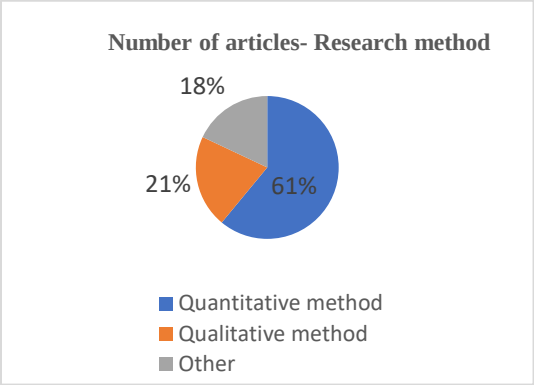


Figure 3



Coding and Categorization[2]

The selected articles were classified and coded using the NVivo software. First, papers were read in depth and summarized in a tabular format according to the author, journal, PI approach, innovation type, purpose, type of article, data analysis method, unit of analysis, industry, country and main conclusions. From this table, positive and negative arguments in relation to the interplay between PI approaches and product innovation were identified. Second, we focused on PI definitions and related constructs and practices, and grouped the main concepts into eight main categories: "process management", "waste minimization", "information analysis and reporting", "customer focus", "continuous improvement", "employees' involvement", "top management support", "teamwork". These categories were compiled by using previous research scales in the operations management literature (e.g. Kaynak, 2003, Saraph and Schroeder, 1989, Flynn et al., 1994, Shah and Ward, 2007). For example, practices related to process control, total preventive maintenance, formalization were grouped under "process management"; practices related to quality data, information analysis, statistical process control (SPC) etc. were grouped under "quality information and reporting"; the "waste minimization" category involves attributes and practices such as avoiding waste, flow and variation reduction (Shah and Ward, 2003). PI attributes and practices that are related to employees' involvement, empowerment, training and coaching, and human resource management were grouped under "employees' involvement". On the basis of the analysis, two views of PI approaches were derived: (1) the control-oriented view, which is principally based on tools and techniques (the "hard" aspects); (2) the learning-oriented view, which is based on both "hard" and "soft" aspects, i.e., the behavioral elements of PI approaches. Finally, the main areas of similarity and difference between the two main arguments were identified. The next section presents the results of the review and describes the control-oriented and the learning-oriented views in greater details.

Findings

The coding of the selected articles shows that two main conceptualizations of PI approaches exist in the literature. This distinction is not only important from a theoretical point of view, but also from an empirical one, as authors adopting a control-oriented view of PI tend to find that PI impedes product innovation - in particular radical innovation - whereas those adopting a learning-oriented one conclude the opposite. The main premises of the two perspectives are summarized in Table 1. The following section examines the two perspectives, identifying their main conceptualizations, definitions, PI attributes and practices used, theoretical and empirical arguments over the link between PI approaches and product innovation, and main areas of tensions and agreement.

[2] More details on the papers coding and analysis are available from the authors

Table 1-Premises of the control-oriented and learning-oriented perspectives

	Control-oriented perspective	Learning-oriented perspective
Conceptualization	PI approaches are efficiency-oriented practices that are based on discipline, conformity and adherence to existing rules, formalization, variation reduction, standardization, and exploitation.	PI approaches are means to create an environment that fosters collaboration, learning, openness, trust, knowledge creation, exploitation and exploration
Practices / attributes	Focus on the "hard" aspects (tools and techniques) such as process management, waste minimization, SPC and structured methods	Encompasses both "hard" and "soft" aspects such as employee involvement, teamwork, human resource management practices and leadership
Impact on innovation	PI approaches may enable incremental innovation, but hinder radical innovation because of standardization and reduction of slack resources.	PI approaches enable both radical and incremental product innovation through continuous improvement, employees' involvement and process management
Main differences	• The control perspective considers the hard aspects of PI as rigid and inherently in contradiction with risk-taking, experimentation and exploration, which are required for product innovation, especially radical. • The learning perspective considers the hard aspects as enablers for innovation since they provide a sense of clarity, assist companies in maintaining stable goals, help understand customer needs and reduce time-to-market. The soft aspects contribute to create a learning environment, which in turn supports radical product innovation.	

Control-oriented View

This perspective considers PI approaches mainly as sets of efficiency-oriented practices that are based on discipline, conformity and adherence to rules, formalization, reduction of variation, standardization, and exploitation of existing knowledge (Benner and Tushman, 2002, 2003, Lopez-Mielgo et al., 2009, Prajogo and Sohal, 2004, 2001). For example, Benner and Tushman (2003) suggest that "process management, based on a view of an organization as a system of interlinked processes, involves concerted efforts to map, improve, and adhere to organizational processes" (p. 238). Similar to process management, continuous improvement is also seen as aiming to reduce variability, minimize waste and ensure conformity, using, for example, "Plan, Do, Check, Act" (PDCA) cycles and SPC (Moreno Luzon and Valls Pasola, 2011). Considering quality management, several authors, such as Naveh and Erez (2004), have also argued that the implementation of practices and tools, such as ISO 9000, result in a culture "attention to detail" that values standardization and conformity to existing rules.

Control-oriented view: Process improvement and innovation

The control-oriented view is mainly based on the "hard" aspects (i.e., tools and techniques – (See e.g., Bortolotti et al., 2015, Zeng et al., 2015) of PI such as process management, waste minimization, SPC, collecting and reporting information, structured methods for problem-solving and to interact with customers (Benner and Tushman, 2003, Perdomo-Ortiz et al., 2006). Scholars that adopt such view have criticized the effectiveness of PI approaches, arguing that they can impede product innovation, especially radical, for three main reasons (Benner and Tushman, 2003, 2015). First, these approaches aim to reduce variation in processes (Benner and Tushman, 2002), whereas radical innovation requires variation-increasing activities and slack resources (Troilo et al., 2014, Helander et al., 2015). Second, PI approaches often rely on standardization and formalization to maintain improvements and stability (Zeng et al., 2015). However, standardization may impede flexibility, creativity and innovativeness (Zeng et al., 2015). Third, the customer-centric element of PI approaches can trap organizations in improving their existing products instead of creating radically new ones (Sadikoglu and Zehir, 2010, Slater and Narver, 1998). The emphasis on the existing

products establishes "a focus on easily available efficiency and customer satisfaction measures" (Benner and Tushman, 2003: 239), which go against radical innovation and penalize adaptation and long-term goals (Adler et al., 2009).

In addition to the above theoretical arguments, several empirical studies provide support for the control-oriented view. For example, Benner and Tushman (2002) found a negative relationship between process management and radical innovation. Also, Leavengood et al. (2014) found that quality-oriented firms are risk-averse and focus on meeting current customer needs instead of targeting new customers; therefore, they "deliberately choose not to pursue innovation" (p.1136). According to Parast (2011), Six sigma projects enhance incremental innovation by emphasizing efficiency, variance reduction and serving current customers; however, they are "not very effective in dynamic environments, where the rate of technological change is dramatic" (p. 45). Also, Salomo et al. (2007) found that in highly innovative projects, PI activities can impose rigidity and prevent projects mangers from reacting quickly to the internal and external changes. Mehri (2006) identified that lean, through *kaizen* and waste minimization, has a negative effect on employees' creativity and their potential to innovate. Similarly, Staats et al. (2011) argued that it is possible to apply lean on knowledge work, but not everywhere, especially if tasks require innovation and experimentation, which will be negatively affected.

Learning-oriented View

Authors adopting this perspective regard PI approaches as sets of learning-oriented practices that aim to create an environment that fosters collaboration, learning, openness and trust (Gil-Marques and Moreno-Luzon, 2013, Gutierrez Gutierrez et al., 2012, Choo et al., 2007, Hung et al., 2010, Moreno Luzon and Valls Pasola, 2011, Perdomo-Ortiz et al., 2006). For example, Gutierrez Gutierrez et al. (2012) considered Six sigma as an organizational learning process that stimulates knowledge absorption by allowing process management and teamwork. According to Kim et al. (2012) quality management is a "holistic management philosophy" that consists of interrelated practices including process management, employee relations, training, leadership, supplier quality management, customer relations, quality data and reporting, and product and service design (p.296). Also, these authors emphasized the importance of investing in various quality management practices to generate "a creative synergy among individual practices" and lead to innovative performance (p. 305). Additionally, Hung et al. (2011) stressed that TQM is more than a set of tools, as it "can also promote a culture of sharing, trust, openness, and innovation when supported by top management, employee involvement, continuous improvement, and customer focus" (p. 223). Also, Moreno Luzon and Valls Pasola (2011) suggested that, by creating a "mistake acceptance culture" instead of a "blame culture", TQM can promote ambidexterity (i.e., the ability to exploit current capabilities and explore new ones) and creativity (p. 938). For Perdomo-Ortiz et al. (2006), quality management and continuous improvement practices "are considered to be a forerunner in the accumulating of innovation capability and, consequently, innovating practices and routines are considered to be determined by the good practice deriving from quality management" (p. 1170). Also, Zeng et al. (2015) support this argument by stressing that quality and product innovation are not "a matter of trade-off, but they can coexist in a cumulative improvement model with quality as a foundation" (p. 216).

Learning-oriented view: Process improvement and innovation

The learning-oriented perspective relies on both "hard" and "soft" aspects (Bortolotti et al., 2015, Zeng et al., 2015) such as employees' involvement, teamwork, human resource practices, leadership, training and people management (Martinez-Costa and Martinez-Lorente, 2008, Choo et al., 2007, Abrunhosa and Sa, 2008). Scholars that adopted this perspective argue that PI can support product innovation, both incremental and radical (Schulze et al., 2013, Kim et al., 2012, Hung et al., 2011, Prajogo and Sohal, 2006). From a theoretical point of view, this perspective regards PI approaches as sets of principles and practices that create a fertile environment for innovation (Pekovic and Galia,

2009, Prajogo and Sohal, 2001). For example, these approaches use iterative cycles of continuous improvement (Santos-Vijande and Alvarez-Gonzalez, 2007), which can create a learning-oriented culture based on trust, openness and sharing (Hung et al., 2011). Indeed, many PI approaches highlight the importance of involving employees in decision making and in the improvement process (Prajogo and Sohal, 2001). This provides employees with a sense of responsibility, engagement and ownership (Slack et al., 2013, Moreno Luzon and Valls Pasola, 2011), which enhance their creativity and their capacity to innovate (Gil-Marques and Moreno-Luzon, 2013). Moreover, "control in process management is likely to assist firms to maintain stable goals, to reduce product development time, and to meet customer needs in both existing and emerging markets" (Kim et al., 2012: 304). Process management can also improve the product development process performance by reducing time-to-market (Dalton, 2009, Kim et al., 2012, Tuli and Shankar, 2015).

Empirically, Prajogo and Hong (2008) found that TQM can be implemented effectively in an R&D environment and have a positive impact on both product quality and innovation. Also, Schulze et al. (2013) revealed that value stream mapping facilitates "feed-forward learning" in new product development processes (p.1146). Sethi and Sethi (2009) concluded that "quality orientation does not adversely affect product novelty in cross-functional product development teams" (p. 206). Similarly, Pekovic and Galia (2009) emphasized the importance of a "well-established quality system" to improve innovation performance (p. 829).

Explicitly considering hard and soft aspects of PI, Prajogo and Sohal (2004) found alignment between "the mechanistic elements of TQM with quality performance and the organic elements with innovation performance" (p. 443), where the "mechanistic elements" reflect the hard aspects and the "organic elements" reflect the soft ones. Abrunhosa and Sa (2008) found that TQM principles have a positive effect on incremental technological innovation. However, this positive effect can be reduced by the lack of maturity of the improvement initiatives and the dominance of a "mechanistic model" (the "hard" aspects of PI). Antony et al. (2016) drew a similar conclusion, but their results indicate that lean six sigma "does have the potential to influence radical/breakthrough innovation" (p.124). Moreover, Gil-Marques and Moreno-Luzon (2013) highlighted the importance of TQM human resources management (HRM) practices in changing the culture toward "exploitation" and "exploration", and found a positive effect of the TQM HRM practices on both incremental and radical innovation. Hoang et al. (2006) found that TQM has a positive effect on companies' innovativeness and emphasized the importance of TQM practices, such as leadership, people management, process and strategic management, as means to foster innovation. Also, Wiengarten et al. (2013) identified that "seven practices closely related to TQM, namely visionary leadership, internal and external cooperation, learning, process management, continuous improvement, employee fulfilment, and customer satisfaction have a significantly stronger impact on operational performance in companies characterized by a high level of innovativeness" (p. 3055). Kim et al. (2012) found that quality management practices through process management enable radical and incremental product and process innovation. According to them "information and knowledge in a set of routines accumulated through process management help firms establish a learning base and facilitate innovative and creative activities" (P. 303). Santos-Vijande and Alvarez-Gonzalez (2007) reinforced the argument that TQM can enable innovativeness; however, they found that the impact of TQM on innovation culture is stronger in stable environments rather than in turbulent ones. Moreno Luzon and Valls Pasola (2011) found that TQM is a supportive platform for creating radical and incremental innovation. Also, Martinez-Costa and Martinez-Lorente (2008) stressed the importance of TQM in creating an environment that supports innovation.

Other scholars considered the effect of PI approaches on the new product development (NPD) process' speed and performance. For example, Dalton (2009) argued that a theory of constraints approach could help improve NPD processes by creating a culture of continuous innovation and by helping identify bottlenecks in the innovation process. Sun and Zhao (2010) found that TQM is positively related to NPD speed. Also, Tuli and Shankar (2015) argued that lean can improve NPD

process performance in term of quality, time to market, and risk management by aligning people and processes towards a common goal.

In summary, two main perspectives emerge from the literature. Authors adopting a control-oriented view tend to find that PI approaches may enable incremental innovation, but hinder radical innovation (Benner and Tushman, 2002, 2003, Parast, 2011, Salomo et al., 2007). On the contrary, scholars taking a learning-oriented perspective find a positive relationship between PI approaches and both incremental and radical product innovation (Asif and de Vries, 2015, Kim et al., 2012, Zeng et al., 2015, Antony et al., 2016).

Control-Oriented Vs. Learning-Oriented View

This review of the literature on the interplay between PI and product innovation further reveals that there are seven principal themes on which scholars appear to diverge. These are: capabilities, customer orientation, formalization, attitude toward risk, availability of slack resources, continuous improvement, and employee involvement.

Capabilities. PI approaches encourage stability, variation reduction and process control by applying various statistical techniques to maintain efficiency in a process. This in turn leads to capability exploitation (Benner and Tushman, 2003), which aligns with incremental innovation, but is said to hinder exploration and experimentation that are required for radical innovation (He and Wong, 2004, Benner and Tushman, 2002). This standpoint is consistent with the view that exploitation crowds out exploration (Brunner et al., 2010). On the other hand, according to learning-oriented perspective, investing in process enhancement "aids firms in fostering creative thinking" and "establishing a learning base" (Kim et al., 2012: 304). Here PI approaches are seen to enable both capability exploitation and exploration, which in turn align with incremental and radical innovation (Gil-Marques and Moreno-Luzon, 2013).

Customer orientation. There is consensus that customers are the critical starting point of any improvement process (Sadikoglu and Zehir, 2010, Westphal et al., 1997, Womack and Jones, 1996). However, the benefits and drawbacks of customer involvement have been long debated in the innovation literature (see, e.g., Andriopoulos and Lewis, 2009). Indeed, some innovation management scholars have argued that a high degree of customer orientation can trap the organization in satisfying its current customers, instead of guiding it towards new ones (Benner and Tushman, 2003). Consequently, tight customer orientation has been considered to hinder radical innovation (Andriopoulos and Lewis, 2009). On the other hand, rather than considering customer-orientation as a barrier to radical innovation, authors adopting a learning-oriented perspective regard customer-orientation as a mean to meet and exceed current and future customers' needs (Prajogo and Sohal, 2001), therefore leading to product innovation, both incremental and radical.

Formalization. Some scholars who adopted the control-oriented view (e.g. Benner and Tushman, 2003, Benner, 2009) have stated that formalization and standardization - which result from process management - are important to sustain improvement processes, but act as barriers to radical innovation since they can impose rigidity and hinder creativity which are required for radical innovation. However, researchers adopting a learning-oriented view found that control and standardization are crucial for both incremental and radical product innovation (Moreno-Luzon et al., 2014, Kim et al., 2012). According to them, standardization can provide structure and clarity of goals for the NPD process, which in turn assist companies in maintaining and exceeding current and emerging customers' needs (Prajogo and Sohal, 2001: 546). This result confirms findings by Jansen et al. (2006) in the innovation literature whereby rules and procedures are not detrimental to exploration and therefore to radical innovation.

Attitude towards risk and tolerance of failure. For several authors, the focus of PI approaches on improving flow and value creation by eliminating non-value adding activities (Helander et al., 2015), errors and variation (Schroeder et al., 2008) can hinder radical innovation, which is based on trial and errors and risk taking (Dewar and Dutton, 1986, Atuahene-Gima, 2005). However, others have

emphasized that PI approaches can be characterized by tolerance of mistakes (Moreno Luzon and Valls Pasola, 2011), are not dominated by risk aversion (Santos-Vijande and Alvarez-Gonzalez, 2007: 523), and can create an innovation-oriented culture that encourages exploration (Gil-Marques and Moreno-Luzon, 2013).

Slack resources. From a control-oriented view, slack resources can be considered non-value added activities and therefore should be eliminated in order to improve efficiency (Benner and Tushman, 2003, 2015). On the other hand, radical innovation requires extra resources to develop new products and eliminating waste may inhibit it (Troilo et al., 2014). Even though the link between slack resources and innovation was not discussed clearly in the studies adopting a learning-oriented view, some scholars examined aspects related to it. For example, according to Kim et al. (2012), efficiency-orientation that results from reducing non-value added activities in the process "plays a significant role in completing a radical project on time and budget" (p. 300). This view is consistent with Nohria and Gulati (1996) who found that there is an inverse U-shape relationship between the availability of slack resources and innovation. That is because having too little slack discourages experimentation and having too much slack "breeds complacency and a lack of discipline that makes it possible that more had projects will he pursued than good" (p.1260). Therefore, the discipline that results from the PI principle of reducing the non-value-added activities might not necessarily be a barrier for radical innovation.

Continuous improvement and employee involvement. Scholars who adopted the learning-oriented perspective considered these two additional dimensions, which were both positively associated with innovativeness. According to them, the iterative learning process of continuous improvement creates a culture that encourages knowledge sharing, trust, openness, employees' involvement and participation in decision-making. This environment also fosters a sense of ownership and encourages knowledge creation and innovation (Gil-Marques and Moreno-Luzon, 2013).

Conclusions

"Organizations often find themselves torn between contradictory and conflicting goals" (Adler et al., 2009: 110). One of these contradictory goals is the tension between incremental and radical innovation. Innovation and strategy scholars have proposed ways to manage such tension and have often identified PI approaches, such as TQM, lean and six sigma, as barriers to radical innovation (Benner and Tushman, 2003, Adler et al., 2009). On the other hand, operations management researchers have presented an opposing argument stating that PI approaches can enable both types of innovation (Kim et al., 2012, Moreno Luzon and Valls Pasola, 2011).

In order to clarify and understand the reasons behind these contradictory arguments, we reviewed the literature on the relationship between PI approaches and product innovation. Findings show that two main perspectives exist in the literature: control-oriented and learning-oriented. While the former considers PI as a set of efficiency-oriented, rigid practices that hinder product innovation, especially radical, the latter regards PI approaches as means for creating a learning environment that facilitates knowledge creation and, ultimately, product innovation.

The main criticism made by scholars adopting a control-oriented perspective is that PI approaches focus on efficiency improvement, variation reduction and standardization which can impede flexibility and trap the organization in improving current products rather than introducing radically new ones. However, while flexibility and extra resources are important for generating radical product innovation, having too many additional resources and excessive flexibility can reduce discipline and lead to wasted resources. Moreover, the control that results from the implementation of PI approaches can assist firms in being faster-to-market (Sun & Zhao, 2010), in satisfying current and latent customers' need, and, eventually, in generating both incrementally and radically innovative products, as long as such control does not stifle the generation of new ideas and the trial-and-error process required for product innovation (Kim et al., 2012; Moreno-Luzon et al., 2014).

This review also identifies several areas for future research. First, future studies could investigate the effects of both hard and soft aspects of PI on product innovation: what sorts of behaviors do they drive? Do they enable or hinder different types of innovation? Second, previous research emphasized the importance of environmental dynamism when it comes to the relationship between PI approaches and innovation (Parast, 2011). Further research could investigate other contingency factors that can affect this relationship. Third, despite the impact of PI approaches such as lean on improving the NPD process performance, few studies have considered how this impact varies at different stages of the NPD process. Fourth, most research has been at the organizational level; therefore, little is known as to whether the impact of PI on innovation will differ at the supply chain level, especially with the change in the locus of innovation from within the companies to across companies through collaboration (Benner and Tushman, 2015). Fifth, some scholars have argued that cross-functional product development teams can enable organizations to create innovative products within quality-oriented organizations (Sethi and Sethi, 2009). However, we still know little about the impact of PI approaches on radical and incremental product innovation at the team level. Finally, the majority of studies are cross-sectional and survey-based. Given the complexity of the relationship between PI approaches and innovation (Perdomo-Ortiz et al., 2006), future research could use other methods such as case-based research or panel data to consider potential changes in the relationship between PI and innovation over time, for example because of learning effects.

This paper is not without limitations. Despite using a systematic process to conduct this review, articles published in journals that did not meet the journal quality criteria were omitted. Moreover, books and conference papers, which could provide insights into the relationship between PI and product innovation, were also excluded.

References[3]

Adler, P. S., Benner, M., Brunner, D. J., Macduffie, J. P., Osono, E., Staats, B. R., Takeuchi, H., Tushman, M. L. & Winter, S. G. 2009. Perspectives On The Productivity Dilemma. *Journal Of Operations Management,* 27**,** 99-113.

Benner, M. & Tushman, M. 2002. Process Management And Technological Innovation: A Longitudinal Study Of The Photography And Paint Industries. *Administration Science Quarterly,* 47**,** 676-706.

Benner, M. J. & Tushman, M. L. 2015. Reflections On The 2013 Decade Award-"Exploitation, Exploration, And Process Management: The Productivity Dilemma Revisited" Ten Years Later. *Academy Of Management Review,* 40**,** 497-514.

Gil-Marques, M. & Moreno-Luzon, M. D. 2013. Driving Human Resources Towards Quality And Innovation In A Highly Competitive Environment. *International Journal Of Manpower,* 34**,** 839-860.

Gutierrez Gutierrez, L. J., Bustinza, O. F. & Barrales Molina, V. 2012. Six Sigma, Absorptive Capacity And Organisational Learning Orientation. *International Journal Of Production Research,* 50**,** 661-675.

Kim, D.-Y., Kumar, V. & Kumar, U. 2012. Relationship Between Quality Management Practices And Innovation. *Journal Of Operations Management,* 30**,** 295-315.

Mehri, D. 2006. The Darker Side Of Lean: An Insider's Perspective On The Realities Of The Toyota Production System. *Academy Of Management Perspectives,* 20**,** 21-42.

Moreno Luzon, M. D. & Valls Pasola, J. 2011. Ambidexterity And Total Quality Management: Towards A Research Agenda. *Management Decision,* 49**,** 927-947.

Pekovic, S. & Galia, F. 2009. From Quality To Innovation: Evidence From Two French Employer Surveys. *Technovation,* 29**,** 829-842.

Perdomo-Ortiz, J., Gonzalez-Benito, J. & Galende, J. 2006. Total Quality Management As A Forerunner Of Business Innovation Capability. *Technovation,* 26**,** 1170-1185.

Sethi, R. & Sethi, A. 2009. Can Quality-Oriented Firms Develop Innovative New Products? *Journal Of Product Innovation Management,* 26**,** 206-221.

Staats, B. R., Brunner, D. J. & Upton, D. M. 2011. Lean Principles, Learning, And Knowledge Work: Evidence From A Software Services Provider. *Journal Of Operations Management,* 29**,** 376-390.

[3] A full list of references is available from the authors