

ORGANIZATIONAL INNOVATION WORKSHOP



ORGANIZATIONAL INNOVATION WORKSHOP

Valencia, February, 21st, 2013

UNIVERSIDAD POLITÉCNICA DE VALENCIA

*DIRECCIÓN: Dr. JOSE LUIS HERVAS OLIVER & Dr. FRANCISCA SEMPERE-
RIPOLL*

**ORGANIZATIONAL INNOVATION AND ITS ANTECEDENTS,
PERFORMANCE CONSEQUENCES AND TECHNOLOGICAL
COMPLEMENTARITIES: TOWARDS A RESEARCH AGENDA**



Management Dept. (DOE), Universidad Politecnica de Valencia (Spain)

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PROGRAM

Time	Title	Author	Topic
08.45-09.00	<i>Presentation and Welcome</i>	Dr. José Albors-Garrigos Head of Research, Management Dept. & Jose-Luis Hervas-Oliver, Co-director of the Workshop, Management Dept. Polytechnic University of Valencia.	Welcome
Chair: Dr. Jose-Luis Hervas-Oliver			
09:00-9.30	<i>'Management innovation: Past to present'</i>	Dr. Mol, M . Warwick University (UK)	Conceptual and state-of-the-art revision
09.30-10.00	<i>Institutional Pressure, Technological Capability, And Firm Environmental Performance: Mediating Effects Of The Implementation Of ISO 14001</i>	Deepa Aravind, College of Staten Island, City University of New York (USA) Fariborz Damanpour, Rutgers University (USA) Carlos Devece, Universitat Politècnica de València (Spain)	Implementation of managerial innovations and performance consequences
10.00 - 10.30	<i>Synchronous co-adoption of technological and non-technological innovation strategies in non-R&D performers: unpacking complementarities and their performance consequences</i>	Hervas-Oliver, JL+ and Francisca Sempere-Ripoll+ +Universidad Politécnica de Valencia	Complementarities between Technological and Management Innovation CIS data
10.30-10.55	<i>The key role of Human Resource Practices for the promotion of creativity and innovation: a Spanish case study</i>	Naiara Escribá-Carda M. Teresa Canet-Giner Francisco Balbastre-Benavent University of Valencia	Managerial practices, Creativity, innovation, Human Resource Practices, Case study
10.55-11.15	<i>Coffee break</i>		
Chair: Dr. Michael Mol			
11.15-11.45	<i>The Fateful Triangle: Complementarities In Performance Between Product, Process and Organizational Innovation in France and the UK</i>	Gérard BALLOT1, Fathi FAKHFAKH1, Fabrice GALIA2 and Ammon SALTER3 1 ERMES (EAC CNRS 7181) Université Paris II-Sorbonne universités and TEPP-CNRS, (France) 2 Burgundy School of Business – Dijon Paris, (France)	Complementarities between Technological and Management Innovation, Supermodularity France and UK CIS data

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		3 Imperial College Business School London, (UK)	
11.45-12.15	Management Innovation: Learning Through Inter-Firm Networks	Carlos Martin-Rios, Director Center for the Study of Management Innovation & Universidad Carlos III (Spain)	Antecedents of management innovation, cooperation; knowledge sharing, inter-firm networks, social network analysis
12.15—12.45	Understanding Organizational Innovation From Its Practice	Maria Larraza Malkorra University of Deusto (Spain)	Organizational innovation as practice, grounded theory, case study
Chair: Dr. Carlos Martin-Rios			
12.45—13.15	'New to the firm and new to the industry management innovations: How do they differ?	Dr. Mol, M. Warwick University (UK)	Management innovation typology, conceptual, empirical
13.15-14.15 Lunch Break			
Chair: Dr. Francisca Sempere-Ripoll			
14.15-14.40	Product, Process, Marketing And Organizational Innovations in the Spanish Arts, Heritage & Recreation Industries	Blanca de-Miguel-Molina+ José-Luis Hervás-Oliver+ María de-Miguel-Molina+ +Universidad Politécnica de Valencia (Spain) Rafael Boix^ ^Universitat Valencia (Spain)	Management innovation and technological innovation co-adoption in creative and cultural industries, dynamics and persistence. CIS data
14.40-15.05	Drivers Of Organizational Innovations	Angel L. Meroño Cerdán* Carolina López Nicolás* *Dpto Organización de Empresas y Finanzas Universidad de Murcia	Organizational adoption and its antecedents. CIS data.
15.05-15.30	Managing Risk-Taking To Enhance Innovation In Organizations	Oscar Llopis-Córcoles Ana Garcia-Granero Anabel Fernández-Mesa CSIC- Universitat Politècnica de València-- University of Valencia Joaquín Alegre-Vidal, University of Valencia	Innovation performance, managers' risk taking, organizational climate, perceived risk taking, signaling theory, social cognitive theory
15.30—16.00	Debate and Agenda setting Foreclosure		

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Universities enrolled:

Warwick University (UK), Imperial College (UK), City University of New York (USA), Rutgers University (USA), Burgundy School of Business – Dijon Paris (France), Univesite Paris-II (France), Universidad de Murcia (Spain), Universidad Carlos III (Spain), Universidad de Deusto (Spain), Universidad Politécnica de Valencia (Spain), INGENIO-CSIC (Spain), Universitat de València (Spain),

Scientific Committee

<i>Dr. Michael Mol</i>	<i>Warwick University, UK</i>
<i>Dr. Carlos Martín-Ríos</i>	<i>Carlos III University, Spain</i>
<i>Dr. José Luis Hervas-Oliver</i>	<i>Universidad Politécnica de Valencia, Spain</i>
<i>Dr. Fabrice Gala</i>	<i>Groupé ESC Dijon Bourgogne Burgundy School of Business DIJON, France</i>
<i>Dr. Francisca Sempere</i>	<i>Universidad Politécnica de Valencia, Spain</i>
<i>Dr. José Alhors Garrigos</i>	<i>Universidad Politécnica de Valencia, Spain</i>

Local Organizing Committee

Roberto Cervelló Royo (Coordinator, UPV), José Luis Hervas Oliver (Co-director, UPV), Jose Alhors Garrigós (UPV), Blanca de Miguel (UPV), Francisca Sempere Ripoll (Co-director, UPV), Carlos Devece Caravana (UPV), Rafael Boix (UV) Marta Peris Ortiz (UPV), Carles Boronat (UPV),

COLABORA Y PATROCINA: Generalitat Valenciana, Universidad Politécnica de Valencia, Facultad de ADE de la UPV, DEPARTAMENTO DE ORGANIZACIÓN EMPRESAS de la UPV, Ministerio de Economía y Competitividad (ECO2010:17.318)



ECO:2010-17.318 Innoclusters

Máster Universitario en Gestión de Empresas, Productos y Servicios

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EDITED BY

JOSE LUIS HERVÁS OLIVER



Jose-Luis Hervás-Oliver, PhD., is associate profesor at Universidad Politécnica de Valencia (UPV, Spain). His research interests lies at the intersection between strategic management, innovation management and the economic geography. Dr. Hervás-Oliver is specially active in clusters and innovation in small firms using non-R&D indicators. His publications are in *Technovation*, *Journal of Economic Geography*, *Entrepreneurship and Regional Development*, *International Journal of Technology Management*, *European Planning Studies*, *Service Business*, *Asian Journal of Technology Management*, *Journal of Technology Transfer*, *International Journal of Information Management*, *Economics of Innovation and New Technology*, together with book chapters in a diverse set of international leading editorials (*Edward Elgar*, *Springer*, IGI Global, etc.); He has visited as visiting fellow the London School of Economics, Maastricht University (MERIT Innovation Institute), the University of Edinburgh, the University of Southampton or INHOLLAND University, among others.

FRANCISCA SEMPERE RIPOLL

Francisca Sempere Ripoll, PhD, is Industrial Engineer by training and serve as associate profesor at Universidad Politécnica de Valencia (UPV, Spain). His research interests lies at the core of innovation studies, being specially intensive in using innovation micro-data to obtain evidence about firms' innovation strategies, especially process innovation.

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DRIVERS OF ORGANIZATIONAL INNOVATIONS

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INSTITUTIONAL PRESSURE, TECHNOLOGICAL CAPABILITY, AND FIRMENVIRONMENTAL PERFORMANCE: MEDIATING EFFECTS OF THE IMPLEMENTATION OF ISO 14001

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Abstract

This study focuses on the implementation of managerial innovations and argues that quality of implementation plays a key role in gaining benefits out of implementing the adopted innovation. Moreover, this research reflects on the role played by some relevant factors, internal and external to the company, in the relationship between managerial management and performance. We examine how technological process innovation capability and pressure from external stakeholders affect performance through the mediation of quality of implementation, providing a model of the relationship between extent of implementation of managerial innovations and performance.

We develop hypotheses and test them using survey data from 192 ISO 14001 certified facilities in the US. The results suggest that quality of implementation partially mediate the effect of process innovation capability but fully mediate the effect of external pressure on environmental performance. We discuss the implication of these findings for research and practice on the implementation of managerial innovations.

Key words: managerial innovation, performance, technological capability, ISO14001

1. Introduction

Interest in international voluntary environmental initiatives such as the Business Charter for Sustainable Development, OECD Guidelines for Multinational Enterprises, the United Nations Global Compact, the ISO 14001 Environmental Management System (EMS), and Eco-Management and Audit Scheme (EMAS) has proliferated in recent years. They are an important tool for regulating corporate environmental conduct and is an alternative to command and control regulation in a global economy (Christmann& Taylor, 2002). Much has been written about the reasons why firms join them and their ability to achieve the intended results in terms of reducing the firms' environmental impact, i.e., to improve their environmental performance (Paton, 2000). A recent development in this literature is the recognition that mere adoption of initiatives such as these is not enough to get the benefits associated with these initiatives: attention should also be paid to how they are implemented on a daily basis in firms (Aravind&Christmann, 2011; Yin &Schmeidler, 2009). However, extant literature has not advanced beyond this recognition in terms of identifying additional variables that may also affect the extent of implementation – environmental performance relationship.

Environmental performance represents a firm's effectiveness in meeting and exceeding society's expectations with respect to concerns for the natural environment (Judge & Douglas, 1998). It goes beyond mere compliance to environmental regulations to embrace a more proactive stance in terms of managing environmental activities. Environmental performance is an important dimension of firm performance, which needs to be considered by firms (Judge & Douglas, 1998). Some scholars argue in fact that firms have a societal duty to attend to their environmental performance (e.g., Starik&Rands, 1995). Furthermore, the strategic management literature encourages the examination of multiple measures of organizational outcomes since firms have to satisfy multiple stakeholders (Judge & Douglas, 1998; Venkatraman&Ramanujam, 1986).

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We aim to contribute to the literature on environmental management and organizational innovation in two ways. First, we provide a more nuanced model of the relationship between extent of implementation and firm environmental performance. More specifically, we introduce two variables: institutional pressure and technological capability as antecedents to the extent of implementation. External institutional pressure from stakeholders such as customers who prefer to do business with firms that are environmentally responsible is an important reason why firms adopt it (Christmann & Taylor, 2001). Certification to ISO 14001 allows adopting firms to signal to their stakeholders that they are environmentally responsible (King et al., 2005). The variable has also been found to have an impact on environmental performance. For example, Lee (2009) found that public corporations, as opposed to private ones, were exposed to greater institutional pressure, and that such pressure led to consistently better environmental performance. Given the critical impact that institutional pressure from external stakeholders has on managerial innovations, our model includes this variable.

Additionally, findings in extant literature point to the performance implications of technological process innovation capability (Augusto, Lisboa & Yasin, 2011; Prajogo, 2006). For instance, Augusto et al. (2011) found that process innovation was positively related to firm performance, and Prajogo (2006) reported that in manufacturing firms, process innovation had a stronger relationship with firm performance than product innovation.

In this study, we focus on one international VEI, ISO 14001, an environmental management system standard, and conceptualize it as a management innovation as has been done by other studies on management standards (Henriques & Sadowsky, 2007; Naveh, Melich, & Marcus, 2006).

The ISO 14001 environmental management system (EMS) is particularly suited for our study. While it is often difficult to measure the performance significance of a managerial innovation (Damanpour & Aravind, 2011), performance consequences of ISO 14001 EMS can be more easily measured as its implementation affects one specific aspect of organizational performance, namely,

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environmental performance. We use a questionnaire survey as our data source, supplemented with secondary data sources like the Dunn and Bradstreet and Quality Systems Update (QSU) databases. Our analysis is based on 192 survey responses obtained from facility managers in the US who are responsible for ISO 14001 in their facilities. We test our hypotheses using Structural Equation Modeling (SEM), which is a rigorous procedure for analyzing mediating effects (Bollen, 1987; Cheung, 2007). The results generally suggest that while quality of implementation partially mediates the effect of process innovation capability on environmental performance, it fully mediates the influence of external pressure.

2. Theory and Hypotheses

Innovation Types

Innovation is generally defined as the development or use of new products, services, production processes, organizational structures, or administrative systems that are new to the adopting firm (Damanpour&Aravind, 2011; Rogers, 1995; Walker et al., 2011). Innovation researchers have distinguished between managerial and technological innovations. The distinction between technological and managerial innovations is important because it reflects the general distinction between social structure and technology in firms (Gopalakrishnan&Damanpour, 1997). Managerial innovations are new organizational structures, administrative systems, management practices, processes, and techniques that could create value for the organization (Birkinshaw et al., 2008; Damanpour&Aravind, 2011; Kimberly, 1981). They are departures from traditional management principles, processes, and practices that alter ‘the way the work of management is performed’ and change ‘how managers do what they do’ (Hamel, 2006: 75–76). The primary purpose of managerial innovations is to improve the efficiency of internal operational and administrative processes. In this study, we focus on the implementation of managerial innovation. Implementation of innovation has been defined as “the process of gaining targeted organizational members’ appropriate and committed use of an innovation” (Klein & Sorra, 1996: 1055). Innovation implementation is

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preceded by innovation adoption, a decision that is typically made by senior managers on the assumption that the adopted innovation will be used by the members of the organization.

Managerial innovations are very different in nature than technological innovations because they represent investments in knowledge, processes and behavior rather than artifacts, are more tacit in nature and not easily codified thereby allowing a higher level of subjective interpretation on the part of the user, typically does not deliver results until several years after implementation, and the fact that very few firms have well-established and specialized expertise on managerial innovation (Birkinshaw&Mol, 2006; Kraus et al., 2011). By its very nature, therefore, managerial innovations generate much more uncertainty and ambiguity within firms than technological innovation. Before such innovations can be adopted and appropriately implemented, there exists the need for establishing legitimacy of the innovation by validation by sources external to the firm such as media, consultants, industry associations, and non-governmental organizations (Birkinshaw&Mol, 2006; Birkinshaw et al., 2008; Kraus et al., 2011). What external constituents such as these say about the innovation has an important effect on legitimating the innovation (or not) which in turn would affect employees' motivation to implement the innovation (Birkinshaw et al., 2008).

Technological innovations in contrast, are directly related to the primary work activity of the organization and produce changes in its outputs and operating systems. Product and process innovations are conceived as two types of technological innovations. *Product innovations* are defined as new products or services introduced to meet an external user need, and *process innovations* are defined as new elements introduced into a firm's production or service operation to produce a product or render a service (Damanpour&Aravind, 2006; Schilling, 2008; Utterback, 1994). While product innovations are "products or services that are new to the market", process innovations are "new ways of manufacturing existing or new products" (Damanpour&Aravind, 2006: 41). The drivers of product innovations are primarily customer demand for new products and managers' desire to penetrate new markets, whereas the drivers of process innovations are mainly

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reduction in delivery lead time, lowering of operational costs, and increase in flexibility (Boer & Durning, 2001; Schilling, 2008). Technological process innovations change the way products are produced by introducing change in technology related to equipment and machinery, operational techniques, and production systems (Boer & Durning, 2001; Damanpour&Aravind, 2006; Utterback, 1994). In this study, we examine joint effects of technological process and managerial innovations on performance. In particular, we propose an enhanced version of the technological innovation-managerial innovation-performance model (Georgantzis& Shapiro, 1993).

3. ISO 14001 Environmental Management System

We investigate the ISO 14001 EMS, which, along with other similar management standards like the ISO 9000 Quality Management System, has been conceptualized as a managerial innovation (MI) in previous studies (Henriques&Sadorsky, 2007; Naveh, Melich, & Marcus, 2006). The ISO 14001 EMS is a formal system intended to help organizations manage their environmental issues such as waste and emissions. It was established by the International Organization for Standardization in 1996 and is the most widely adopted certifiable EMS standard with more than 250,972 certified facilities in 155 countries as of December 2010 (<http://www.iso.org/iso/iso-survey2010.pdf>, accessed January 2012).

The implementation of ISO 14001 requires reviewing environmental issues regularly, ascertaining what needs to be done to minimize environmental impacts, providing continuous training for employees, conducting regular reviews and internal audits, and maintaining documentation that will help in codifying the facility's environmental knowledge. The standard specifies process requirements for the design of the EMS. Firms can obtain ISO 14001 certification of their EMS by passing an audit conducted by independent accredited third-party registrars and need to be recertified every three years. The implementation of EMS involves significant internal organizational changes involving changes in environmental policies, goals, strategies, and administrative procedures (Coglianese& Nash, 2001). We define the extent of implementation of ISO 14001 as the degree to which the firm adheres to the

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requirements of the EMS and embeds the activities prescribed by the ISO 14001 standard in its daily routines (Aravind&Christmann, 2011). Firms that implement to a lesser extent fail to continuously comply with the EMS's requirements or use the prescribed activities in their daily operations, while those that implement to a higher extent consistently comply with the requirements of the EMS and embed the prescribed activities into their daily routines.

Environmental Performance

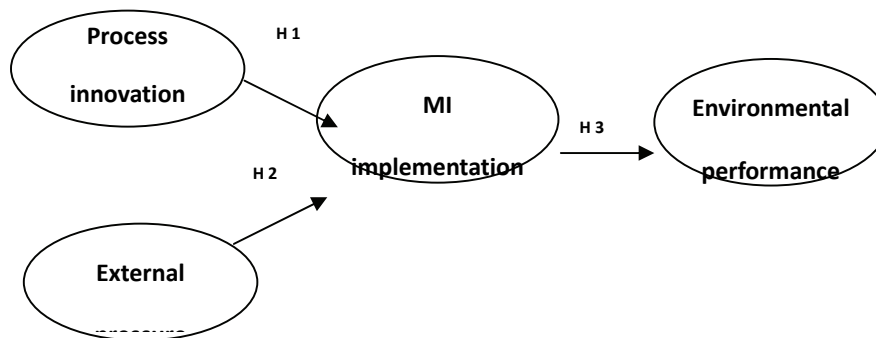
Environmental performance is a critical dimension of organizational effectiveness that needs to be considered by firms (Judge & Douglas, 1998). The expectation is that firms' adherence to the formal requirements of ISO 14001 will lead to changes in how environmental issues are managed that can result in improvements in their environmental performance. First, requirements of the standard such as the senior management commitment, establishment of environmental policies, involvement and training of employees and managers, and regular tracking of firms' environmental performance and progress towards the achievement of its environmental goals contribute to environmental performance improvements. Second, practices such as the identification of environmental aspects in work practices, development of training programs for employees and management, and documentation of environmental practices help to integrate environmental concerns into daily practice, raise management and employee awareness, and add more rigor to environmental programs (Jiang & Bansal, 2003). Third, the implementation of the ISO 14001 EMS often fosters the adoption of additional environmental practices, such as substitution of polluting and hazardous materials, recycling systems, responsible disposal of waste and residues, and acquisition of clean technology (Gonzalez-Benito & Gonzalez-Benito, 2008; Sroufe, 2003). Fourth, ISO 14001's third-party audit system provides a monitoring mechanism that is intended to ensure that certified firms comply with the ISO 14001 requirements. It is intended to assess the extent to which firms comply with ISO requirements and to help spot opportunities for improvement (Jiang & Bansal, 2003). Thus, if implemented well, ISO 14001 has the potential of improving a firm's environmental performance.

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Figure 1 provides our hypothesized model. We propose that a firm's process innovation capability as well as external pressure to be environmentally responsible affect environmental performance, but through the extent of implementation of ISO 14001.

Additionally, findings in extant literature on the performance implications of both process innovation (Augusto, Lisboa&Yasin, 2011; Prajogo, 2006) and external pressure (Lee, 2009), prompted us to include these variables as primary antecedents in our model. For instance, Augusto et al. (2011) found that process innovation was positively related to firm performance, and Prajogo (2006) reported that in manufacturing firms, process innovation had a stronger relationship with firm performance than product innovation. Regarding external pressure, Lee (2009) found that public corporations, as opposed to private ones, were exposed to greater external pressure, and that such pressure led to consistently better environmental performance.

Figure 1: Hypothesized Model



Process Innovation Capability and MI Implementation

Process innovation capability is defined as a firm's ability to introduce innovations in its production processes. This capability is important in gaining the most out of the adoption of new practices. For instance, Christmann (2000) found that process innovation capability is important in gaining a cost

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advantage from implementing environmental best practices such as the use of pollution prevention technologies and addressing environmental issues earlier than competitors.

Firms with high levels of process innovation capability are likely to have a better understanding of their production processes. This understanding is likely to aid them in the measurement, monitoring, and documentation of environmental impacts and the implementation of corrective actions, which are integral to the implementation process of the ISO 14001 EMS. In addition, process innovation capability calls for increased employee skills and involvement, which are required for a greater level of implementation of an EMS (Whitelaw, 2004). Furthermore, process innovation capabilities are also likely to help firms conform to the continuous improvement principle of the ISO standard. Once the ISO system is in place, a firm is supposed to continuously improve the system and manage its environmental issues better. Over time, continuous improvement will call for broader changes in underlying process design and technology (Hart, 1995), which will be easier to implement for firms with higher levels of process innovation capabilities. Therefore, firms with higher process innovation capability are likely to implement the EMS to a higher extent. Such firms are also more likely to gain competitive advantage out of adopting ISO 14001 as opposed to those firms that implement it to a lesser extent. The above discussion leads to the following hypothesis:

Hypothesis 1: Process innovation capability is positively related to the extent of implementation of the ISO 14001 EMS standard.

External Pressure and MI Implementation

The uncertainty and ambiguity related to the adoption and implementation of managerial innovation calls for the critical role of external pressure in enhancing the legitimacy of the innovation, as outlined earlier. Further, external pressure plays a critical role in shaping firm behavior. For instance, institutional theory suggests that firms face significant pressures from

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external constituents such as regulatory agencies, industrial associations, and other stakeholders to adopt practices and structures (Meyer & Rowan, 1977; Scott, 1987; Zucker, 1987). If firms do not conform to these institutional demands, they risk losing their legitimacy, social support, access to resources and other benefits that are associated with conformance (Meyer & Rowan, 1977; Scott, 1987; Zucker, 1987).

In the case of ISO 14001, firms often face pressures from various sources to be environmentally responsible. Such sources include regulatory agencies, neighboring community, customers, shareholders, non-governmental organizations, and so on (Henriques&Sadorsky, 2007; Lee, 2009). Firms also face pressures from neighboring community and environmental organizations. These pressures can also be quite significant as these groups often protest against environmental emissions that reduce their quality of life. Moreover, nearly all industrialized countries now regulate industrial wastes and emissions and firms must undertake pollution control activities in order to remain within the law (Henriques&Sadorsky, 2007). Thus, in many countries firms face significant pressures to conform to environmental regulations. Failure to conform to these pressures could result in negative consequences to the firm. Adoption of ISO 14001 allows firms to signal their environmental responsibility to external stakeholders (Aravind&Christmann, 2011; Christmann& Taylor, 2001).

Studies have suggested that external pressures can induce a firm to work harder at trying to reduce their environmental effects thereby resulting in better quality of EMS implementation. For instance, Sharma and Henriques (2005) found that even when corporate headquarters did not require it, facilities often exceeded governmental regulations pertaining to the environment due to community pressures. Lee (2009) found that those firms that faced higher external pressures are more likely to respond to such pressures by modifying their behaviors. Therefore, we hypothesize:

Hypothesis 2: External pressure is positively related to the extent of implementation of the ISO 14001 EMS standard.

MI Implementation and Performance

Some scholars view the adoption of management innovation as due to firms' desire to conform to institutional requirements and improve their reputations rather than to improve performance (Abrahamson, 1996; Staw& Epstein, 2000). Staw& Epstein (2000) in fact found some evidence that some firms improve their image and reputation, but not their financial performance, by adopting management innovation. There is also another argument within the innovation literature that management innovation can in fact improve performance (Armbruster et al., 2008; Damanpour et al., 1989). This is because firms seek to maintain or improve their level of performance and adopt innovations with the hope of achieving this goal (Naranjo-Gil, 2009). Such positive effects on performance could be due to improved operational efficiency, product quality, flexibility, lower administrative and transaction costs, and improved employee satisfaction and productivity (Armbruster et al., 2008; Gunday et al., 2011). Innovations in fact can have effects on several dimensions of performance such as financial performance, market performance, innovative performance, and production performance (Gunday et al., 2011).

However, for an innovation to deliver these improvements and actually affect the different dimensions of organizational performance, it is necessary for it to be implemented, through the acceptance and regular use of the innovation by employees and other constituents (Walker et al., 2011). Existing evidence on the relationship between implementation of managerial innovation and organizational performance generally points to a positive effect between the two constructs (Camison& Lopez, 2010; Han et al., 1998; Ho, 2010; Mol&Birkinshaw, 2009). For example, in a study of best managerial practices, Camison& Lopez (2010) found that implementation of managerial innovations is positively related to both economic performance and stakeholder satisfaction. Ho (2010), in a study of implementation of strategy, structure, systems, and culture, also found a positive relationship between managerial innovation and both financial and market

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performance. Similarly, Mol&Birkinshaw (2009) found that the implementation of new managerial practices is positively related to firm financial performance.

With regard to the ISO 14001 EMS, if firms implement the system to a high extent, this can lead to changes in their management of environmental issues, which can result in improvements in their environmental performance. For example, senior management commitment, the establishment of environmental policies, involvement and training of employees and managers, and documentation of environmental practices can contribute to environmental performance improvements. Such practices help integrate environmental concerns into daily activities, raise management and employee awareness, and add more rigor to environmental programs (Jiang & Bansal, 2003).

Extant literature that examines the relationship between the extent of implementation of managerial innovation and environmental performance is rare, though more recently a few studies have examined this link. Yin and Schmeidler (2009) found that managers in certified facilities with low quality of the ISO 14001 implementation believe that ISO 14001 does not result in environmental performance benefits. In a study based primarily on survey data on the implementation of the ISO 9000 standard, Naveh et al. (2006) found that the extent of implementation of ISO 9000 is positively related to both operational and financial performance improvements. Using an external measure for environmental performance, Aravind and Christmann (2011) found that certified ISO standard implementers have better environmental performance than their non-certified counterparts. Based on the above evidence, we suggest that:

Hypothesis 3: The extent of implementation of the ISO 14001 EMS standard is positively related to environmental performance.

4. Methods

Sample and Data

Since data on the implementation of ISO 14001 in facilities cannot be obtained from public sources, we tested our hypotheses using data from a mail questionnaire survey of ISO 14001 certified facilities in the United States (Aravind&Christmann, 2011). We obtained a list of 5284 ISO certified facilities from QSU Publishing Company's *ISO 14001 Worldwide Certified Company Directory* (QSU, 2006), the most comprehensive database of certified facilities in the United States. To ensure that we would be able to perform adequate follow-up to the survey resulting in a good response rate, we restricted our mailing sample to six hundred randomly selected facilities from the QSU directory.

The target respondent in our survey was the individual who was responsible for ISO 14001 EMS at the facility and most knowledgeable about the implementation of the system. This approach is the principal methodological solution to using single respondents (Campbell, 1955; John & Reeves, 1982), as the respondent can validly assess the construct (Crampton& Wagner, 1994). We initially identified this individual from the QSU database and made phone calls to each facility in our sample to confirm the identity of this individual. The job title of most respondents was Environmental, Health, and Safety (EHS) Manager (59.9%) or Quality Manager (13.5%). Their average management experience was 14.3 years.

The survey questionnaire was developed based on existing literature and incorporated feedback from managers. We discussed our initial questionnaire during personal interviews with four facility EHS or quality managers who also provided us with extensive written feedback on the survey questions. After making changes based on their suggestions we conducted a pilot study of a shortened version of the questionnaire containing our key measures with managers who attended a regional meeting of the American Society for Quality. Based on this pilot study, we modified some

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of our items and designed a final version of the survey. We based the survey administration on tailored design method which has been shown to improve response rates to mail survey questionnaires (Dillman, 2000).

Two weeks after our first mailing, we sent a reminder letter. We then did two follow-up mailings. Of the 600 mailed surveys, 13 were undeliverable due to incorrect addresses, and of the remaining 587 surveys, 199 were returned completed, yielding an overall response rate of 33.9 percent. Due to incomplete data only 192 of these responses were usable for testing our model. The median size of our respondent facilities was 200 employees with the number of employees ranging from 6 to 2700. The facilities were on average 5.2 years ISO 14001 certified with a minimum of one year and a maximum of eleven years.

We performed several tests to ensure that the respondents were representative of our mailing sample. First, we compared respondents and non-respondents along a known characteristic – facility size – and we compared response rates across industries and geographic locations. We found no significant differences between the two groups of firms in terms of number of employees per facility and no differences in response rate across two-digit SIC industries and states ($p < .05$). Second, we conducted wave analysis to determine whether a self-selection bias existed such that facilities with certain characteristics were more likely to respond to the survey. This method is based on the observation that non-respondents tend to be more similar to late respondents than to early respondents (Fowler Jr., 1993). We found no significant differences in the levels of the variables included in our study or in the relationships among these variables between respondents to the first and the third mailings.

Since common method bias could pose problems for survey research that relies on self-reported data, especially if the data are provided by the same person at the same time (Campbell & Fiske, 1959; Podsakoff et al., 2003), we tried as much as possible to reduce this bias or at least estimate its extent. First, we guaranteed anonymity to the respondents and reduced evaluation

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apprehension by assuring respondents that there are not right or wrong answers. Second, we made every effort to improve our questionnaire items by (1) avoiding vague concepts, (2) keeping questions simple and precise, (3) decomposing questions with more than one possibility to simple, more focused questions, and avoiding double-barreled questions. Third, there may be a concern that because the person responding to the questionnaire is the person responsible for ISO 14001 at the facility, he/she might answer questions related to ISO 14001 in a favorable light. However, this seems not to be problematic in our survey as we received a wide range of qualitative comments about ISO 14001 from the respondents. Some respondents were very optimistic about the system, whereas others were obviously not satisfied with it and viewed it as burdensome and unnecessary. Fourth, we conducted Harman's single factor test (Podsakoff et al., 2003) for the extent of common method variance. Multiple factors with eigenvalues greater than 1.0 emerged from these analyses that accounted for 66% of the total variance. No single factor accounted for a majority of the variance in the data. Together, these suggest that common method bias could not account for all the relationships among scale items in our data set and is not a serious problem in this study.

Measures

Appendix 1 lists the questions used to construct our measures. Reliability coefficients for all multi-item scales are provided in Table 1.

Process innovation capability (PIC) was measured by four items and is based on Christmann (2000). We used the stem question "relative to your major competitors, your facility focuses on" followed by items including "being a leader in process innovation" and "capital investment in new equipment and machinery".

Our measure of *extent of implementation of ISO 14001* (MII) was based on four items used in previous studies (Christmann & Taylor, 2006; Naveh & Marcus, 2005; Naveh & Marcus, 2004). We used the stem question "this question pertains to the implementation and perceptions of the ISO

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14001 EMS at your facility. To what extent” followed by items including “are the documents created for the purpose of ISO 14001 used in daily practice?” and “is the system regularly ignored?”. A low score indicates low extent of MI implementation and a high score indicates a high extent.

We measured *environmental performance* (EP) using six survey items based on Judge and Douglas (1998) and Chan (2005). The stem question was “how does your facility compare with other facilities in your industry along the following dimensions?”, followed by items including “limiting environmental impact beyond complying with regulations” and “preventing environmental accidents”.

Our measure for *external pressure* (ExPr) used four survey items: the stem question was “how strong were the following forces in pressuring your facility to be environmentally responsible” and was followed by regulatory agencies, neighbours of your facility, environmental NGOs and immediate suppliers of your facility.

We controlled for three variables that could potentially affect environmental performance and its relationship with the ISO implementation. First we considered age as a control variable because newer firms may have state-of-the-art facilities and latest production processes and equipment, thereby affecting ISO implementation and environmental performance. Age was measured as the square root of the years since the firm obtained its ISO Certification. Second, we controlled for size because larger firms may have more financial, human, and other resources which would have an effect on our variables of interest. The implementation processes in such firms also tend to be more complex. Size was measured by the logarithm base 10 of the number of employees. Finally, we controlled for technical change in the industry as a rapid pace of technical change in an industry could make it more difficult to implement and maintain management systems as more frequent modification and updates of documentation are required. We measured technical change in industry with a survey item that asked “how would you rate your main product in terms of percent of sales along the following characteristic?” followed by “slow changing technology” (1) to “fast

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changing technology” (7). Table 1 provides descriptive statistics and correlations for all the variables used in the analysis.

Table 1. Means, Standard Deviation and Correlations

Variables	Mean	SD	Correlations						
			PIC	MII	EP	ExPr	Size	Age	
PIC (Processinnovationcapability)	4.92	1.20	(.87)						
MII (Extent of MI implementation)	5.32	1.08	.28**	(.81)					
EP (Environmental performance)	5.38	.85	.382*	.56**	(.88)				
ExPr (Externalpressure)	3.55	1.19	.06	.26**	.28**	(.72)			
Size (Log # of employees)	2.37	.47	.10	.04	.05	.04			
Age (Sq. Rt. years since ISO certification)	2.21	.50	.167*	.15*	-.003	.13	.25**		
Technicalchange in industry	4.46	1.51	.16**	.18*	.13	.23**	.21**	.14	

Note: Reliability coefficients (Cronbach's alpha) for the scales are in parenthesis;

n= 192

* p< .05; ** p < .01(two tailed).

Analysis

We tested our hypotheses with structural equations, employing the EQS 6.1 software to estimate the model (Bentler& Wu, 1995). We used the maximum-likelihood method combined with the method of robust standard estimators to avoid restrictions on the normality of the data (Satorra&Bentler, 2001). Our hypothesized model shown in Figure 1 consists of two exogenous variables (process innovation capability and external pressure) and two endogenous variables (extent of MI implementation and environmental performance). The overall fit of the models was evaluated by a

combination of absolute, incremental, and parsimonious fit indexes recommended by Hair et al. (1992) and Jöreskog and Sorbom (1993). Before the hypothesized model was estimated, the measurement scales of the multi-indicator variables were assessed by conducting confirmatory factor analysis (CFA).

5. Results

Measurement Models

The reliability of the PIC measurement model was assessed by a CFA. The goodness-of-fit indexes of the four-item PIC scale are provided in Appendix 2. The incremental fit indexes (non-normed fit index [NNFI] = .986, comparative fit index [CFI] = .995, incremental fit index [IFI] = .995) exceeded the recommended minimum value of 0.90 (Hair et al. 1992). The absolute fit index root mean square error of approximation (RMSEA) (.053) was sufficiently low, and the parsimonious normed chi-square (NC) index (1.54) was lower than the maximum value of 3.0 (Kline 1998). Besides, all the loadings were greater than 0.70, surpassing the minimum value recommended of 0.50 (Hair et al. 1992). These tests guarantee that the PIC scale fulfills the psychometric properties necessary in measurement scales.

The MI implementation (MII) measurement model was initially composed of 5 items (see Appendix 2). After conducting a CFA, because some of the fit indices were low, we modified the initial model to reach an acceptable fit. Specifically, the item MII 5 was suppressed because of its low factor loading. The resulting measurement model of four items provided an ambiguous fit to the data (see Appendix 2). All the fit indexes considered were higher than 0.90 (CFI = 0.954; IFI = 0.955), except the NNFI that was low (.861); however, the value of the normed fit index was high (NFI=0.942, data not shown). On the other hand, the absolute fit index root mean square error of approximation (RMSEA =.135) was too high (threshold at 0.80). This can be justified by the small sample, but the loading of the item MII 4, reversely scored, is too low (.386) and should be

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discarded to improve the scale. Nevertheless, in order to avoid the saturation of the measurement model and because the scale does not affect the good fit of the structural models, the item MII 4 has been kept in the final scale. The Cronbach's alpha for the four-item scale is 0.742.

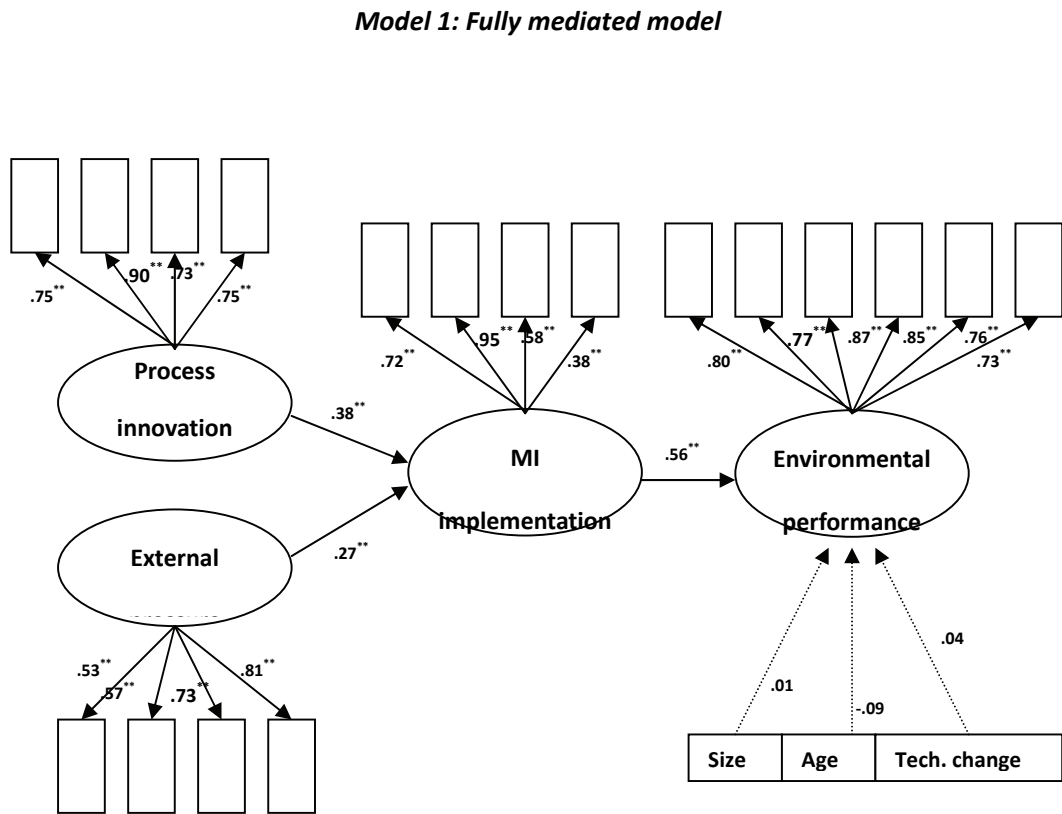
The environmental performance scale, after suppressing the item EP 6 because of its low factor loading (factor loading = .415) provided a perfect fit to the data (see Appendix 2).

The external pressure measurement model was initially composed of five items, but since the CFA results showed a deficient fit, the scale was depurated suppressing the item with lowest loading (ExPr 1, factor loading = .254). The resulting four-item scale obtained an excellent fit in the subsequent CFA (see Appendix 2).

Structural Models

Hypothesized model: The relationships established in the hypotheses were jointly assessed by the structural model (Model 1) and are shown in Figure 2. Applying the maximum-likelihood method, all the indices indicate that the hypothesized model has adequate fit to the data (NNFI = 0.90; CFI = 0.92, IFI = 0.92; NC = 1.40; RMSEA = 0.59). Figure 2 also contains the parameter estimates for the main predictors, significance levels, and proportions of explained variance (R^2).

Figure 2: Path Coefficients for the Hypothesized Model



$R^2 = .32$

$R^2 = .22$

$\chi^2 = 295.7$; d.f. = 186; NNFI = 0.90; CFI = 0.92, IFI = 0.92; NC = 1.40; RMSEA = 0.59

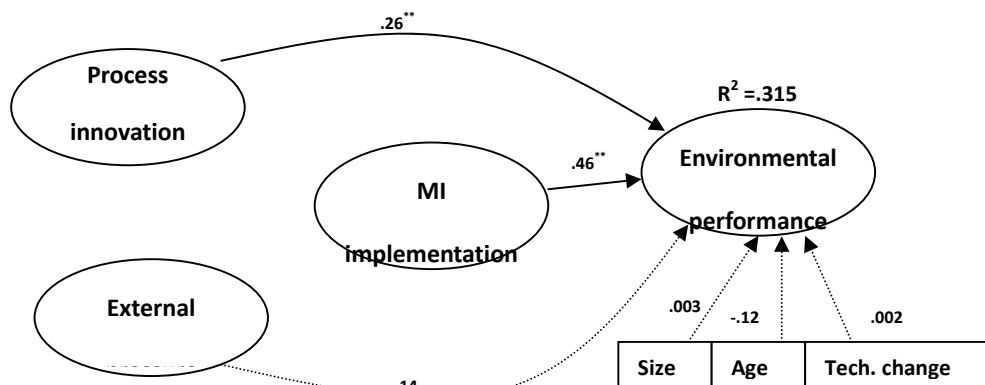
* $p < .05$; ** $p < .01$

The results support all the hypotheses. Hypotheses 1 and 2 were confirmed as the path coefficient of PIC (.38) and ExPr (.27) on MII are positive and significant ($p < .01$), explaining jointly 22% of the MII variance. Hypothesis 3 was also supported as the effect of MII on EP is significant ($p < .01$) and the R^2 of EP is 0.32. None of the three control variables significantly affected EP ($p > .05$).

Alternative Models: The hypothesized model (Model 1) is a fully mediated model because the effects of PIC and ExPr on EP are considered indirect and mediated by MII. To shed more light on the PIC-EP and ExPr-EP relationships, we conducted additional SEM analyses to test the validity of non-mediated and partially mediated models (Figure 3). Model 2 is a non-mediated model and assesses the independent effects of PIC, ExPr, and MII on EP. Model 3 is a partially mediated model where the effects of PIC and ExPr on EP are considered both direct and indirect through MII. These models allow the comparison of direct and indirect effects of PIC, ExPr, and MII on EP.

Figure 3: Alternative Models

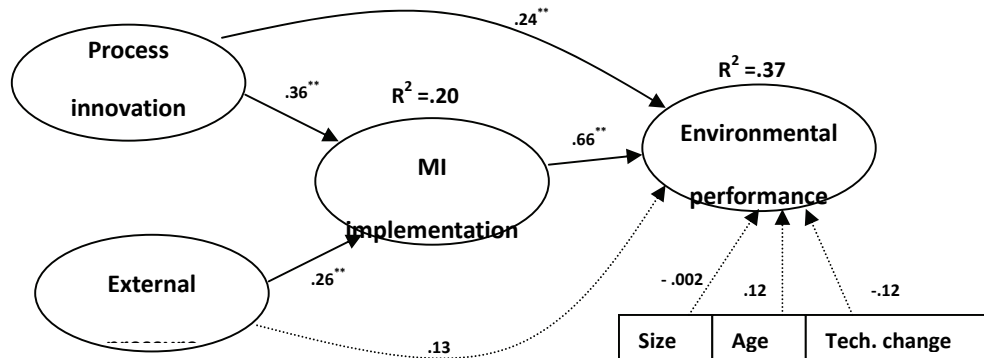
Model 2: Non-mediated model



$\chi^2 = 186.9$; d.f. = 186; NNFI = 0.90; CFI = 0.90, IFI = 0.90; NC = 1.01; RMSEA = 0.064

* $p < .05$; ** $p < .01$

Model 3: Partially mediated model



$\chi^2 = 285.3$; d.f. = 184; NFI = 0.91; NNFI = 0.93; CFI = 0.92, IFI = 0.92; NC = 1.55; RMSEA = 0.057

* p < .05; ** p < .01

In Model 2, the data fitted adequately but just in the threshold to be considered a good fit (NNFI = 0.90; CFI = 0.90, IFI = 0.90; NC = 1.01; RMSEA = 0.064). It is interesting to highlight that the effect of ExPr on EP is not significant whereas the effect of PIC on EP is significant at the 0.01 level. We compared Model 1 and Model 2 to find out which one provides a better fit. Because these models are not nested, the change in the chi-square gives only a relative measure of the difference between them. Hence, we evaluated the difference between the AIC scores of Models 1 and 2 to assess their fit. Because the AIC score for Model 1 (-76.3) is lower than that for Model 2 (-59.1), the hypothesized model (fully mediated model) represents a better fit than the non-mediated alternative model.

The results for Model 3 showed a good fit (NFI = 0.91; NNFI = 0.93; CFI = 0.92, IFI = 0.92; NC = 1.55; RMSEA = 0.057) (Figure 3). In this alternative model, the path coefficient between external pressure and environmental performance is not significant ($p > .05$) suggesting that the ExPr-EP relationship is fully mediated by MII. However, the PIC-EP relationship is partially mediated because the coefficient between PIC and EP is significant ($p < .01$). The addition of this

path makes Model 3 better than Model 1. The difference of chi-squares between Model 1 and Model 3 is 9.78 ($p=.008$), delineating that hypothesized model (Model 1) is inferior to the partially mediated model (Model 3). Model 3 has also a better fit than Model 2 ($\Delta\chi^2 [2] = 29.23, p = .000$).

6. Discussion and Conclusion

Strategy scholars suggest that innovating across the organization would enable an organization to renew its ability to build, reconfigure, and integrate internal and external competencies to cope with environmental change and remain effective over time (Eisenhardt & Martin, 2000; Van den Bosch, Volberda, & de Boer, 1999). Also, the resource-based view suggests that the use of the organization's internal resources, including technological and managerial knowledge resources, lead to performance consequences (Barney, 1991; Damanpour et al., 2009). The importance of both technological and managerial innovations for firm performance and economic growth have also been noted in the economic literature (Lazonick, 1991; Nelson, 1996; Sanidas, 2005).

In this study, we examined ISO 14001 EMS as a managerial innovation and examined the technological innovation-managerial innovation-performance model (Georgantzis & Shapiro, 1993) in the context of US firms. Specifically, we investigated whether the extent of ISO 14001 implementation mediates the relationship between technological process innovation capability and organizational performance. Additionally, we examined the influence of external pressures the extent of implementation of ISO 14001 and organizational performance. We used Structural Equation Modeling to test our hypotheses on a sample of ISO 14001 EMS certified facilities in the US and found that the extent of managerial innovation implementation (1) partially mediates the relationship between technological process innovation capability and environmental performance, and (2) fully mediate the relationship between external pressure and environmental performance.

These findings make several contributions to the literature. First, scholars have suggested that managerial and technological innovations are interdependent and may have synergistic effects

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on performance, that is both together are likely to improve performance to a higher extent than each alone (Ettlie, 1988; Georgantzias& Shapiro, 1993; Naranjo-Gil, 2009). Two models have been identified, based on adoption sequence (Georgantzias& Shapiro, 1993). However, the innovation literature has not, as yet, reached a conclusion as to whether the technological innovation-managerial innovation-performance model or the managerial innovation-technological innovation-performance model is more valid. However, there is reasonable consensus that both models are feasible (Damanpour& Evan, 1984; Damanpour et al., 2009; Gunday et al., 2011; Han et al., 1998; Subramanian & Nilakanta, 2006; Walker, 2004). We contribute to this debate by focusing on the technological innovation-managerial innovation-performance model and finding that this model is indeed valid in our study.

Some researchers have argued for a balanced rate of adoption of managerial and technological innovations as more effective in improving performance than implementing either of them alone (Damanpour and Evan, 1984; Damanpour et al., 1989; Naranjo-Gil, 2009; Santos & Alvarez-Gonzalez, 2007; Tuominen&Antila, 2006). While this study cannot draw conclusions on the rate of adoption of the two types of innovations, the study corroborates the view that both innovations together have positive effects on performance.

Second, we went beyond extant studies (Aravind&Christmann, 2011; Yin &Schmeidler, 2009) and suggested a more nuanced model to clarify the mediating role of the extent of implementation of managerial innovation on performance. We found that technological process innovation capability affects environmental performance directly, as well as indirectly through the extent of implementation of ISO 14001. This finding suggests the need for firms to invest in process innovation capability in order to get more benefits out of managerial innovations like the ISO 14001 EMS. Moreover, we found that extent of implementation of ISO 14001 completely mediates the relationship between external pressure for firms' environmental responsibility and environmental performance. This finding adds to prior studies (e.g., Lee, 2009), which have not captured the true

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nature of the impact of external pressure on performance dimensions, and suggests that external pressure does not affect environmental performance unless it is channeled through proactive initiatives such as implementing ISO 14001 to a higher extent.

Third, we address the imbalance in the innovation literature where technological product innovation has received much of the scholarly attention to the detriment of technological process and managerial innovations (Keupp, Palmie, & Gassmann, 2011). More recently, it has been suggested that managerial innovation may be one of the very important and sustainable sources of competitive advantage for firms (Hamel, 2006, 2007; Mol & Birkinshaw, 2009). So scholars have to pay much more attention to this type of innovation to provide a more balanced account of these types of innovation. Our study contributes to this area by focusing on both managerial and technological process innovation.

Fourth, we focus on the role of implementation of managerial innovation that has not received much research attention. In the environmental management literature for instance, studies of environmental management systems have not considered implementation issues much and have almost exclusively considered adoption or the act of certification (Darnall, 2001, 2003; King et al., 2005). Prior innovation research suggests that if an innovation is not implemented, it will not affect firm processes and behavior and will not influence performance outcomes. Thus, ineffective implementation could be a major cause for the inability of firms to improve their performance through innovation adoption (e.g., Klein & Sorra, 1996). Accordingly, we found that the extent of managerial innovation implementation does indeed have a significant impact on environmental performance. In this vein, our findings underscore the need for practicing managers to be cognizant of implementation issues and allocate necessary resources to ensure effective implementation of managerial innovations to attain desired performance outcomes.

A limitation of this research is that there may be other variables that affect the implementation of management innovation and firm performance. For example, organizational

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culture or employee behaviors can have an impact on innovation implementation. Our data did not allow us to test these effects. Also, future research should attempt to avoid the issue of common method bias by utilizing multiple data sources. Qualitative and more longitudinal studies examining the variables studied in this research would also be valuable contributions to research. Finally, the findings of our study emerge from data collected based on data at one point in time from one country which indicates that the findings need to be corroborated by further research in other contexts.

In summary, this study suggests that a better understanding of performance consequences of innovation adoption and implementation requires developing and testing more complex models that account for the interplay between managerial innovation implementation with process innovation capability and external pressure for environmental responsibility. Future research could contribute by including additional variables to our model, testing other types of managerial innovation, utilizing different analytical methods, and developing entirely new models to examine performance consequences of managerial innovation in organizations.

7. References

- Aravind, D. and P. Christmann, 2011, "Decoupling of standard implementation from certification: Does quality of ISO 14001 implementation affect facilities' environmental performance?" *Business Ethics Quarterly*, 21: 75-104.
- Augusto M., J. Lisboa J. and M. Yasin, 2011, "The impact of innovation on the relationship between manufacturing flexibility and performance: A structural modelling approach". *International Journal of Business Research*, 11: 65-72.
- Barney, J., 1991, "Firm resources and sustained competitive advantage". *Journal of Management*, 17: 99.
- Bentler, P.M. and E. J. C. Wu, 1995, *EQS for Windows: User's guide*. Encino, CA: Multivariate Software, Inc.
- Birkinshaw, J., G. Hamel and M. J. Mol, 2008, "Management innovation". *Academy of Management Review*, 33: 825-845.
- Boer, H. and W. Doring, 2001, "Innovation, what innovation? A comparison between product, process and organisational innovation", *International Journal of Technology Management*, 22: 83-107.
- Bollen, K. A., 1987, "Total, direct, and indirect effects in structural equation models". In C. C. Clogg (Ed.), *Sociological methodology*, Washington, DC: American Sociological Association, pp 37-69.
- Camison, C. and A. V. Lopez, 2010, "An examination of the relationship between manufacturing flexibility and firm performance: The mediating role of innovation". *International Journal of Operations and Product Management*, 30: 853-78.
- Campbell, D. T., 1955, "The informant in quantitative research". *American Journal of Sociology*, 60: 339-342.
- Campbell, D. and D. Fiske, 1959, "Convergent and divergent discriminant validation by the multitrait-multimethod matrix". *Psychological Bulletin*, 56: 81-105.
- Chan, R. Y. K., 2005, "Does the natural-resource-based view of the firm apply in an emerging economy? A survey of foreign investment enterprises in China". *Journal of Management Studies*, 42: 625-666.
- Cheung, M. W. L., 2007, "Comparison of approaches to constructing confidence intervals for mediating effects using structural equation models". *Structural Equation Modeling*, 14: 227-246.
- Christmann, P., 2000, "Effects of "best practices" of environmental management on cost advantage: The role of complementary assets". *Academy of Management Journal*, 43: 663-680.

ORGANIZATIONAL INNOVATION WORKSHOP

- Christmann, P. and G. Taylor, 2001 “Globalization and the Environment: Determinants of Firm Self-Regulation in China”. *Journal of International Business Studies*, 32: 438-458.
- Christmann, P. and Taylor, G. 2002, “Globalization and the Environment: Strategies for International Voluntary Initiatives”. *Academy of Management Executive*, 16(3): 121-135.
- Christmann, P. and G. Taylor, 2006, “Firm self-regulation through international certifiable standards: Determinants of symbolic versus substantive implementation”. *Journal of International Business Studies*, 37: 863-878.
- Coglianesi, C. and J. Nash, 2001, “Environmental Management Systems and the new policy agenda”. In C. Coglianesi & J. Nash (Eds.), *Regulating from the inside. Can Environmental Management Systems achieve policy goals?* Washington, DC: Resources for the Future, pp 1-26.
- Crampton, S. M. and M. A. Wagner, 1994, “Percept-percept inflation in microorganizational research”. *Journal of Applied Psychology*, 79: 67-76.
- Damanpour, F. and D. Aravind, 2006, “Product and process innovations: A review of organizational and environmental determinants”. In J. Hage & M. Meeus (Eds.) *Innovation, science, and institutional change*. Oxford: Oxford University Press, pp38–66.
- Damanpour, F. and D. Aravind, 2011, “Managerial Innovation in Organizations: Conceptions, Processes and Antecedents”. *Management and Organization Review*. doi: 10.1111/j.1740-8784.2011.00233.x
- Damanpour, F., R. M. Walker and C. N. Avellaneda, 2009, “Combinative effects of innovation types on organizational performance: A longitudinal study of public services”. *Journal of Management Studies*, 46: 650–675.
- Darnall, N., 2001, *Adopting ISO 14001: Why some firms mandate certification while others encourage it*. Paper presented at the 23rd Annual Research Conference for the Association for Public Policy Analysis and Management Fall conference, Washington D.C.
- Darnall, N., 2003, *Why U.S. firms certify to ISO 14001: An institutional and resource-based view*. Paper presented at the Best Paper Proceedings of the Academy of Management Conference, Seattle, Washington.
- Dillman, D.A., 2000, *Mail and Internet surveys: The tailored design method*. John Wiley and Sons, New York, NY.
- Douglas, T. J. and W. Q. Judge, 2001, “Total Quality Management implementation and competitive advantage: The role of structural control and exploration”. *Academy of Management Journal*, 44: 158-169.
- Edquist, C., C. L. Hommen, and M. McKelvey, 2001, *Innovation and employment: Process versus product innovation*. Cheltenham, UK: Edward Elgar.

ORGANIZATIONAL INNOVATION WORKSHOP

- Eisenhardt, K. and J. A. Martin, 2000, "Dynamic capabilities: What are they?". *Strategic Management Journal*, 21: 1105–1121.
- Fowler Jr., F. J. S., 1993, *Survey research methods*. Newbury Park, CA: Sage.
- Gonzalez-Benito, J. and O. Gonzalez-Benito, 2008, "Operations management practices linked to the adoption of ISO 14001: An empirical analysis of Spanish manufacturers". *International Journal of Production Economics*, 113: 60-73.
- Hair, J. F., R. E. Anderson, R. L. Tatham and W. C. Black, 1992, *Multivariate data analysis*. New York: Macmillan Publishing Company.
- Hamel, G., 2006, "The why, what and how of management innovation". *Harvard Business Review*, 84: 72–84.
- Han, J. K., N. Kim and R. K. Srivastava, 1998, "Market orientation and organizational performance: Is innovation the missing link?". *Journal of Marketing*, 62: 30-45.
- Henriques, I. and P. Sadowsky, 2007, "Environmental technical and administrative innovations in the Canadian manufacturing industry". *Business Strategy and the Environment*, 16: 119-132.
- Ho, L., 2010, "Meditation, learning, organizational innovation, and performance". *Industrial Management and Data Systems*, 111: 113-131.
- Jiang, R. J. and P. Bansal, 2003, "Seeing the need for ISO 14001". *Journal of Management Studies*, 40: 1047-1067.
- John, G. and T. Reeves, 1982, "The reliability and validity of key informant data from dyadic relationships in marketing channels". *Journal of Marketing Research*, 19: 517-525.
- Judge, W. Q. and T. J. Douglas, 1998, "Performance implications of incorporating natural environmental issues into the planning process: An empirical assessment". *Journal of Management Studies*, 35: 241-262.
- Keupp, M. M., M. Palmié and O. Gassmann, 2011, "The strategic management of innovation: A systematic review and paths for future research. *International Journal of Management Reviews*. doi: 10.1111/j.1468-2370.2011.00321.x
- Kimberly, J. R., 1981, "Managerial innovation". In P. C. Nystrom & W. H. Starbuck (Eds.), *Handbook of organizational design*. New York, NY: Oxford University Press, pp 104.
- Klein, K. J. and J. S. Sorra, 1996, "The challenge of innovation implementation". *Academy of Management Review*, 21: 1055-1080.
- Kline, P. B., 1998, *Principles and practices of structural equation modeling*. New York: Guilford.
- Joreskog, K. G. and D. Sorbom, 1993, *LISREL 8 user's reference guide*. Chicago: Scientific Software International.

ORGANIZATIONAL INNOVATION WORKSHOP

- King, A. A., M. J. Lenox and A. Terlaak, 2005, "The strategic use of decentralized institutions: Exploring certification with the ISO 14001 management standard". *Academy of Management Journal*, 48: 1091-1106.
- Lazonick, W., 1991, *Business organizations and the myth of the market economy*. New York: Cambridge University Press.
- Min-Dong, P. L., 2009, "Does Ownership Form Matter for Corporate Social Responsibility? A Longitudinal Comparison of Environmental Performance between Public, Private, and Joint-venture Firms". *Business & Society Review*, 114: 435-456.
- Meyer, J. W. and B. Rowan, 1977, "Institutionalized organization: Formal structure as myth and ceremony". *American Journal of Sociology*, 83: 340-363.
- Naveh, E. and A. A. Marcus, 2004, "When does the ISO 9000 quality assurance standard lead to performance improvement? Assimilation and going beyond". *IEEE Transactions on Engineering Management*, 51: 352-363.
- Naveh, E. and A. Marcus, 2005, "Achieving competitive advantage through implementing a replicable management standard: Installing and using ISO 9000". *Journal of Operations Management*, 24: 1-26.
- Naveh, E., O. Meilich and A. A. Marcus, 2006, "The effects of administrative innovation implementation on performance: An organizational learning approach". *Strategic Organization*, 4: 275-302.
- Nelson, R. R., 1996, "The evolution of comparative or competitive advantage: A preliminary report on a study". *Industrial and Corporate Change*, 5: 597-617.
- Podsakoff, P. M., S. B. MacKenzie, J.-Y. Lee and N. P. Podsakoff, 2003, "Common method biases in behavioral research: A critical review of the literature and recommended remedies". *Journal of Applied Psychology*, 88: 879.
- Prajogo, D. I., 2006, "The relationship between innovation and business performance—a comparative study between manufacturing and service firms". *Knowledge & Process Management*, 13: 218-225.
- Repenning, N. P., 2002, "A simulation-based approach to understanding the dynamics of innovation implementation". *Organization Science*, 13: 109-127.
- Rogers, E. M., 1995, *Diffusion of innovations*. New York: Free Press.
- Sanidas, E., 2005, *Organizational innovations and economic growth: Organosis and growth of firms, sectors, and countries*. Cheltenham, UK: Edward Elgar.
- Satorra, A. and P. M. Bentler, 2001, "A scaled difference chi-square test statistic for moment structure analysis". *Psychometrika*, 66: 507-514.

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- Schilling, M. A., 2008, *Strategic management of technological innovation*. New York: McGraw-Hill Irwin.
- Scott, R. W., 1987, "The adolescence of institutional theory". *Administrative Science Quarterly*, 32: 493-511.
- Sroufe, R. P., 2003, "Effects of environmental management systems on environmental management practices and operation". *Production and Operations Management*, 12: 416-431.
- Starik, M., and Rands, G. P., 1995, "Weaving an integrated web: Multilevel and multisystem perspectives of ecologically sustainable organizations". *Academy of Management Review*, 20(4): 908-935.
- Staw, B. M. and L. D. Epstein, 2000, "What bandwagons bring: Effects of popular management techniques on corporate performance, reputation, and CEO pay". *Administrative Science Quarterly*, 45: 523-556.
- Utterback, J. M., 1994, *Mastering the dynamics of innovation*. Cambridge, MA: Harvard Business Press.
- Van den Bosch, F.A.J., H. W. Volberda and M. De Boer, 1999, "Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities". *Organization Science*, 10: 551-568.
- Venkatraman, N., and V. Ramanujam, 1986, "Measurement of business performance in strategy research: A comparison of approaches". *Academy of Management Review*, 11(4): 801-814.
- Walker, R.M., F. Damanpour and C. A. Devece, 2011, "Management innovation and organizational performance: The mediating effect of performance management". *Journal of Public Administration Research & Theory*, 21: 367-386.
- Whitelaw, K., 2004, *ISO 14001 Environmental Systems Handbook* (2 ed.) Butterworth-Heinemann.
- Yin, H. and P. Schmeidler, 2009, "Why do standardized ISO 14001 environmental management systems lead to heterogeneous environmental outcomes?". *Business Strategy and the Environment*, 18: 469-486.
- Zucker, L. G., 1987, "Institutional theories of organizations". *Annual Review of Sociology*, 13: 443-464.

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Construct	Indicator
<i>Environmental performance</i>	<p><u>Survey Items: (rated on 7-point Likert scale)</u></p> <p>How does your facility compare to other facilities in your industry along the following dimensions? (<i>Much below average...Average...Much above average</i>)</p> <ol style="list-style-type: none">1) Complying with environmental regulations2) Limiting environmental impact beyond complying with regulations3) Preventing environmental accidents4) Lessening the impact of environmental accidents5) Educating employees about the environment6) Environmental performance
<i>Extent of MI implementation</i>	<p><u>Survey Items: (rated on 7-point Likert scale)</u></p> <p>This question pertains to the implementation and perceptions of the ISO 14001 EMS at your facility. To what extent (<i>Not at all..To a large extent</i>):</p> <ol style="list-style-type: none">1) are the documents created for the purpose of ISO 14001 used in daily practice?2) has the ISO 14001 system become part of your regular routine?3) are preparations for external audits made at the last minute? (reverse-scored)4) is the system regularly ignored? (reverse-scored) <p>(Correlated this measure with average emissions data from US TRI database – obtained a significant negative correlation)</p>
<i>Process innovation capability</i>	<p><u>Survey Items: (rated on 7-point Likert scale)</u></p> <p>Relative to your major competitors, your facility focuses on(<i>Strongly disagree..Strongly agree</i>):</p> <ol style="list-style-type: none">1) being the first in the industry to try new methods and technologies2) using the latest technology in production3) capital investment in new equipment and machinery4) being a leader in process innovation
<i>External pressures</i>	<p><u>Survey Items: (rated on 7-point Likert scale)</u></p> <p>How strong are the following forces in pressuring your facility to be environmentally responsible? (<i>No pressure..Moderate pressure..Intense pressure</i>)</p>

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1) Immediate suppliers of your facility

2) Regulatory agencies

3) Environmental Non-Governmental Organizations (NGOs)

Technological 4) Neighbors of your facility

change in industry Survey Items: (rated on 7-point Likert scale)

How would you rate your main product (in terms of percent of sales) along the following characteristic?

1) Slow changing technology...Fast changing technology

Facility size

Logarithm of the number of employees in the facility.

Survey question:

Approximately, how many employees does your facility have?

(Triangulated with data from Dunn and Bradstreet database)

Control Variables

Time since ISO certification

Square root of the number of years since initial ISO 14001 certification, based on the response to the survey question:

In which year did your facility first obtain ISO 14001 certification?

(Triangulated with data from QSU database)

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Appendix 2: Measurement Model Properties

Item	Process innovation capability	Loadings ^a	R ²
PIC 1	Being the first in the industry to try new methods and technologies	0.774	0.599
PIC 2	Using the latest technology in production	0.915	0.837
PIC 3	Capital investment in new equipment and machinery	0.741	0.549
PIC 4	Being a leader in process innovation	0.740	0.548

NNFI = 0.986; CFI = 0.995; IFI = 0.995; NC = 1.54; RMSEA = 0.053

Item	Extent of MI implementation	Loadings ^a	R ²
MII 1	Are the documents created for the purpose of ISO 14001 used in daily practice?	.721	.519
MII 2	Has the ISO 14001 system become part of your regular routine?	.978	.957
MII 3	Does facility management implement corrective actions based on ISO 14001 audit findings?	.548	.300
MII 4	Are preparations for external audits made at the last minute? *	.386	.149
MII 5	Is the system regularly ignored? *†	-	-

NNFI = 0.861; CFI = 0.954; IFI = 0.955; NC = 4.46; RMSEA = 0.135

Item	Environmental performance	Loadings ^a	R ²
EP 1	Complying with environmental regulations	0.810	0.656
EP 2	Limiting environmental impact beyond complying with regulations	0.797	0.635
EP 3	Preventing environmental accidents	0.869	0.755
EP 4	Lessening the impact of environmental accidents	0.856	0.732
EP 5	Educating employees about the environment	0.751	0.564
EP 6	Educating the public about the environment†	-	-
EP 7	Environmental performance	0.726	0.527

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NNFI = 0.984; CFI = 0.990; IFI = 0.991; NC = 1.60; RMSEA = 0.057

Item	External pressures	Loadings^a	R²
ExPr 1	Immediate customers of your facility †	-	-
ExPr 2	Immediate suppliers of your facility	0.553	0.306
ExPr 3	Regulatory agencies	0.566	0.321
ExPr 4	Environmental Non-Governmental Organizations (ENGO??)	0.749	0.560
ExPr 5	Neighbours of your facility	0.801	0.641

NNFI = 1.02; CFI = 1.0; IFI = 1.0; NC = 0.306; RMSEA = 0.000

* Item is reversely scored

† Item dropped from the final scale

^aLoadings are standardized

p< .01 for all loadings

THE FATEFUL TRIANGLE. COMPLEMENTARITIES IN PERFORMANCE BETWEEN PRODUCT, PROCESS AND ORGANIZATIONAL INNOVATION IN FRANCE AND THE UK

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Abstract

This paper explores the relationships among product, process and organizational innovation, examining the complementarities-in-performance between these forms of innovation, within a supermodularity framework. Drawing upon two rich samples of French and UK manufacturing firms using CIS4 (2002-2004), we explore whether firms can find a beneficial interplay between different forms of innovation. Since unconditional tests are often inconclusive about these complementarities, we implement a new procedure involving a pairwise relation conditional on the presence/absence of a third form. Using this approach, we find complementarities between product and process innovations in French and UK firms and between organization and product innovations in French firms, but no complementarities between all three forms of innovation. Using different sub-samples, we show that the presence of complementarities depends on the national context as well as on firm size and firm capabilities, which gives support to the contingency perspective.

Keywords: Innovation, Product Innovation, Process Innovation, Organizational Innovation Complementarities, Supermodularity, UK, France

JEL codes: C12, D24, L25, O31

1. Introduction

This paper explores the relationship between product, process and organizational innovations in order to better understand the complementarities between different forms of innovation. Milgrom and Roberts's (1990, 1995) seminal contributions provoked increased research interest in the complementarities in economics and management. This body of work explores conditions when the sum is more than its parts, and examines the beneficial interplay between different parts in a system (Athey & Stern, 1998). The complementarities perspective does not constitute a theory of organizational design or performance, but rather is an approach that provides a better understanding of relational phenomena and how relationships between parts of a system create more value than the system's individual elements (Ennen & Richter, 2010). The complementarities perspective helps to enrich our understanding of how different practices and strategies are combined and recombined, and how such combinations shape subsequent performance.

Complementarities research uses two broad approaches to measure and understand complementarities: we term them *complementarities-in-use* and *complementarities-in-performance*. *Complementarities-in-use* arise from the linking between two sets of activities such that employment of one practice often requires the addition of some other practice. In this case, there is a good fit between these practices, suggesting a mutual and beneficial interaction. Researchers investigating complementarities in use have sought to identify relatedness in the use of different practices and to show that certain practices tend often to be linked. *Complementarities-in-performance* explores the effects on performance of the use of different practices in combination. This group of studies directly tests the economic value to the firm of combining different activities or practices, and shows that their joint application can produce economic benefits that are greater than the individual parts.

Using UK and French Community Innovation Survey 2005 data, we explore the effects on performance of the presence of different combinations of three forms of innovation. We test for

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complementarity by applying a supermodularity framework and proxying performance by sales per employee. Our approach builds on techniques developed in Mohnen and Röller (2005) and implemented by Leiponen (2005), Cassiman and Veugelers (2006), Cozzarin and Percival (2006) and Miravete and Pernias (2006). To test these complementarities, we implement a conditional test procedure involving pairwise relations conditional on the presence/absence of the third form. We investigate the complementarities between the different forms of innovation: product, process and organization and then explore differences across sub-samples from two countries, from different size groups, and among high-R&D and low-R&D intensive firms. The results show that complementarities between innovation forms are highly contingent. We find that firms derive benefits from the combination of product and process innovations, and from the combination of organizational and product innovations, but gain no advantage from a combination of all three forms of innovation. We show also that the national context and firm characteristics matter. UK firms appear less able than French firms to exploit the complementarities between different forms of innovation, and smaller firms and less R&D intensive firms are less able to profit from the complementarities between different forms of innovation than large firms and R&D intensive firms. Our paper is among the firsts to investigate simultaneously the complementarities between technological and organizational innovations within the supermodularity framework. The results help to enrich the understanding of the relations between different forms of innovation obtained by previous research methodologies (Schmidt and Rammer, 2007; Mol and Birkinshaw, 2009; Battisti and Stoneman, 2010; and Evangelista and Vezzani, 2010).

The structure of the paper is then as follows. The section 2 presents the evolution of the literature on complementarities and the associated methodologies. Section 3 describes the data set and the econometric methodology and section 4 the results. A final section concludes.

2. Complementarities in the innovation literature

2.1 The classical literature on complementarities among innovations

The recent focus in the innovation literature on complementarities is not new. Since Schumpeter (1934), it has been widely acknowledged that there are strong complementarities between forms of innovation. For example, innovation scholars have highlighted that radical innovations often involve changes in products and in production processes (Freeman & Soete, 1997; Utterback, 1994) as well as changes to the marketing, delivery and geographic scope of sets of production or service activities. This characteristic of innovation suggests that studies that focus on one form of innovation, for example product, process or organization innovation may overlook important relationships between these forms. In order for the firm to benefit from innovation it may be necessary to make changes to other parts of its innovation efforts, including the system of production or delivery and the organizational structure that supports the innovation (Pisano, 1990). The importance of different forms of innovation is reflected in Teece's (1986) profiting from innovation framework, which emphasizes that the returns from innovation usually accrue to organizations that hold valuable and rare complementary assets. Organizational coherence is critical to ensure the benefits of complementarity, but the complexity of a complementarity strategy has also the advantage of protecting against imitation and may provide a lasting competitive advantage (see Rivkin (2000)).

Empirical research on the complementarities between different forms of innovation is being enabled by data provided by the Community Innovation Surveys. Several studies focus on the complementarities-in-use between product and process innovation (Martínez-Ros & Labeaga, 2009) and show that new products may require changes to production processes or vice-versa. For a sample of UK manufacturing firms, Reichstein and Salter (2006) found that the overlap between the two forms of innovation was greatest when the level of novelty of the innovations was high.

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However, their methodology has some limitations since it is based on correlation among residuals. These limitations include omitted variables and endogeneity problems, and lack of evidence of the impact of these combinations of innovations on performance (Athey & Stern, 1998).

In 2005, the CIS3 collected information on a wider range of innovative efforts, renewing research interest in the relationship between product/process innovation and ‘non-technological’ innovation. According to the Oslo manual (OECD, 2005), non-technological innovation covers “new or significantly amended forms of organization, business structures or practices, aimed at step changes in internal efficiency or effectiveness or in approaching markets and customers”. The concept of ‘non-technological innovation’ remains associated with ‘organizational’ or ‘managerial’ innovation, and has spawned a wide range of research on its causes and consequences and its relation to other forms of innovations (see Schmidt and Rammer, 2007; Ballot, Fakhfakh, Galia and Salter, 2011).

Recently researchers have focused on complementarities-in-performance using interaction terms and cluster methodologies. Some studies investigate interaction terms in a performance equation.¹ Schmidt and Rammer (2007) use German CIS4 data to investigate the link between non-technological innovation and profit margins. They find that the propensity to introduce technological and non-technological innovations is similar and that these forms are closely related. They find also that the effects of non-technological innovation on the firm’s profit margins are much smaller than the effects of technological innovation, but that the combination of technological and non-technological innovation has a positive impact on profit.

Sapprasert and Clausen (2012) explore the impact of organizational innovation for a sample of Norwegian firms, using information from two waves of the CIS and published data on

¹ For purposes of brevity, we do not include work on the effects of different forms of innovation (including non-technological innovation) on performance that does not consider formal interactions between these forms of innovations (Mol and Birkinshaw, 2009) or when it excludes technological innovation (Shaparov and Kattuman, 2010).

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performance. They find that “firms can better reap the rewards of reorganization by jointly reorganizing with technological innovation”, indicating that there is strong complementarity between organizational and technological innovation (Sapprasert and Clausen 2012: 1298). They use a dummy for the joint occurrence of technological and non-technological innovation to capture this complementarity, and the associated outcome is a score based on six effects of organizational innovation. However, this approach of using interaction terms between more than two forms of innovation may not be suited to testing for complementarities because it requires to take into account all possible interactions, which can lead to severe multi-collinearity problems and make interpretation difficult.

Cluster analysis is another methodology frequently used to study complementarities in innovation. Firms are grouped according to form of innovation, with or without factor analysis. Using this approach, Battisti and Stoneman (2010) explore the relationships among different forms of innovation. They find that organizational innovation plays an important role in shaping the innovative activity in UK firms. Their two-step cluster analysis shows that firms that are innovative in one dimension tend to be more innovative in other dimensions, suggesting a degree of complementarity between different forms of innovation. A study of Spanish firms by Hervás-Oliver et al. (2012) also finds evidence that the development of organizational innovations increases amplify the likelihood of introducing a process innovation. Evangelista and Vezzani (2010) in a study of Italian firms explore the performance of firms using four different strategies of innovation, which correspond to different combinations of product, process and organizational innovations. Although they do not formally test for complementarities, they find that those firms whose development strategies involve more than one form of innovation grow faster than those firms that concentrate on one form of innovation. Evangelista and Vezzani (2012) explore the impact of technological and organizational innovations on employment in six EU countries, exploiting CIS4 microdata and using a clustering method. They find that a combination of product, process and

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organizational innovation has the strongest impact on employment.

Although useful, the results of these cluster and factor approaches discussed above may fail to directly test the effect of complementarities on performance. According to Shaparov and Kattuman (2010), "[t]he clusters or factors are linear combinations of the underlying practice variables and their use as explanatory variables in a performance equation will not capture any non-linear interaction effects between practices". However, it is these non-linear interaction effects that are at the heart of the complementarity concept.

2.2 The supermodularity approach

To overcome the limitations associated with the approaches discussed above, we use a methodology based on the supermodularity framework. Milgrom and Roberts (1990) propose mathematical tools based on lattice theory (Topkis, 1978; 1998) to develop economic models of Edgeworth complementarity and Milgrom and Roberts (1995) propose a simple model to explain the move from the Fordist ("mass production") firm to the "modern" lean, flexible firm. Complementarity implies that the main factors have to switch together to very different values, including the extreme case where new factors appear (such as the flexible machines) in order to make the new organization of the firm more efficient than the Fordist firm.

A major problem with the analysis of complementarities in empirical analysis was the need for the divisibility of the choice variables, the smoothness and continuity of the objective function. This was a major obstacle for considering changes in organisation and introduction of innovations, which are often discrete. Milgrom and Roberts (1990) show that lattice theory refers to the possibility of ordering: doing more than one thing increases the returns to doing more of another. Smoothness, concavity and even continuity are not necessary. In the simplest case in which two factors x and y take two values, 0 and 1, the complementarities are expressed by the following condition on the objective function $f(x, y)$:

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$$f(1,1) - f(1,0) > f(0,1) - f(0,0)$$

Such a function is said to be strictly supermodular in x and y .

This framework has been applied to find complementarities between practices in a range of settings, including human resources management, strategy, resources, knowledge management, advanced manufacturing technology (see Ennen & Richter, 2010 for a summary of this literature).

In the literature on innovation, two seminal empirical papers have implemented the methodology of supermodularity in the field of innovation, although they have not dealt with the complementarities between forms of innovation. Mohnen and Röller's (2005) study examines the factors that affect innovation, using micro data on four countries from CIS1 for 1992. They consider four obstacles to innovation: risk and finance, knowledge-skill within the enterprise, knowledge-skill outside the enterprise, and regulation. Their results suggest several complementarities between pairs of obstacles with the probability of becoming an innovator as the objective function, and more substitutabilities if the objective function is intensity of innovation.² Cassiman and Veugelers's (2006) paper tests the complementarity in performance between internal R&D and external knowledge acquisition, for a sample of 269 Belgian firms. They find complementarity and show also that this complementarity has a stronger effect on performance if the sample is reduced to firms that rely heavily on basic R&D, that is, firms are more reliant on information from research institutes and universities than information from suppliers and customers.

A small number of studies exploit supermodularity methods to estimate the complementarities-in-performance between forms of innovation. Miravete and Pernias (2006) test for the existence of complementarity between product innovation, process innovation and scale of production (measured by output) for a set of 432 Spanish firms in the ceramic tile industry. They

² Cozzarin and Percival (2006) and Percival and Cozzarin (2008) investigate complementarities in performance among four variables and Leiponen (2005) applies supermodularity tests to three variables, but do not deal with the different forms of innovation presented above.

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conclude that the significant association between product and process innovation is due mostly to unobserved heterogeneity. Polder, van Leeuwen, Mohnen and Raymond (2010) use the supermodularity approach in a three-step model within the CDM framework. They first explain the level of R&D expenditure and Information and Communication Technologies (ICT) usage then use a trivariate probit to explain product, process and organizational innovations by R&D and ICT. These three forms of innovations are then used in the production function, which corresponds to total factor productivity, and then the authors conduct tests for complementarities. Their model is estimated using Dutch firm data; the main result is that product and process innovations, and process and organizational innovations, are complementary, but that product and organizational innovations are substitutes.

Doran (2012), using Irish CIS 2006 data, tests the complementarities between four forms of innovation: products new to the market, products new to the firm, process innovation, and organizational innovation. Doran tests for pair-wise complementarities and substitutions and out of six possible innovative combinations, finds strict³ complementarity for new to the market product and organizational innovations, and new to the firm product and process innovations, and weak complementarity between process and organization innovations. Doran finds no evidence of substitutability. He interprets the strict complementarities between the two distinct combinations as winning synergies. Organizational innovation is required to facilitate new to the market product innovation, while process innovation accompanies new to the firm innovation (the causality probably goes both ways). There is some logic in the fact that new to the market innovation requires some reorganization within the firm and that new to the firm innovation, which is a weaker form of innovation, in fact imitation, does not. These are interesting results, but need to be extended since the method employed raises some questions. For example, the sample size (562 firms) limits interpretation because the 16 combination forms include only a small number of firms. It is likely

³ See Appendix 1 to the present paper for the distinction between strict and weak complementarity.

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that very few firms will introduce innovations according a given combinatorial form. Also, tests for endogeneity of the combination forms would be helpful. Another problem is that the highest effect on performance is obtained for the ‘no innovation’ case, which is a strange result.

The present paper seeks to extend this literature in three ways. First, by implementing a new test for complementarities based on conditional complementarities we are able better to identify if and which pairs of complementarities exist, which adds to the toolkit for assessing complementarities between different forms of innovation. Second, since most studies of complementarities among forms of innovation focus on single countries, the generalizability of their findings to other institutional set-ups or national systems of innovation is unclear. Our focus on the UK and France allows us to identify what is shared (or not) in terms of complementarities across different innovation systems. Third, in examining the importance of firm size and R&D intensity as conditioning factors shaping the ability of firms to profit from complementarities, we provide a richer contextual understanding of the patterns observed in previous studies and clearer identification of some of the mechanisms that allow firms to gain from complementarities.

3. Data, variables description and econometric methodology

3.1. Data and variables description

We use data from CIS4 for France and the UK, which is a firm-level survey that ask organizations to provide information on the level and type of their innovative efforts. Although respondents are provided with definitions of innovation and examples, the survey data are based on self-reported information from firm managers and therefore contain subjective elements (OECD, 2005). CIS data are comprehensive and detailed. They cover all sectors of the private economy, and capture information on many different aspects of firm’s innovative efforts and have become crucial for economics and management studies on understanding the innovation process (Smith, 2005; Mairesse & Mohnen, 2010).

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The 2005 UK Innovation Survey was implemented by the Office of National Statistics in April 2005, covering the 2002-2004 period, and sent to 28,000 firms. Although voluntary, it received 16,446 responses, a response rate of 58%. The sample was based on a census of firms with over 250 employees and a stratified sample of small and medium sized firms. It covers only firms with over 10 employees. Overall, the pattern of responses mirrors that of the original population in terms of size, sector and regional distribution

CIS4 in France was carried out by SESSI (Ministry of Economics, Finances and Industry) in 2005 and covers the 2002-2004 period. Like the UK survey, it focused on firms with over 10 employees, a stratified sample of firms under 250 employees and census of large firms. The survey population includes 25,000 firms, drawn from the manufacturing, services and construction sectors. Response to the CIS is mandatory in France and the response rate was 86%, including 8,438 firms from manufacturing sector. As expected, with such a high response rate, the sample closely mirrors the original population.

In order to ensure consistency, we focus on only manufacturing firms, as service firms appear to have different patterns of innovation. In total, we have 9,318 firms, with 3,627 for the UK and 5,691 for France, for the analysis. When we come to the complementarity tests, we only include the subset of firms that were active in technological innovation (either innovating, trying or abandoning trying), as only firms active in technological innovations completed the entire French questionnaire. We are then left with 5215 firms, 2014 for the UK and 3201 for France. Although the CIS surveys are based on a core questionnaire, there are slight differences between the UK and French versions. In the case of overlapping information, wherever possible, we have developed mirrored variables across the two surveys. In some cases this is not straightforward since the nature of the questions differs, especially for organizational innovation (see discussion below).

We focus on three innovation forms: product, process and organizational innovation (see Table 1 for statistics on the variables). Product innovation was taken from a question on both

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surveys that asked whether the firm had developed a product that was new to their market. This form of product innovation is closer to the definition of innovation than a new-to-the-firm innovation, which is considered to be imitation. A process innovation is defined as the use of new or significantly improved methods for the production or supply of a good or service.

To measure organizational innovation, our approach builds on the techniques in Schmidt and Rammer (2007) and Mol and Birkinshaw (2009). Organizational innovation is measured using the responses to questions on the French and UK CIS about ‘wider innovation’ (UK) and ‘organizational and marketing innovations’ (France).

In the UK questionnaire, ‘wider innovation’ is meant to refer to “new or significantly amended forms of organization, business structures or practices, aimed at step changes in internal efficiency or effectiveness or in approaching markets and customers”. Respondents are provided with four items; we exploit three of these items that correspond to the items in the French survey. They are: ‘implementation of advanced management techniques, e.g. knowledge management systems, Investors in People’; ‘implementation of major changes to your organizational structure’; and ‘implementation of changes in marketing concepts or strategies’, with examples for each. The French survey goes into more detail on ‘organizational and marketing innovations’, and includes nine items covering different aspects of this broad concept. We used four of these nine items: ‘a new or significantly improved system of knowledge management’, ‘important modifications of work organization within the firm’, ‘significant modification design and packaging of goods or services’ and ‘new methods or significant modifications of sales or distribution methods’, which match with the items in the UK survey. Firms doing any of these four actions are considered ‘organizational innovators’.

We used this broad measure of organizational innovation to ensure that the action was consistent with the approach used in the CIS for product and process innovation. In the survey, product and process innovation are also defined broadly and firms need to declare only a single

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innovation in either category over the three-year period to be labelled respectively as a product or a process innovator. We adopted this strategy also for pragmatic reasons to help to ensure a reasonable number of firms for each of our eight potential combinations of forms of innovation.

The measure of organizational innovation in the CIS is a rather simplistic and incomplete measure of a broad and rich concept (Damanpour & Evan, 1984; Damanpour, 1991; Birkinshaw, Hamel & Mol, 2008). Also, the 2nd version of the Oslo Manual (OECD, 1997) and many policy documents (OECD, 2010) refer to this form of innovation as ‘non-technological innovation’, which is somewhat confusing since it is defining something by what it is not rather than what it is.

Our measure of firm performance is based on the sales per employee in 2004, the last year covered by the survey, in order to reduce the possibility of a simultaneity bias. Although highly imperfect as a measure of performance, it is used in many other studies of the effects of innovation on performance using CIS data (Crépon, Duguet & Mairesse, 1998; Griffith et al., 2006; Roper, Du & Love, 2008).

We also include a number of control variables to exclude alternative explanations. First, since large firms are likely to be more productive than smaller firms, we control for firm size measured as the log of employment. Second, research shows that R&D expenditure is often associated with productivity so we include a measure of the firm’s R&D intensity for 2004. Third, investment in training may allow firms to increase performance by upgrading employee skills. We introduce a control variable for whether the firm invests in staff training. Fourth, we capture whether the firm has formal collaborations for innovation. Such relationships may allow the firm to draw on the resources and capabilities of other organizations and have been shown to shape firms’ abilities to profit from innovation. Fifth, researchers have shown that openness to external sources improves the firm’s ability to innovate. Following Laursen and Salter (2006), we introduce a control variable for external sources of knowledge in the innovation process. This variable is based on the ten common sources of external knowledge in the two surveys. Sixth, we capture the financial,

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knowledge and market obstacles that firms face in their innovation activities. These variables are constructed based on the approach in Mohnen & Röller (2005), by creating three groups of two items from the question on the CIS about the barriers to innovation. The firm is assigned 1 if it indicates that this type of obstacle was an ‘important’ or a ‘very important’ barrier. Seventh, to profit from innovations firms need take steps to protect their knowledge. We include two control variables to capture strategic and legal methods of protection used by the firm. Both variables are constructed by counting the number of different mechanisms used by a firm for strategic and legal types of appropriability. Eighth, research shows that international-oriented firms are higher performers in terms of innovation and productivity than firms that focus on local or domestic markets. We include a control for whether the firm is involved in the international market. Ninth, we control for whether the firm is part of a large group, which may allow it to draw on the resources and knowledge of other group members not available to independent firms, which may result in better performance. Tenth, we control for industry differences by including ten manufacturing sector dummies.

3.2. Econometric Methodology: testing complementarity-in-performance

Our approach to investigating the complementarities among forms of innovation is based on the complementarity-in-performance concept within the supermodularity framework. We regress our performance measure on the eight combinations of innovations. These are defined from (0, 0, 0), when none of the three forms of innovation (product, process and organization) is introduced; to (1, 1, 1) where all the three forms of innovation are introduced together. The estimated coefficients of these combinations are used to perform the complementarity (substitutability) tests. We consider the possible endogeneity of these combinations of innovation forms.

A supermodularity test is implemented in order to test for complementarity-in-performance between the three forms of innovations.

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There is a risk of selection bias because subsequent estimations are on the sub-sample composed of (product and/or process) innovating firms, firms that are trying to innovate, and firms that have tried and abandoned, so that the decision to engage in technological innovation cannot be considered as exogenous. The choice of this sub-sample is dictated by the lack of information on key explanatory variables for those firms that did not innovate and did not try to introduce a product or process innovation, according to the French survey. This may lead to a bias in our results. We use a Heckman regression to explore the effects of each of the eight innovation combinations on firm performance. Our selection here is based on firms that are active in technological innovation (either innovating, trying to innovate or abandoning efforts to innovate) versus firms that are not active in technological innovation. Building on Mairesse and Mohnen (2005) the selection equation includes group membership (group), selling in the international market, and the three kinds of obstacles to innovation (financial, knowledge or marketing). This guarantees the exclusion restrictions. In all the specifications used, the Likelihood Ratio (LR) test rejects the absence of selection problem. This justifies use of the Heckman selection procedure.

We perform an endogeneity test of the combinations of forms of innovation using a regression based Hausman test (Wooldridge 2002). We run a multinomial logit on the exclusive combinations of innovation forms by controlling for selectivity using a Mill's ratio, where R&D, training, size, cooperation, openness, obstacles and appropriability are the explanatory variables. The residuals associated with each combination are added to the performance equation using a Mill's ratio. We tested for the joint significance of these residuals and found no endogeneity. When not controlling for the selection, we find endogeneity. The somewhat surprising result of no endogeneity is obtained mainly because participation in technological innovation activity is already controlled for.

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We estimate a linear model in which the dependent variable proxies for firm performance, that is, log of sales per employee. This performance specification allows us to test for complementarity between the three forms of innovation using the supermodularity approach.

We test first for unconditional complementarity for each pair of innovation forms, that is, whatever the status of the third form of innovation (presence or absence). Second, we implement a new approach by testing for conditional complementarity for each pair of innovation forms, that is, distinguishing between presence and absence of the third form of innovation. In the case of both tests, we test also for substitutability for each pair of innovation forms.

3.3 Unconditional complementarity

To test for supermodularity in each pair of innovations, that is, [product and process], [product and organization] and [process and organization], we need to test for a pair of inequality restrictions. For example, to test for complementarity between product and process innovation, we need to test the following two restriction constraints simultaneously (R1 when organizational innovation is absent and R2 when organizational innovation is present):

$$H0: \begin{cases} W110+W000-W010-W100 > 0 \text{ R1 (absence of organizational innovation)} \\ W111+W001-W011-W101 > 0 \text{ R2 (presence of organizational innovation)} \end{cases}$$

$$H1: \begin{cases} W110+W000-W010-W100 \leq 0 \text{ (absence of organizational innovation)} \\ W111+W001-W011-W101 \leq 0 \text{ (presence of organizational innovation)} \end{cases}$$

If the first two restrictions are simultaneously accepted, the performance function is supermodular in product and process. For the reasons described below, in this paper we say that product and process are unconditional complements. In other words, product and process complementarity occurs independently of the absence or presence of organizational innovation.

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We have also to test for unconditional complementarities for the two other pairs of innovations forms [product and organization] and [process and organization]. To test for unconditional substitutability between product and process innovation, we have to test the same restriction constraints as above by replacing '>' with '<' in H0.

In order to test these pairs of inequality conditions for unconditional complementarity and for unconditional substitutability we apply the distance or Wald test. Like Mohnen and Röller (2005), we follow Kodde and Palm (1986) who compute lower and upper bound critical values for this test. As indicated in Appendix 1, critical values for the two constraints are: the 5% level, lower bound (df=1) = 2.706 and upper bound (df=2) = 5.138; and the 1% level, lower bound (df=1) = 5.412 and upper bound (df=2) = 8.273. We accept H0 if the LR statistic is smaller than the lower bound. We reject H0 if the LR statistic is larger than the upper bound. If the LR statistic is between bounds, the outcome is within the region of uncertainty.

To conclude that complementarity or substitutability are present, we have to test separately for supermodularity and submodularity and combine the outcomes of these tests. According to Appendix 1, if we accept supermodularity while simultaneously rejecting submodularity, then we can say there is strict complementarity. If supermodularity is supported and submodularity is in the region of doubt, there is weak complementarity. Similarly, if submodularity is supported and supermodularity is rejected, there is strict substitutability. If submodularity is supported and supermodularity is in the region of uncertainty, there is weak substitutability. In all three remaining cases, the test is inconclusive.

3.4 Conditional complementarity

In order to overcome the inconclusive interpretations of unconditional tests in many of our samples, we apply a novel and more detailed test for complementarity, that is, conditional complementarity, which we define as complementarity between two forms of innovation

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conditional on the introduction or not of the third form of innovation. For example, testing for conditional complementarity between product and process implies testing complementarity conditional on the absence and, separately, on the presence of organizational innovation.

In that case, either of the two following restrictions C1 or C2 must be accepted:

$$\begin{array}{l} C1: \left\{ \begin{array}{l} H0: W110+W000-W010-W100 > 0 \text{ (absence of organizational innovation)} \\ H1: W110+W000-W010-W100 \leq 0 \text{ (absence of organizational innovation)} \end{array} \right. \\ \\ C2: \left\{ \begin{array}{l} H0: W111+W001-W011-W101 > 0 \text{ (presence of organizational innovation)} \\ H1: W111+W001-W011-W101 \leq 0 \text{ (presence of organizational innovation)} \end{array} \right. \end{array}$$

As we need to test the complementarities for each other pair of innovations forms, we have to test for conditional complementarity between product and organizational innovation conditional on the absence or presence of process innovation. This applies also to process and organizational innovation. We applied similar methods to test for conditional substitutability. Based on the results of these tests for conditional complementarity and conditional substitutability, we can provide a visual representation of the multiple relationships (see triangles in Figure 1).

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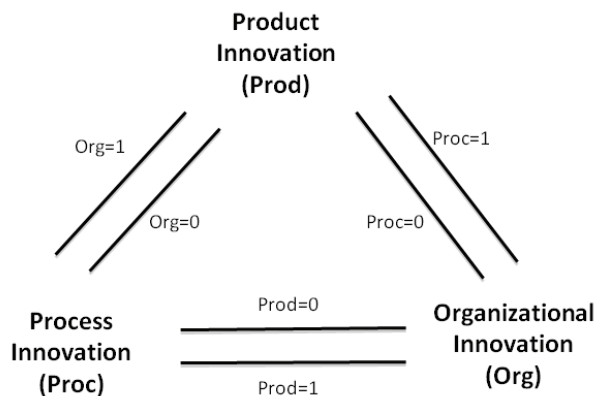


Fig. 1: Exploring the Fateful Triangle:

Testing conditional complementarity and conditional substitutability

4. Results

Table 1 shows that French firms, on average, are slightly more productive and are larger and invest more in R&D than UK firms. Cooperation is more in common among French firms than among UK firms and French firms face more financial obstacles than UK firms. French firms are more active in the international market and more often belong to a group. UK firms are more likely to provide training for their employees, access a broader range of sources for innovation, and tend to protect their innovations more aggressively.

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Table 1: Definition of variables and descriptive statistics (firms with technological innovating activities – Product, Process or Project – and all firms¹)

<i>Name of variables</i>	<i>Description</i>	<i>Pooled</i>	<i>UK</i>	<i>France</i>
		5215 firms (9318 firms)	2014 firms (3627 firms)	3201 firms (5691 firms)
Product innovation	If the firm introduces a product that is new-for-the-market (0,1)	50.74 % (28.40 %)	49.35% (27.40 %)	51.61% (29.03 %)
Process innovation	If the firm introduces a new process (0,1)	67.69 % (37.88 %)	55.16% (30.63 %)	75.57% (42.50 %)
Organizational innovation	If the firm introduces an organizational innovation (0,1)	63.97 % (46.39 %)	60.43% (43.64 %)	66.20% (48.15 %)
Project of technological innovation	If the firm has abandoned and/or still ongoing innovation projects (0,1)	8.23 % (4.77 %)	11.37% (6.58 %)	6.44% (3.62 %)
Firm performance	Sales per employee (in 2004 in Euro and logs)	4.97 (4.87)	4.79 (4.70)	5.08 (4.97)
Size	Log of number of FTE employees	4.69 (4.33)	4.41 (4.11)	4.87 (4.46)
R&D	Amount of internal R&D expenditures per employee (in Euros and logs)	0.81 (N.A.)	0.59 (N.A.)	0.95 (N.A.)
Training	Dummy for firms investing in training for innovation (0,1)	61.82 % (N.A.)	65.39 % (N.A.)	59.58 % (N.A.)
Cooperation	If innovation cooperation arrangements with other firms or institutes (0,1)	42.45 % (N.A.)	33.11 % (N.A.)	48.33 % (N.A.)
Openness	Number of 'important' or 'very important' sources of innovation: internal, suppliers, customers, consultants competitors, universities, public research institutes, conferences, scientific and trade publications, and professional and industry associations (0-10)	4.13 (N.A.)	4.69 (N.A.)	3.78 (N.A.)
Financial obstacles	If lack of finance inside or outside the firm is 'very important' or 'important' (0,1)	50.64 % (44.61 %)	34.61 % (31.07 %)	60.73 % (53.24 %)
Knowledge obstacles	If lack of qualified personnel, lack of information on technology or lack of information on market are 'very important' or	55.22 % (46.94 %)	52.73 % (43.75 %)	56.79 % (48.97 %)

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	‘important’ (0,1)			
Market obstacles	If market dominated by established enterprises or uncertain demand for innovative good or services are ‘very important’ or ‘important’ (0,1)	58.66 % <i>(51.94 %)</i>	57.89 % <i>(49.79 %)</i>	59.14 % <i>(53.31 %)</i>
Formal appropriability	Number of formal methods for protection for innovation, including registration of designs, trademarks, patents and copyrights (0-4)	1.57 <i>(1.15)</i>	2.01 <i>(1.53)</i>	1.29 <i>(0.91)</i>
Informal appropriability	Number of informal methods of protection for innovation, including secrecy, complexity of design or lead-time advantage on competitors (0-3)	1.54 <i>(1.10)</i>	2.24 <i>(1.72)</i>	1.09 <i>(0.71)</i>
International market	Dummy for firms operating in ‘European’ or ‘International’ markets (0,1)	79.48 % <i>(66.84 %)</i>	73.53 % <i>(61.79 %)</i>	83.22 % <i>(70.07 %)</i>
Group	Dummy for firms belonging to a group (0,1)	62.20 % <i>(52.74 %)</i>	48.31 % <i>(41.36 %)</i>	70.94 % <i>(59.99 %)</i>
Industry	Dummies for: Textile, Paper, Chemical, Plastics and rubber, Basic metals, Fabricated metal, Machinery, Electric equipments, Transport equipment and other for the remaining firms.			
French	Dummy for French firms (0,1)	61.38% <i>(61.08%)</i>		

Sources: CIS 4 (UK and France)

¹ Figures in brackets and italics concern all firms in the sample (9318 firms). Other figures concern the sample of firms with technological innovating activities (Product, Process or Project).

² Figures are not available.

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Among the three forms of innovation (Table 2), process innovation is the most frequent in the pooled sample (68% of firms introduced process innovations), followed by . organizational innovation (64% of firms) and product innovation (51%). We found important differences in innovative performance between France and the UK. In particular, French firms are more liable to introduce process innovations than UK firms: three out of four French firms introduced process innovation during the period compared to only half of UK firms, while 61% of UK firms and 66% of French firms introduced organizational innovation.

Table 2: Descriptive statistics of forms of innovations and the eight exclusive associated combinations

	<i>Pooled</i>	<i>UK</i>	<i>France</i>
Product innovation	2646 (50.74%)	994 (49.35%)	1652 (51.61%)
Process innovation	3530 (67.69%)	1111 (55.16%)	2419 (75.57%)
Organizational innovation	3336 (63.97%)	1217 (60.43%)	2119 (66.20%)
Product innovation only (W100)	374 (7.17%)	192 (9.53%)	182 (5.69%)
Process innovation only (W010)	637 (12.21%)	229 (11.37%)	408 (12.75%)
Organizational innovation only (W001)	395 (7.57%)	229 (11.37%)	166 (5.19%)
Product and process innovation (W110)	423 (8.11%)	137 (6.80%)	286 (8.93%)
Product and organizational innovation (W101)	471 (9.03%)	243 (12.07%)	228 (7.12%)
Process and organizational innovation (W011)	1092 (20.94%)	323 (16.04%)	769 (24.02%)
All forms of innovations (W111)	1378 (26.42%)	422 (20.95%)	956 (29.87%)
None (W000)	445 (8.53%)	239 (11.86%)	206 (6.44%)
Nb of firms with technological innovating activities (Product, Process and/or Project)	5215	2014	3201

Sources: CIS 4 (UK and France)

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The simultaneous introduction of all three forms of innovation, was the most frequent of the exclusive combinations of innovation forms, which suggests some degree of complementarity among product, process and organization innovation. This applied to 26% of firms in the pooled sample, 21% of UK firms and 30% of French firms. The next most frequent combination is process and organizational innovations - 21%, 16% and 24% respectively for the pooled, UK and French samples. Introduction of no innovations applies to 8.5% of the pooled sample, 11% of the UK sample and 6.5% of the French sample. The percentage of firms, introducing only one form of innovation is only 5% to 12% in each country. The most frequent single form of innovation in both the UK and France is process innovation.

The results of the performance function estimation - (log of) performance measured by sales per employee, regressed on a set of explanatory variables plus the eight combinations of innovation are presented in Table 3. All the exclusive forms of innovation combinations have a positive and significant effect on performance. The mere attempt (not successful) to introduce a technological innovation (W000) has a positive effect; introducing all forms of innovation at the same time (W111) has the greatest effect, for each country. The results do not show a monotonic increase in performance with the addition of forms of innovation. Firm size has no influence, probably suggesting constant returns to scale, while R&D has the expected positive effect on performance. Financial and knowledge obstacles have a negative sign but are not always significant, while market obstacles are always significant and have a negative effect. Appropriability methods appear to have no effect on performance.

Table 3: Exclusive innovation combinations and performance.

Dependent variable: Log of sales per employee (2004 in Euro)

	<i>UK</i>		<i>France</i>	
	Coef.	z	Coef.	z
W000	0,843***	7.71	0,758***	5.35
W100	0,813***	7.45	0,723***	5.16
W010	0,876***	7.97	0,759***	5.23
W001	0,866***	7.80	0,734***	5.16
W110	0,903***	8.00	0,773***	5.33
W101	0,878***	8.00	0,789***	5.47
W011	0,880***	8.07	0,758***	5.31
W111	0,886***	7.93	0,775***	5.43
Firm performance (2002)	0,833***	32.57	0,886***	53.89
Size	0,009	1.25	-0,006	-0.78
R&D (log)	0,045***	3.79	0,011*	1.81
Training	0,020	1.25	0,005	0.52
Cooperation	-0,012	-0.74	0,004	0.42
Openness	-0,002	-0.49	-0,002	-0.56
Financial obstacles	-0,013	-0.78	-0,076***	-4.06
Knowledge obstacles	-0,010	-0.54	-0,027	-2.26
Market obstacles	-0,043***	-2.70	-0,010**	-0.97
Formal appropriability	0,003	0.52	-0,016	-1.52
Informal appropriability	-0,001	-0.19	0,003	0.59

Sources: CIS 4 (UK and France), Industry dummies are not reported.

Significance levels at *** 1%, ** 5% and * 10%.

Wijk refers to the exclusive innovation combinations: the combination of

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innovations forms (0/1, 0/1, 0/1) reflect whether a firm has introduced a product, process and/or organizational innovation.

All the tests reject the independence between the selection and the performance equation.

Dropping R&D from this equation performance did not change the results.

Statistics for endogeneity tests (regression based Hausman test, Wooldridge 2002) are the following: for UK $F(7, 1987)=1.31$, $Prob>F=0.241$ and for France $F(7, 3174)=1.44$, $Prob>F=0.186$.

Complementarities-in-performance tests are based on the estimated coefficients W_{ijk} and the results are presented in Table 4. We briefly discuss the results of the unconditional tests since they are mostly inconclusive, and then focus on the conditional tests. We first apply the traditional unconditional Kodde-Palm LR test (see Appendix 2-1 and 2-2). For the samples at the Nation level, the tests are inconclusive. When we consider samples split by the types of firms (large / small and medium firms; and low R&D / high R&D intensive firms), we only find one result, namely weak substitution between process and organizational innovations for large UK firms (Appendix 2-2). We do not find the classic complementarity between product and process innovation.

Table 4: Testing *conditional complementarities-in-performance* between forms of innovations

		UK		France		
		Chi2	P-value	Chi2	P-value	
H0: C1=0 & C2=0		1.83	0.601	3.21	0.799	
Organizational innovation = 0:						
H0: C1=W110+W000-W010-W100 >/< 0 ?						
Product / Process	Complements (C1>0) / Substitutes (C1<0)	COMPL.	0.911	COMPL.	0.915	
	Organizational innovation = 1:					
	H0: C2=W111+W001-W011-W101 >/< 0 ?					
	Complements (C2>0) / Substitutes (C2<0)	NONE		NONE		

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Product / Organization	H0: C1=0 & C2=0	1.29	0.475	4.55**	0.897
	Process innovation = 0:				
	H0: C1=W101+W000-W100-W001 >/< 0 ?				
	Complements (C1>0) / Substitutes (C1<0)	NONE	0.849	COMPL.	0.983
	Process innovation = 1:				
Process / Organization	H0: C2=W111+W010-W110-W011 >/< 0 ?				
	Complements (C2>0) / Substitutes (C2<0)	NONE		NONE	
	H0: C1=0 & C2=0	3.56	0.831	3.54	0.830
	Product innovation = 0:				
	H0: C1=W011+W000-W010-W001 >/< 0 ?				
Product / Organization	Complements (C1>0) / Substitutes (C1<0)	NONE		NONE	
	Product innovation = 1:				
	H0: C2=W111+W100-W110-W101 >/< 0 ?				
	Complements (C2>0) / Substitutes (C2<0)	SUBST.	0.964	SUBST.	0.959
	Nb of observations	3627		5691	
Nb of uncensored obs.	2014		3201		

Sources: CIS 4 (UK and France)

Significance levels at *** 1%, ** 5% and * 10%

Wijk refers to the exclusive innovation combinations: the combination of innovations forms (0/1, 0/1, 0/1) reflect whether a firm has introduced a product, process and/or organizational innovation.

All the tests reject the independence between the selection and the performance equation.

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These mostly inconclusive results for pairwise relations allow us not to test for unconditional complementarity and substitutability among the three forms of innovation occurring simultaneously, since for global supermodularity (submodularity) to hold, the three pairwise complementarities (substitutions) are necessary. This is in line with the literature that finds no significant results for more than two factors. These findings suggest that conditional tests might be more informative.

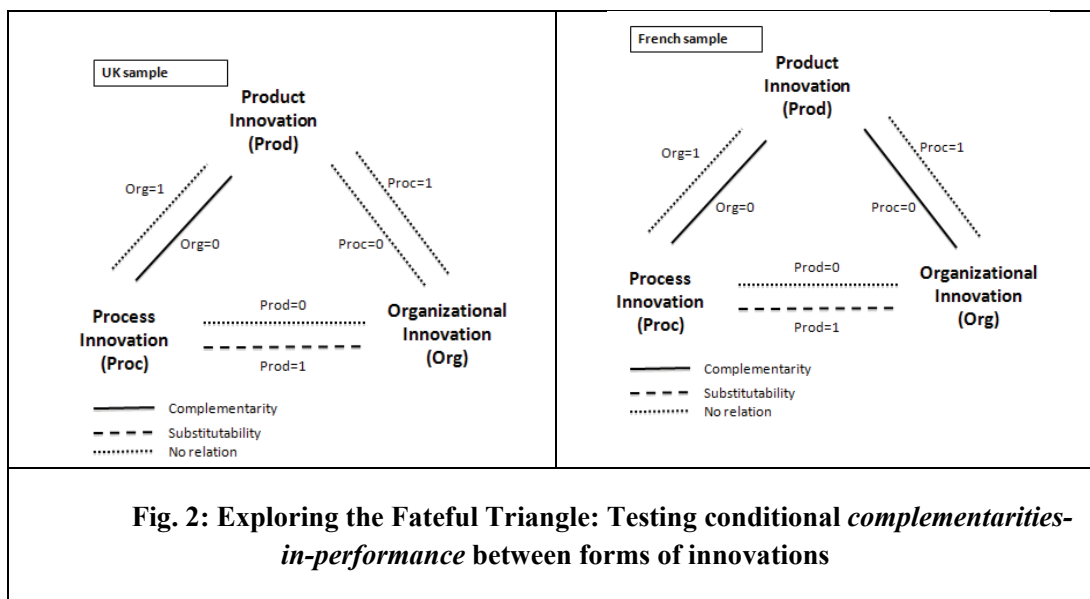
Turning to the relationships among product, process and organization, the results are presented graphically by triangles in Figure 2 and in detail in Table 4. For the UK case, we can identify three main results. First, product and process innovation appear to be conditional complements if (and only if) organizational innovation is not introduced. This result is consistent with previous research showing complementarity between product and process innovations. It can be interpreted as the technical necessity, in many cases, of introducing a process innovation in order to develop a product that is new to the market. However, it appears that simultaneous organizational change is not a requisite. Second, we find no relation between product innovation and organizational innovation. Third, we find a substitution effect between process innovation and organizational innovation if the firm also introduces a product innovation. This suggests that the better performing UK firms tend to focus on product and process innovations rather than introducing all three forms of innovation. This result could be explained by the cost involved in simultaneously introducing all three forms of innovation, and/or the complexity of that enterprise.

For French firms, the results are similar for conditional complementarities between product and process innovation when organizational innovation is absent. Also product and organizational innovations are conditional complements if firms do not introduce process innovations. This is in

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the line with Chandler (1962).⁴ Finally we find a substitution effect between process innovation and organizational innovation if the firm also introduces a product innovation. Hence, French firms tend to adopt one of two strategies: product/process innovation or product/organizational innovation. Neither strategy dominates.⁵

The difference between high performance innovation strategies between countries as well as among firms within a country is not a problematic result. It provides empirical confirmation of a well-established management theory, contingency theory. Contingency theory states that the most appropriate structure for a firm is the one that best fits a given operating contingency (Burns & Stalker, 1961; Mintzberg, 1981). This means that there are no ex-ante theoretical and empirical reasons to find a) global complementarity among all “positive” (i.e. innovation) strategies, and b) a unique best complementarity strategy for all the firms in our sample, which contradicts the main findings of the supermodularity theory.



⁴ Lam (2010) for a survey of literature on innovative organizations and typologies of firms.

⁵ This can be tested using the following procedure. Recall that C1 (p. 19) correspond to the linear restriction for the conditional complementarity between product and process in the absence of organization innovation. Let C1* be the corresponding test of conditional complementarity between product and organizational innovations when there is no process innovation. Dominance is obtained by testing whether $C1 >$ (or $<$) $C1^*$.

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Unfortunately, the CIS data do not provide sufficient information to explore why French firms have a choice of complementarity strategies compared to UK firms. It might be that French firms, which have a long tradition of social conflict and multi-level bargaining (at the firm and /or at the industry level), require greater organizational change to accompany their technological innovations. In contrast, in the UK, managerial decisions are less influenced by labour regulations, with the result that technological innovations can be implemented without major organizational change. However, without more information on the work practices of UK and French firms and more refined measures of organizational innovation, this argument remains highly speculative.

One way to explore the different results for the UK and France in more detail is to consider the samples splits - by size and by R&D intensity. This may identify contingencies associated with the complementarities between different forms of innovation. We conducted an additional analysis to determine how the complementarities among product, process and organizational innovations are shaped by the firm's resources and capabilities. We use firm size and relative R&D expenditure respectively to proxy for resources and capabilities.

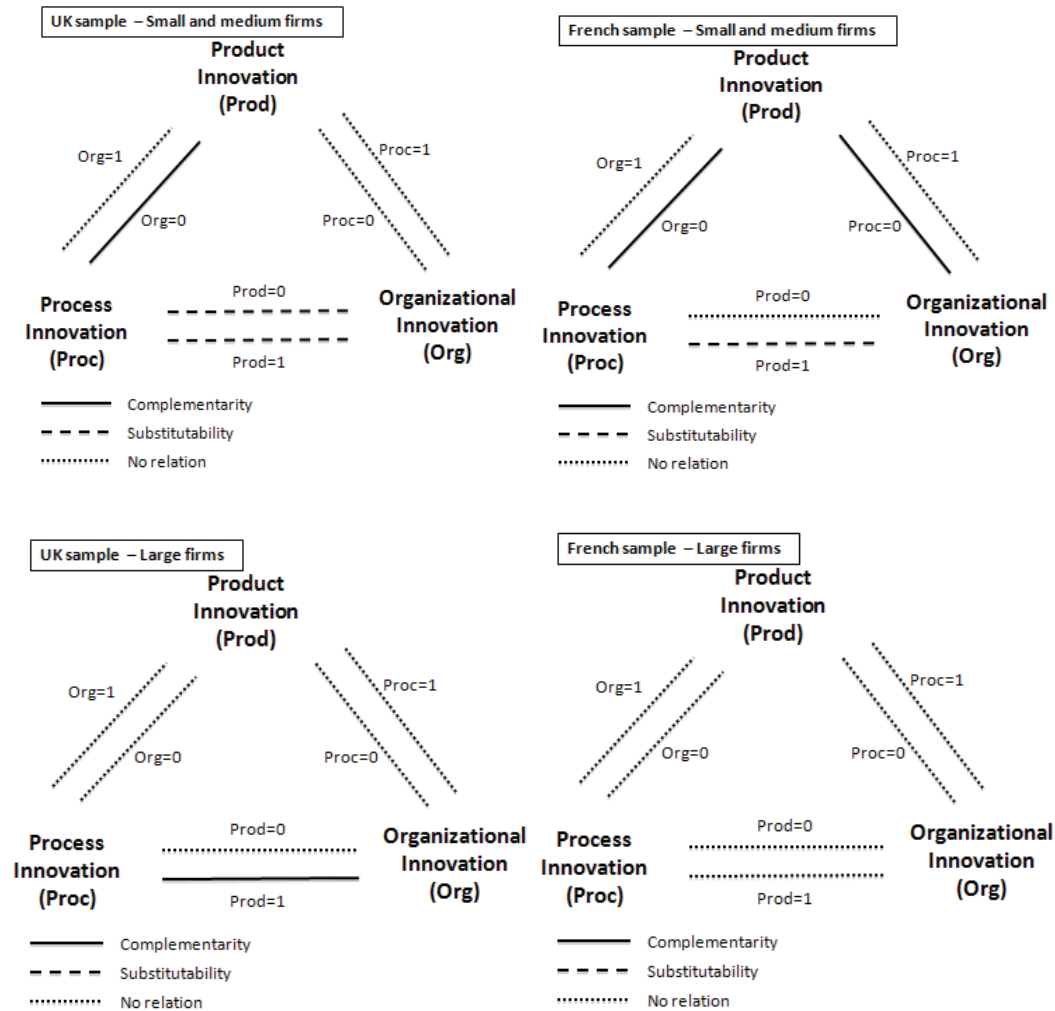
In the case of firm size, we distinguish between small and medium sized firms (less than 250 employees) and large firms (more than 250 employees). Figure 3 shows that the complementarities-in-performance between the forms of innovation differ. To compare them, we count the number of each type of conditional relation for the sum of the two samples (UK, France). For small and medium firms, we find three complementarities, six non-relations and three substitutions. For large firms, we find one complementarity, eleven non-relations and no substitutions. This suggests that the patterns of firm strategies are different according to the size of the firms. The substitutions apply only to small and medium sized firms and refer to process and organizational innovations. In two out of the three cases, product innovation is also present. This can be explained by the high cost of introducing product, process and organization innovation for small and medium sized firms. In the UK, a focus on product-process innovation has the highest performance payoff for small and

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medium sized firms. In France, product/process combinations along with product/organization combinations provide the greatest performance benefits.

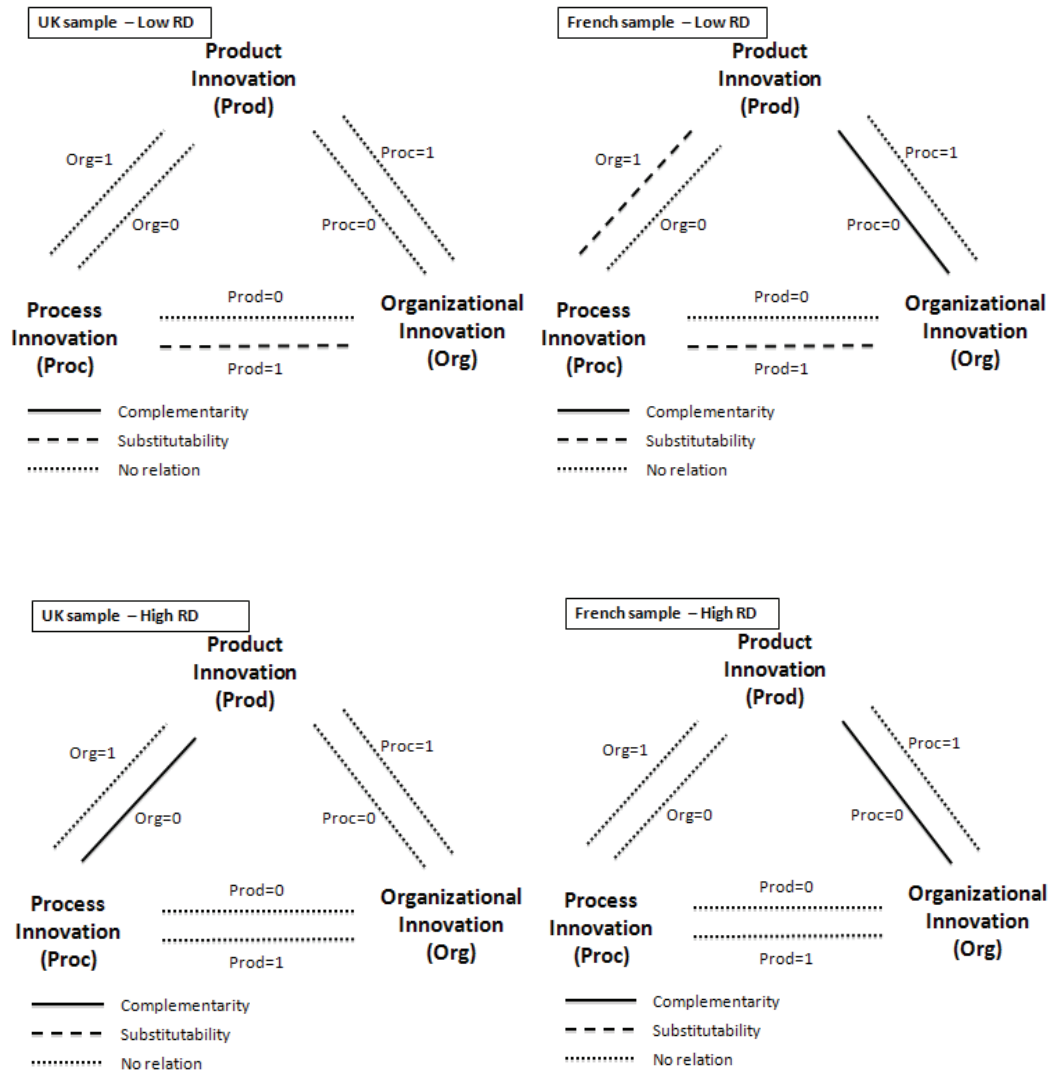
Among the corresponding conditional strategies for large firms, the pattern is different. For UK firms, but not French firms, we find process-organization innovation complementarity. It appears that large UK firms profit from a combined organizational change and process innovation strategy, and this benefit applies when product innovation is present. It is likely that the resources available to large firms in the UK are sufficient to meet the managerial costs and challenges associated with innovating across the board.

Fig. 3: Testing *conditional complementarities-in-performance* between forms of innovations for small and medium firms (less than 250 empl.) and large firms (more than 250 empl.)



For the role of R&D capabilities in shaping the value from combinations of different forms of innovation, the results are interesting. R&D capabilities are captured by a higher/lower level of R&D expenditure per employee than the industry average, scored according to a ten-industry classification index. For the high R&D intensive firms, we find two conditional complementarities, ten non-relations, and no substitutions. For the low R&D intensive firms we find one conditional complementarity, eight non-relations, and three substitutions.

Fig. 4: Testing *conditional complementarities-in-performance* between forms of innovations for low and high R&D firms



The differences in strategies when measured as above show no substitutability-in-performance for the high R&D intensive firms, and some substitutability for the low R&D intensive firms. This is a coherent result since high R&D intensive firms probably experience higher levels of competition in their market segment and need more sophisticated innovation strategies. The choice of complements is different for France and UK, perhaps reflecting wider national differences. UK high R&D intensive firms focus on product-process innovation complementarity, while

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corresponding French firms favour product-organizational innovations. Low R&D intensive UK firms show no complementarity, while similar French firms favour product-organization innovations.

5. Discussion and conclusions

There is a pattern of diversity among firms in relation to the simultaneous introduction of the different forms of innovation and to their effects on performance. This suggests that no strategy is winning in all circumstances, and it seems that the effectiveness of the various strategies is dependent on the institutional context and firm characteristics.

A preliminary step in our study has been to look at the raw statistics on the exclusive combinations of innovation forms. Observation of the raw data shows that around 26% of firms in the sample introduced all three forms of innovation during the three-year period analysed, a large but not huge percentage. The second and third most frequent combinations of innovations are process-organization and process only. The no innovation category includes only 8.5% of firms which tried to innovate in product and/or process but were not successful in their innovation efforts in any form (including organization). These statistics question the simple economic theory of strategic complementarities based on Milgrom & Roberts (1990), which suggests a polarization between the two extreme strategies of all forms of innovations if the costs allow, and no innovation if they are prohibitive. CIS data show a more mixed picture of firms adopting a range of strategies based on their capabilities and environment.

The central objective of the paper is to assess complementarities-in-performance. We proceeded to three steps in the analysis. We estimated a performance equation using a Heckman ordinary least square to control for firms that did not try to innovate in product and/or process. The equation shows that firm performance is enhanced by any innovation effort or by a combination of innovation forms, and even more by a combination of all three forms of innovation. The results are

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robust to the possible presence of endogeneity of these combination forms, which we tested for but did not find. However, the higher coefficient of the combination of all forms is not proof of the complementarity effects on performance of the joint introduction of all forms of innovations. In fact, studies that use interactions terms, such as Supprasert and Clausen (2012), do not necessarily prove the complementarity effects of performance. These findings provide encouragement to proceed to formal tests for complementarities and substitutions.

The next two steps in the analysis correspond to the two types of tests for supermodularity and submodularity. In the second step, we show that unconditional pairwise complementarities in performance do not appear either in the national samples or in the sample splits. We find no unconditional pairwise substitutions except a weak substitution between process and organizational innovations for the large UK firms group. Thus, in our case, there is no global supermodularity, which is in line with Polder, van Leeuwen, Mohnen and Raymond (2010) and Doran (2012). These results also contradict interaction and clustering approaches that provide positive results for complementarities-in-performance from the introduction of all three forms of innovation. Our results suggest that, for many firms, the associated costs and/or the complexity involved in introducing all three forms of innovation in the same three-year period may be higher than the benefits.

The third step considers the conditional pairwise complementarities and substitutes in performance for firms introducing different combinations of innovation forms. These are summarized by the (double) triangles of pairwise relations. The first result of these tests is that no strategy of complementarity/substitution is always the most productive. However, substitutions appear to be less common than complementarities. The second result, based on the study of sub-samples, is that both the national context and the characteristics of the firm, proxied here by firm size and firm capabilities (in-house R&D relative to the sector mean) significantly influence the

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ability of the firm to gain from introduction of multiple forms of innovation.⁶ This suggests that a contingency perspective on the benefits and costs of complementarities among different forms of innovations may be required. Moreover, the complementarities between two forms of innovation are usually conditional on the presence/absence of the third form. The third result concerns the combinations of innovations or strategies selected. Among the set of possible conditional strategies, at the national level, two strategies dominate. One strategy is based on product-process innovation, which is shown to be beneficial for both French and UK firms. Our methodology confirms the results derived from less demanding methods, such as cluster analysis (see Battisti and Stoneman, 2010 for the UK). The other strategy of introducing product and organizational innovation is beneficial for French firms (Doran (2012) finds the same effect for Irish companies).

In considering all the sub-samples, complementarities are more frequent than substitutions. We find that high R&D intensive UK firms compared to low R&D intensive firms appear to benefit more from complementarity strategies. This is in line with the idea that the former firms need more sophisticated innovation strategies to compete in the market. This difference is not significant for French firms. These results suggest reducing the focus on the presence of global complementarities in large-scale samples of national firms and concentrating on a more refined understanding of why and when firms are able to profit from different forms of innovation activity.

It would be useful to have more fine grained information on non-technological forms of innovation, described here as ‘organizational innovation’. The measures currently used by innovation surveys fail to capture the rich and diverse features of organizational innovation. Future innovation surveys should seek to refine the questions related to non-technological forms of innovation and to harmonize them with measures used for advanced human resource practices or organizational change.

⁶ R&D intensity might be a characteristics of the market segment in which the firm is competing and an element of the external context.

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There are several possibilities for future research. First, subject to data availability, firm performance could be investigated based on value added, firm growth, return on assets, survival and profits. Different combinations of forms of innovation activities may drive different performance outcomes. Second, different waves of CIS surveys could be used to consider the timing of innovation forms to improve our understanding of how firms profit from the interplay among different forms of innovation. For instance, does product innovation precede process innovation? Does process innovation require subsequent organizational innovation? Third, using firm panel data would allow us to control for unobserved individual heterogeneity and should produce more robust and reliable results.

The stringent tests of complementarities on the innovation survey data improve our understanding on how and when firms would gain from introducing multiple forms of innovation. The investigation in this paper highlights the contingencies that shape the benefits and costs to firms of introducing more than one form of innovation.

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References

- Athey, S., & Stern, S. 1998. An Empirical Framework for Testing Theories about Complementarity in Organizational Design, Working Paper. Cambridge, MA.: NBER.
- Ballot, G., Fakhfakh, F., Galia, F., & Salter, A. 2011. The Fateful Triangle: Complementarities between Product, Process and Organizational Innovation in the UK and France. Working Paper ERMES, No. 11-05.
- Battisti, J., & Stoneman, P. 2010. How Innovative are UK Firms? Evidence from the Fourth UK Community Innovation Survey on Synergies between Technological and Organizational Innovations, *British Journal of Management*, 21: 187–206
- Birkinshaw, J., Hamel, G. & Mol, M., 2008. Management Innovation. *Academy of Management Review*, 33(4): 825-845.
- Burns, T. & Stalker, G.M. 1961. *The Management of Innovation*. London:Tavistock.
- Cassiman, B., & Veugelers, R. 2006. In Search of Complementarity in Innovation Strategy. *Management Science*, 52(1): 68-82.
- Chandler, A. D.1962. *Strategy and Structure: Chapters in the History of the American Industrial Enterprise*.Cambridge MA: MIT Press.
- Cozzarin, B. P., & Percival, J. C. 2006. Complementarities between Organisational Strategies and Innovation. *Economics of Innovation and New Technology*, 15(3): 195-217.
- Crépon, B., Duguet, E., & Mairesse, J. 1998. Research Innovation and Productivity: An Econometric Analysis at the Firm Level. *Economic of Innovation and New Technologies*, 7: 115-158.
- Damanpour, F. 1991. Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators. *Academy of Management Journal*, 34(3): 555-590.

ORGANIZATIONAL INNOVATION WORKSHOP

- Damanpour, F., & Evan, W. M. 1984. Organizational Innovation and Performance: The Problem of "Organizational Lag." *Administrative Science Quarterly*, 29: 392-409.
- Doran, J. 2012. Are differing forms of innovation complements or substitutes?, *European Journal of Innovation Management*, 15(3): 351-371
- Ennen, E., & Richter, A. 2010. The Whole Is More Than The Sum of Its Parts - Or Is It? A Review of the Empirical Literature on Complementarities in Organizations. *Journal of Management*, 36(1): 207-233.
- Evangelista, R., & Vezzani, A. 2010. The economic impact of technological and organizational innovations. A firm-level analysis. *Research Policy*, 39: 1253-1263.
- Evangelista, R., & Vezzani, A. 2012. The impact of technological and organizational innovations on employment in European firms. *Industrial and Corporate Change*, 21(4): 871-899.
- Freeman, C., & Soete, L. L. G. 1997. *The Economics of Industrial Innovation*. London: Pinter.
- Galia, F., & Legros, D. 2004. Complementarities between Obstacles to Innovation: Evidence from France, *Research Policy*, 33(8): 1185-1199.
- Griffith, R., Heurgo, E., Mairesse, J., & Peters, B. 2006. Innovation and Productivity Across Four European Countries. *Oxford Review of Economic Policy*, 22(4): 483-498.
- Hervas-Olivier, J.-L., Semepere-Ripoll, F. & Boronat-Moll, C. 2012. Process innovation objectives and management complementarities: patterns, drivers, co-adoption and performance effects, UNU-MERIT Working Paper, 2012-51
- Kodde, D., & Palm, F. 1986. Wald criteria for jointly testing equality and inequality restrictions. *Econometrica*, 54(5): 1243-48.
- Lam, A. 2010. *Innovative Organizations: Structure, Learning and Adaptation*, in *Innovation Perspective for the 21th century*, Madrid: BBVA, 163-175.
- Laursen, K., & Salter, A. 2006. Open for innovation: The role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, 27(2): 131-150.
- Leiponen, A. 2005. Skills and innovation. *International Journal of Industrial Organization*, 23: 303-323.
- Mairesse, J., & Mohnen, P. 2005. The importance of R&D for innovation: a reassessment using French survey data. *Journal of Technology Transfer*, 30(1/2): 183-197.
- Mairesse, J., & Mohnen, P. 2010. "Using Innovation Surveys for Econometric Analysis" in the *Handbook of the Economics of Innovation*, B. H. Hall and N. Rosenberg (editors), Elsevier, Amsterdam, 2010, 1130-1155.
- Martínez-Ros, E., & Labeaga, J. 2009. Product and Process Innovation: Persistence and Complementarities. *European Management Review*, 6(1): 64-75.

ORGANIZATIONAL INNOVATION WORKSHOP

- Milgrom, P. R., & Roberts, B. M. 1990. The Economics of Modern Manufacturing Technology, Strategy and Organization. *American Economic Review*, 80: 511-528.
- Milgrom, P. R., & Roberts, B. M. 1995. Complementarities and Fit: Strategy, Structure and Organizational Change in Manufacturing. *Journal of Accounting and Economics*, 19: 179-208.
- Mintzberg, H. 1981. Organization design: fashion or fit? *Harvard Business Review*, 103-116.
- Miravete, E., & Pernias, J. 2006. Innovation complementarity and scale of production. *Journal of Industrial Economics*, LIV(1): 1-29.
- Mohnen, P., & Röller, L. 2005. Complementarities in innovation policy. *European Economic Review*, 49(6): 1431-1450.
- Mol, M., & Birkinshaw, J. 2009. The sources of management innovation: When firms introduce new management practices. *Journal of Business Research*, 62: 1269-1280.
- OECD. 1997. Proposed guidelines for collecting and interpreting technological innovation data: the 'Oslo Manual'. Paris: Organisation for Economic Development and Co-operation.
- OECD. 2005. Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data. Paris: Organisation for Economic Co-operation and Development.
- OECD. 2010. Innovation in Firms: A Microeconomic Perspective. Paris: Organisation for Economic Co-operation and Development.
- Percival, J. C., & Cozzarin, B. P. 2008. Complementarities Affecting the Returns to Innovation. *Industry and Innovation*, 15(4): 371-392.
- Polder, M., van Leeuwen, G., Mohnen, P. & Raymond, W. 2010. Product, process and organizational innovation: drivers, complementarity and productivity effects. UNU-MERIT Working Paper, 2010-035.
- Reichstein, T., & Salter, A. 2006. Investigating the sources of process innovation among UK manufacturing firms. *Industrial and Corporate Change*, 15(4): 653 - 682.
- Rivkin, J. W. 2000. Imitation of Complex Strategies. *Management Science*, 46(6): 824-844.
- Roper, S., Du, J., & Love, J. 2008. Modelling the innovation value chain. *Research Policy*, 37: 961-977.
- Sapprasert, K., & Clausen, T. 2012. Organizational innovation and its effects. *Industrial and Corporate Change*, 21(5): 1283-1305.
- Schmidt, T., & Rammer, C. 2007. Non-technological and Technological Innovation. In ZEW (Ed.), Discussion Paper: Centre for European Economic Research
- Shaparov D., & Kattuman P., 2010, Complementarities in the adoption of modern management practices and firm performance, Working paper 01/10, Micro-Dyn, Cambridge, February.

ORGANIZATIONAL INNOVATION WORKSHOP

Smith, K. 2005. Measuring Innovation. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford Handbook of Innovation*: 148-179. Oxford: Oxford University Press.

Schumpeter J., 1934, *The theory of economic Development*: Cambridge Mass, Harvard University Press.

Teece, D. J. 1986. Profiting from technological innovation: Implications for integration collaboration, licensing and public policy. *Research Policy*, 15: 285-305.

Topkis, D.M. 1978. Minimizing a Supermodular Function on a Lattice. *Operations Research*. 26(2): 305-321.

Topkis, D.M. 1998. *Supermodularity and Complementarity*, Princeton University Press, Princeton, NJ.

Utterback, J. M. 1994. *Mastering the Dynamics of Innovation*. Boston: Harvard Business School Press.

Wooldridge, J., 2002, *Econometric Analysis of Cross section and Panel Data*, MIT Press.

**TYPES OF INNOVATION IN THE SPANISH ARTS, HERITAGE &
RECREATION INDUSTRIES: PRODUCT, PROCESS, MARKETING AND
ORGANISATIONAL INNOVATIONS**

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Abstract

The objective of this paper is to shed insight about the types of innovation that Spanish firms in arts, heritage and recreation undertook during the period 2006-2011. For this purpose, we examine the types of innovation –product, process, marketing and organizational-, which has a higher share respect to the whole, and how important the organizational innovation is for this firms. The study is based on the sample of firms in the arts, heritage and recreation industry, derived from a survey elaborated by the Spanish Bureau of Statistics. Three important conclusions can be inferred from the results obtained in this paper for the Spanish case. The first is that, although these sectors are less innovative in technological product and process innovations than other industries (i.e. manufacturing and services), they have a similar share in the case of non-technological innovations (organizational and marketing). The second is that, in these sectors, organizational innovations are the most important, followed by marketing, process and product innovations. Therefore, and contrary to what is usually assumed, innovations in these industries are not focused on products. This second conclusion of the paper involves an important advance in the analysis of the arts, heritage and recreation industry, where product innovation is seen as a distinctive feature. The third is that firms which carried out organizational innovations also undertake marketing innovations, since both types of innovations are highly correlated. This situation is not found for the other types of innovations.

Keywords: innovation; organizational innovation; creative industries; cultural industries; arts, heritage and recreation activities

1. Introduction

Arts, heritage and recreation activities are included among the creative industries, although they have been differentiated from other creative industries referring their characteristics of not-for-profit objective and to serve a broader social purpose (Bakhshi and Throsby 2010). Furthermore, it is often assumed that these sectors are less innovative than other creative activities (Stam et al. 2008). The consequence is that NACEs related to services such as arts, heritage and recreation, (codes 90, 91 and 93) are completely neglected in the Community Innovation Survey (CIS) elaborated by Eurostat. However, some exceptions can be found. For example, the Spanish Bureau of Statistics includes “arts and recreation services” in its business innovation survey.

On the other hand, it is also assumed that the majority of innovations carried out by firms in these sectors are focused on the products (Kloosterman 2008). The tendency to focus on product innovation is extensive in the creative and cultural industries, and authors have given different names to them: *aesthetic*, *stylistic*, *soft* and *artistic* innovation (Alcaide-Marzal and Tortajada-Esparza 2007, Cappetta et al. 2006, Stoneman 2010, Galenson 2008). In all cases innovation is focused on changes in products appearance. However, taking the example of the museums, the few studies conducted show that they innovate in products, but also in organization and technology (Camarero et al. 2011). So, despite the efforts to explain peculiarities in the creative industries, the literature about innovation in the arts and cultural sector is also scarce and not much is known about those creative-cultural service industries and their innovation patterns.

Oslo Manual (OECD 2005) distinguishes four types of innovations: product innovations, process innovations, marketing innovations and organisational innovations. The Manual defines product innovation in terms of the “introduction of a good or service that is new or significantly improved”. However, changes in the appearance are included as marketing innovation, which creates a controversy respecting creative industries.

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The outline that we have used in this paper is as follows: in Section 2 we briefly summarize the basic theory on the study of innovation in the Arts, Heritage and Recreation industries. In Section 3, we discuss the empirical study of innovation in the NACEs 90, 91, 92 and 93; we set out the data extracted from the innovation survey elaborated by the Spanish Bureau of Statistics, the variables and the methodology used for the study, as well as the results obtained. Our conclusions can be found in Section 4.

Our paper's goal is to examine how innovative arts and heritage sectors are. For this purpose, we put forward two questions with reference to innovation in these industries:

RQ1: Are sectors in NACEs 90-93 less innovative than other sectors?

RQ2: Are innovations in NACEs 90-93 mostly in products?

To find out the surveys we used the data from Innovation Survey elaborated by Spanish Bureau of Statistics.

2. Innovation in the arts, heritage and recreation industries

The arts, heritage and recreation activities are sectors included in the NACEs 90, 91, 92 and 93 (see Table 1). The NACEs 90 and 91 are part of the Knowledge Intensive Services⁷ (KIS) industries, which are those associated with the knowledge-based economy (Windrum & Tomlinson, 1999; Aslesen & Isaksen, 2007a; Bishop, 2008; Strambach, 2008). Moreover, the NACEs 90, 91 and 93 are considered Creative industries.

The Department for Culture, Media and Sport, DCMS (2009) defined creative industries as “those industries that are based on individual creativity, skill and talent. And which have the potential to create wealth and jobs through developing intellectual property”. Both the definition of creative industries per the British Department for Culture (Pratt, 2008, DCMS, 2009) and the characteristics attributed to KIS sectors (Nählinder, 2005; Doloreux et al., 2008; Strambach, 2008; Muller & Doloreux, 2009; Shearmur & Dolireux, 2009) make reference to the talent and abilities of persons and firms to create knowledge (Larsen, 2001; Aslesen & Isaksen, 2007b). Table 1 shows that creative services are those related to “arts and recreation activities”, so only NACES 90, 91 and 93 are considered as creative activities.

⁷ Knowledge Intensive Services are not the same as Knowledge Intensive Activities. Eurostat considers that an activity is classified as knowledge intensive if tertiary educated persons employed (according ISCED97, levels 5+6) represent more than 33% of the total employment in that activity.

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Table 1. Knowledge Intensive Services and Creative Services

	Service	Knowledge Intensive Service	Creative Industry
HTKIS	59 Motion picture, video and television programme production, sound recording and music publishing activities	X	X
	60 Programming and broadcasting activities	X	X
	61 Telecommunications	X	
	62 Computer programming, consultancy and related activities	X	X
	63 Information service activities	X	
	72 Scientific research and development	X	X
OKIS	50 Water transport	X	
	51 Air transport	X	
	58 Publishing activities	X	X
	64 Financial service activities, except insurance and pension funding	X	
	65 Insurance, reinsurance and pension funding, except compulsory social security	X	
	66 Activities auxiliary to financial services and insurance activities	X	
	69 Legal and accounting activities	X	
	70 Activities of head offices; management consultancy activities	X	
	71 Architectural and engineering activities; technical testing and analysis	X	X
	73 Advertising and market research	X	X
	74 Other professional, scientific and technical activities	X	X
	75 Veterinary activities	X	
	78 Employment activities	X	
	80 Security and investigation activities	X	
	84 Public administration and defense; compulsory social security	X	
	85 Education	X	
	86 Human health activities	X	
	87 Residential care activities	X	
	88 Social work activities without accommodation	X	
	90 Creative, arts and entertainment activities	X	X
91 Libraries, archives, museums and other cultural activities	X	X	
92 Gambling and betting activities	X		
93 Sports activities and amusement and recreation activities	X	X	

Source: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/Annexes/htec_esms_an3.pdf; de-Miguel et al. (2012), UNCTAD (2010), DCMS (2009), KEA European Affairs (2006) and Lazzarretti et al. (2008)

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Concerning innovation, surveys based on the Oslo Manual (OECD 2005) are conducted in more and more countries. However, differences in sectors covered and measures make benchmarking among countries difficult (Bloch and López-Bassols 2009). Eurostat elaborates a survey based on the guide provided by OCDE, the Community Innovation Survey (CIS). Furthermore, some creative services are not included in the CIS Survey. The NACE codes representing services which are not incorporated in the Community Innovation Survey are:

- NACE 90: Creative, arts and entertainment activities.
- NACE 91: Libraries, archives, museums and other cultural activities.
- NACE 92: Gambling and betting activities
- NACE 93: Sports activities and amusement and recreation activities.

More closed to CIS surveys the innovation statistics of the countries, more tendencies to forget these activities. However, some exceptions can be found. For example, the Australian Bureau of Statistics and the Spanish Bureau of Statistics include “arts and recreation services” in its business innovation survey. Moreover, these surveys include the four types of innovation that Oslo Manual (OECD 2005) distinguishes: product innovations, process innovations, marketing innovations and organisational innovations. The use of these categories allows comparing technological and non-technological innovations. The Manual specifies what means every type of innovation as follows:

*“A **product innovation** is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses.*

*A **process innovation** is the implementation of a new or significantly improved production or delivery method.*

*A **marketing innovation** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.*

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An organisational innovation is the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations”.

There is no consensus on how innovative the creative industries are (Müller et al. 2008, Chapain et al. 2010, Bakhshi and McVittie 2009), although they indicate that an important feature of the creative industries is the creation of symbolic products (UNCTAD 2010). Authors have tried to contextualize innovation in the creative industries, using different descriptions like *aesthetic* (Alcaide-Marzal and Tortajada-Esparza 2007), *stylistic* (Cappetta et al. 2006) and *soft* (Stoneman 2010). In every case, innovation is focused on changes in the appearance of the product. Kloosterman (2008) confirms that, in general, innovation in the cultural industries is mostly product innovation.

Stoneman (2010) labels *soft innovation* to those “concerned with changes in products (and perhaps processes) of an aesthetic or intellectual nature, that has been ignored in the study of innovation prevalent in economics”. Cappetta et al (2006) names *stylistic innovations* to those related to fashion industry, but in this case innovations “result from the reassignment of social meaning to an existing product and/or from the change of the aesthetic characteristics of a product generating both a new product – from a physical point of view – and a new meaning”. Alcaide-Marzal and Tortajada-Esparza (2007) use the term *aesthetic innovations* for the fashion oriented products (footwear), in which “appearance is the most strongly perceived value, and is its main novelty”. They emphasise the importance of this kind of innovation because its result can imply that a product “can be perceived as being radically different and can displace earlier products”. It is important to indicate that Oslo Manual (2005) includes the changes in product appearance in marketing innovations, although authors have remarked that in creative industries these innovations are in the product.

In the description of the product innovations, Stoneman and Bakhshi (2009) distinguish between *soft* (aesthetic) and *technological* innovation. Moreover, they identify two types of soft innovation: changes in products that are aesthetic in nature (for example new books or movies) and aesthetic innovation in goods and services that are primarily functional in nature (for example new furniture or car models). Both types of innovation mentioned by Stoneman and Bakhshi (2009) are based on new products (new titles in

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books and video games, new films, new theatre production, new advertising promotion, new clothing line).

Concerning the arts and cultural sector, Bakhshi and Throsby (2010) inform about the lack of studies focused on innovation, ignored in those conducted about creative industries. They mention the specific characteristics that differentiate arts and culture sectors from others creative industries: their not-for-profit objective and to serve a broader social purpose. Finally, they identify four types of innovation that are common to cultural institutions in the creative arts: innovation in audience reach, in artform development, in value creation, and in business management and governance. Camarero et al (2011), for the case of museums distinguish three types of innovations: technological –used to reach audiences, for example-, organizational and in value creation. They reveal that small museums lack internal resources, like human resources, necessary to engage in innovation.

Because literature in creative industries is focused on product innovations, the other types of innovations (process, organisational and marketing) are for the most part forgotten. So, are innovations in arts and cultural activities mostly in product as literature on creative/cultural industries mention?

Method

2.1. Sample and Variables

The data for this study were obtained from statistics compiled by the Spanish National Statistics Institute. Population for the survey, 4690 businesses, includes firms with more than 10 employees in DIRCE 2011 (Central Business Register). The data available for NACEs 90 to 93 are aggregated and the number of businesses which form the sample for these industries is not available.

Data have been set out in a scheme that contains four groups of variables (Table 2), following the framework of Oslo Manual. Therefore, the four groups are the different types of innovations: product, process, organisational and marketing innovations. For each variable, values were taken for six consecutive years (2006–2011) in order to observe the degree of dynamism.

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Framework for data analyses aimed to answer the two research questions set out in this paper is mainly descriptive, due to the lack of business microdata.

Table 2. Variables used in the analysis of types of innovation in the NACEs 90 to 93

Variable	Measure	Number of firms in the survey (Year 2009-2011)
Product Innovation	Enterprises that implemented innovation in product	84
	PTI1: Enterprises that have introduced new or significantly improved products	25
	PTI2: Enterprises that have introduced new or significantly improved services	69
Process Innovation	Enterprises that implemented innovation in process	120
	PCI1: Enterprises that developed process innovation by improving methods of manufacturing or producing	54
	PCI2: Enterprises that developed process innovation by improving logistics, delivery or distribution methods	8
	PCI3: Enterprises that developed process innovation by supporting activities for processes	81
Organisational Innovation	Enterprises that implemented organisational innovation	306
	OI1: Enterprises that introduced new methods of organising work responsibilities and decision making	187
	OI2: Enterprises that introduced new business practices for organising procedures	242
	OI3: Enterprises that introduced new methods of organising external relations	66
Marketing Innovation	Enterprises that implemented marketing innovation	212
	MKI1: Enterprises that introduced significant changes to the aesthetic design or packaging	35
	MKI2: Enterprises that introduced new media or techniques for product promotion	138
	MKI3: Enterprises that introduced new methods for product placement	79
	MKI4: Enterprises that introduced new methods of pricing goods or services	98

Source: INE (Spanish National Statistics Institute). Innovation survey, available at www.ine.es

2.2. Results

In this section we answer the two research question that we set out in this paper:

RQ1: Are sectors in NACEs 90-93 less innovative than other sectors?

RQ2: Are innovations in NACEs 90-93 mostly in products?

Concerning the first research question, Figure 1 shows that arts and recreation activities (NACEs 90 to 93) are less innovative than services and manufacturing industries when referring to technological innovations. However, the percentage of firms with non-technological innovations is similar to services and to the average of total industries. Therefore, results show that arts and recreation sectors are not less innovative (RQ1).

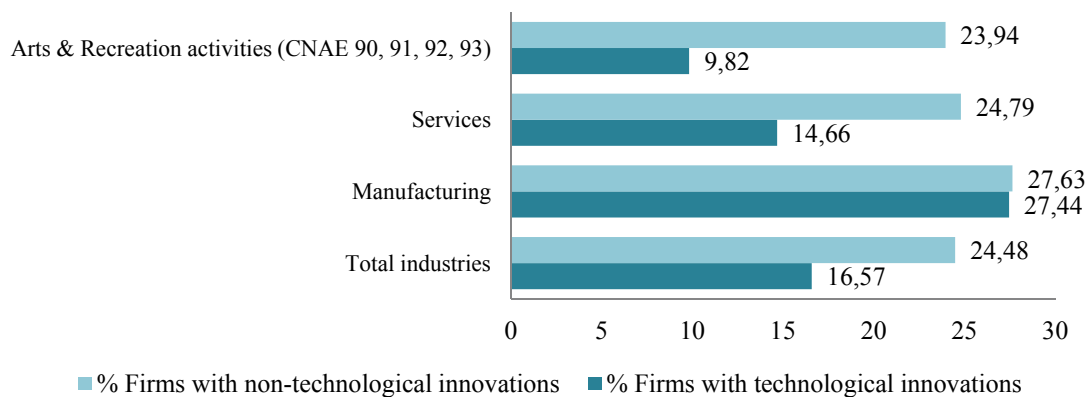


Figure 1. Percentage of firms with technological and non-technological innovations
Source: INE (Spanish National Statistics Institute). Innovation survey, available at www.ine.es

In order to answer the second research question, we focus on NACEs 90, 91, 92 and 93. Our aim is to verify whether innovations in these activities are mainly in product. However, as we can observe in Figure 2, Spanish firms in arts and recreation activities

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innovate firstly in the non-technological types of innovation (organisational and marketing), and the technological innovations are the less important. Consequently, Spanish firms in NACEs 90-93 undertook innovations that are not mostly in product (RQ2).

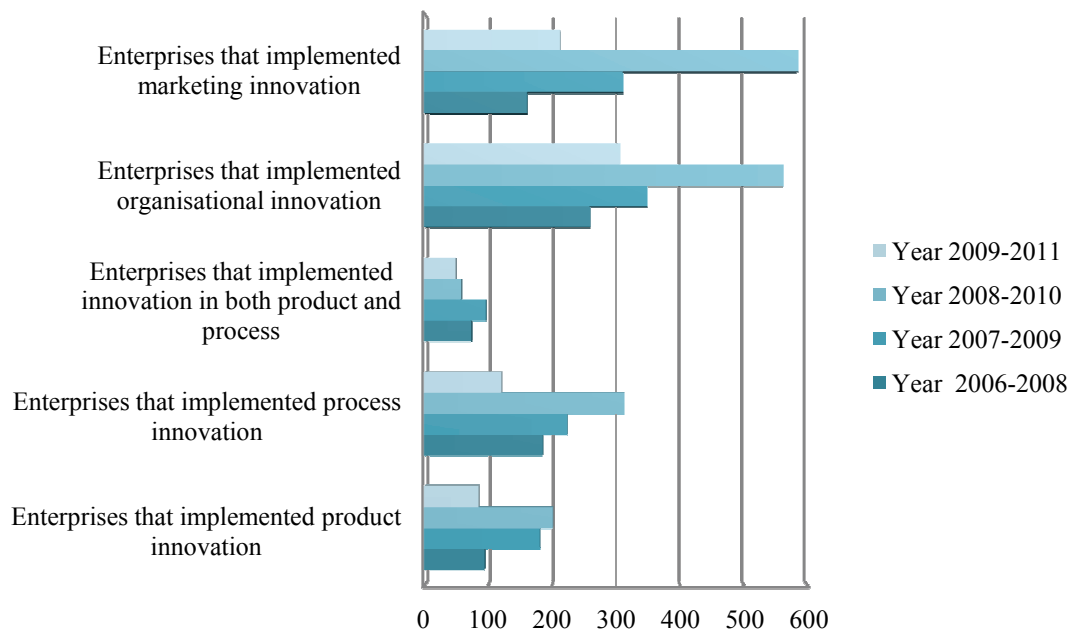


Figure 2. Types of innovations in Spanish NACEs 90-93. Source: INE (Spanish National Statistics Institute). Innovation survey, available at www.ine.es

Similar results can be found in other countries, like Figures 3 and 4 demonstrate. Due to the lack of data from other European and abroad countries, data available are from Australia and New Zealand. In both countries, innovation in art and recreation sectors is not mainly in product. On the contrary, the most important innovations in both cases are those referred to marketing, which are non-technological innovations.

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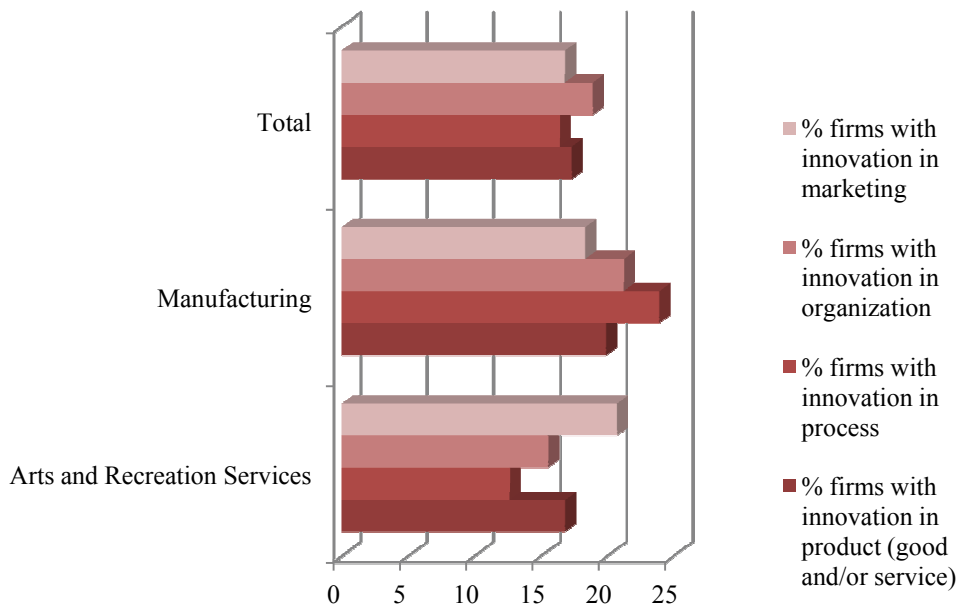


Figure 3. Types of innovations in Australian NACEs 90-93, years 2010-2011. Source: Australian Bureau of Statistics. *Innovation in Australian Businesses*

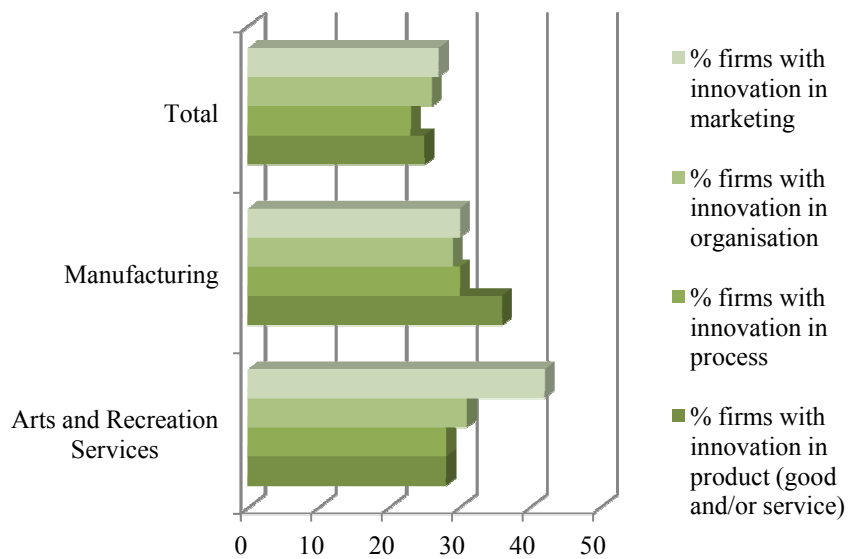


Figure 4. Types of innovations in New Zealand NACEs 90-93, years 2009-2011. Source: Statistics New Zealand. *Innovation in New Zealand: 2011*

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An additional characteristic of the art and recreation sectors is the complementarities between the two kinds of non-technological innovations. Table 3 illustrates that the only significant correlation occurs between marketing and organisational innovations. In the rest of innovations there are not complementarities.

Table 3. Complementarities between product, process, organisational and marketing innovations (Pearson Correlation). Years 2006-2012

	Product Innovation	Process Innovation	Product & Process Innovation	Organisational Innovation	Marketing Innovation
Product Innovation	1	.901	.373	.819	.864
Process Innovation		1	.177	.869	.897
Product & Process Innovation			1	-.221	-.137
Organisational Innovation				1	.996**
Marketing Innovation					1

**Correlation is significant at the 0.01 level (2-tailed).

Source: INE (Spanish National Statistics Institute). Innovation survey, available at www.ine.es

Finally, we have analysed the importance of the four types of innovation and their complementarities using the measures specified in Table 3. Results in Figure 5 indicate that the three most important innovation are included in organisation and marketing, and are the following: new business practises for organising procedures, new methods of organising work responsibilities and decision making, and new media or techniques for product promotion. The three less important measures are: process innovation by improving logistics, delivery or distribution methods, new or significantly improved products, and significant changes to the aesthetic design or packaging. It is important to mention that the last two measures are those more related to what theory about creative industries relates with innovation in its sectors.

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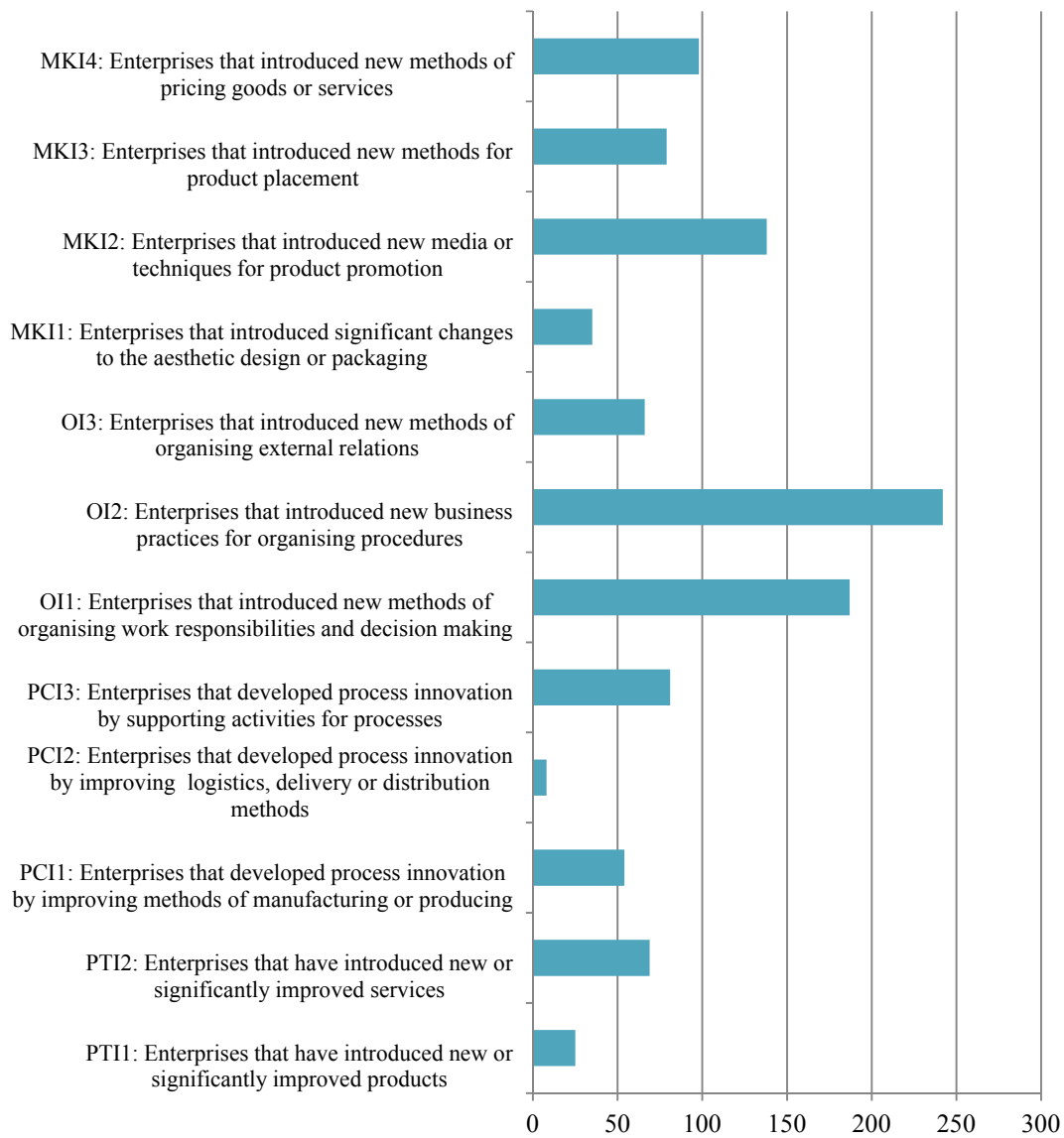


Figure 5. Innovation in Spanish NACEs 90-93, year 2009-2011. Source: INE (Spanish National Statistics Institute). Innovation survey, available at www.ine.es

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We have studied complementarities between the measures included in Table 2 through a factorial analysis (Table 4). In the analysis of the relationships between variables, two factors explained 95.67% of the variance. The first factor alone explained 84.37% of the variance, and the communalities' extraction data were higher than 0.9, thus all the variables reached acceptable levels of explanation. The first component shows highly positive values for marketing, organisational and process innovations, while second component correlates positively the measures for product innovation.

Table 4. Rotated Component Matrix^a

	Component 1	Component 2
PTI1: new or significantly improved products		.942
PTI2: new or significantly improved services		.737
PCI1: process innovation by improving methods of manufacturing or producing	.839	
PCI2: process innovation by improving logistics, delivery or distribution methods	.794	
PCI3: process innovation by supporting activities for processes		.728
OI1: new methods of organising work responsibilities and decision making	.905	
OI2: new business practices for organising procedures	.896	
OI3: new methods of organising external relations		.969
MKI1: significant changes to the aesthetic design or packaging	.931	
MKI2: new media or techniques for product promotion	.911	
MKI3: new methods for product placement	.925	
MKI4: new methods of pricing goods or services	.834	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Source: Innovation in Spanish NACEs 90-93, year 2006-2012. Source: INE (Spanish National Statistics Institute). Innovation survey, available at www.ine.es

3. Conclusions

Literature about arts and recreation activities indicates that these cultural-creative industries tend to be less innovative than other creative activities (Stam et al. 2008). Moreover, authors have pointed that the majority of innovations carried out by firms in these sectors are focused on the products (Kloosterman 2008). Because NACEs related to arts, heritage and recreation, (codes 90, 91 and 93) are neglected in the Community Innovation Survey (CIS) elaborated by Eurostat, with some exceptions (like the Spanish Bureau of Statistics), there are not enough data to make these statements. Our paper analyse these assertions by studying Spanish data for arts and recreation activities.

Data for the analysis come from the survey that Spanish National Statistics Institute (INE) elaborates in order to take information about innovation activities. The framework used by the INE takes into account the different types of innovation specified in the Oslo Manual (OECD 2005), that is, product innovations, process innovations, marketing innovations and organisational innovations.

The results for NACEs 90 to 93 in Spain demonstrate that, businesses are less innovative in the technological innovations (product and process), although they are so innovative than other industries in the non-technological innovations (organisation and marketing). Therefore, contrary to Stam et al (2008), activities in art and recreation are not less innovative than other industries.

On the other hand, results from our study confirm that innovation in marketing and organisation are more important than those in product and process. Consequently, results do not confirm what literature indicates about that innovation in creative industries is mostly in product (Kloosterman 2008, Stoneman 2010).

Acknowledgments

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References

- Alcaide-Marzal, Tortajada-Esparza (2007) Innovation assessment in traditional industries. A proposal of aesthetic innovation indicators. *Scientometrics*, 72.1: 33–57
- Aslesen H W, Isaksen A (2007a) New perspectives on knowledge-intensive services and innovation. *Geografiska. Annaler, Series B: Human Geography*, 89.1: 45–58.
- Aslesen H W, Isaksen A (2007b) Knowledge intensive business services and urban industrial development. *The Service Industries Journal*, 27.3: 321–338.
- Bakhshi H, McVittie E (2009) Creative supply-chain linkages and innovation: Do the creative industries stimulate business innovation in the wider economy? *Innovation: management, policy & practice*, 11.2: 169–189
- Bakhshi H, Throsby D (2010) *Culture of Innovation An economic analysis of innovation in arts and cultural organisations*. NESTA. London, UK.
- Bishop P (2008) Spatial spillovers and the growth of knowledge intensive services. *Tijdschrift voor Economische en Sociale Geografie*, 99.3: 281–292.
- Bloch C, López-Bassols V (2009) Innovation indicators. In: OECD (2009) *Innovation in Firms. A Microeconomic Perspective*, p. 21-68.
- Camarero C, Garrido MJ, Vicente E (2011) How cultural organizations' size and funding influence innovation and performance: the case of museums. *J Cult Econ*, 35:247–266
- Cappetta R, Cillo P, Ponti A (2006) Convergent designs in fine fashion: An evolutionary model for stylistic innovation. *Research Policy*, 35.9: 1273–1290
- Chapain C, Cooke P, De Propriis L, MacNeill S, Mateos-Garcia J (2010) *Creative clusters and innovation. Putting creativity on the map*. NESTA. London, UK.
- DCMS (2009) *Creative Industries Economic Estimates Statistical Bulletin*

ORGANIZATIONAL INNOVATION WORKSHOP

- De-Miguel-Molina B, Hervás-Oliver JL, Boix R, de-Miguel Molina M (2012) The Importance of Creative Industry Agglomerations in Explaining the Wealth of European Regions. *European Planning Studies*, 20.8: 1263-1280.
- Doloreux D, Amara N, Landry R (2008) Mapping regional and sectoral characteristics of knowledge-intensive business services: Evidence from the province of Quebec (Canada). *Growth and Change*, 39.3: 464–496.
- Gallenson DW (2008) Analyzing Artistic Innovation: The Greatest Breakthroughs of the Twentieth Century. *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, 41:3, 111-120
- KEA European Affairs (2006) *The Economy of Culture in Europe* (Brussels: European Commission Directorate—General for Education and Culture).
- Kloosterman RC (2008) Walls and bridges: knowledge spillover between ‘superdutch’ architectural firms. *Journal of Economic Geography*, 8.4: 545–563.
- Larsen J N (2001) Knowledge, human resources and social practice: The knowledge-intensive business service firm as a distributed knowledge system. *The Service Industries Journal*, 21.1: 81–102.
- Lazzeretti L, Boix R, Capone F (2008) Do creative industries cluster? Mapping creative local production systems in Italy and Spain. *Industry and Innovation*, 15.5: 549–567.
- Muller E, Doloreux D (2009) What we should know about knowledge-intensive business services. *Technology in Society*, 31.1: 64–72.
- Müller K, Rammer C, Trüby J (2009) The role of creative industries in industrial innovation. *Innovation: Management, Policy & Practice*, 11.2:148-168
- Nählinder J (2005) *Innovation and Employment in Services. The Case of Knowledge Business Services in Sweden* (Sweden: Unitryck Linköping).
- OECD (2005) *Oslo Manual, 3er edition. The measurement of scientific and technological activities. Proposed guidelines for collecting and interpreting technological innovation data.* Available at www.oecd.org/dataoecd/35/61/2367580.pdf
- Pratt AC (2008) Creative cities: The cultural industries and the creative class. *Geografiska Annaler: Series B. Human Geography*, 90.2: 107–117.
- Shearmur R, Dolireux D (2009) Place, space and distance: Towards a geography of knowledge-intensive business services innovation. *Industry and Innovation*, 16.1: 79–102.
- Stam E, de Jong JPJ, Marlet G (2008) Creative industries in The Netherlands: structure, development, innovativeness and effects on urban growth. *Geografiska Annaler: Series B, Human Geography*, 90.2: 119-132

ORGANIZATIONAL INNOVATION WORKSHOP

Stoneman P (2010) *Soft innovation. Economics, product aesthetics, and the creative industries.* Oxford University Press. UK.

Stoneman P, Bakhshi H (2009) *Soft innovation. Towards a more complete picture of innovative change.* NESTA. London, UK.

Strambach S (2008) Knowledge-intensive business services (KIBS) as drivers of multilevel knowledge dynamics. *International Journal of Services Technology and Management*, 10.2/3/4: 152–174.

UNCTAD. (2010) *Creative Economy, Report 2010.* Geneva: UNDP-UNCTAD.

Windrum P, Tomlinson M (1999) Knowledge-intensive services and international competitiveness: A four country comparison. *Technology Analysis & Strategic Management*, 11.3: 391–408.

THE KEY ROLE OF HUMAN RESOURCE PRACTICES FOR THE PROMOTION OF CREATIVITY AND INNOVATION: A SPANISH CASE STUDY

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Abstract

Management literature suggests that employee creativity can substantially contribute to organizational innovation, effectiveness and survival (Amabile, Conti and Coon, 1996; Nonaka, 1991). On the other hand, the ability to innovate has emerged as a basic strategic option. Innovation models express the need to implement specific human resource practices for the development of skills, knowledge and innovation-oriented behaviours. Human resource practices may become of utmost importance when organizations intend to foster creativity and innovation that are key factors to compete. With this aim we propose the existence of a positive influence of some HRP like training, performance appraisal or reward systems on creativity and innovation. Our results show that there is a positive relationship between HRP and innovation in both, processes and products in the case studied. Some HRP such as autonomy, participation, training, career plan, or a formalized selection process, appear as strongly linked to creativity and innovation. The most important contribution of this paper referred to the mediating effect of creativity between some human resources practices and innovation.

Key words: Creativity, innovation, Human Resource Practices, Case study

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1. Introduction

Management literature suggests that employee creativity can substantially contribute to organizational innovation, effectiveness and survival (Amabile, Conti and Coon, 1996; Nonaka, 1991). On the other hand, the ability to innovate has emerged as a basic strategic option in meeting environmental changes (Baumol, 2004; Danneels, 2002) as firms have to compete in progressively more unstable, unpredictable and uncertain environments, (Andersen, 2000 and 2004; Brews and Hunt, 1999; Bueno and Ordoñez, 2004; Hendry, 2000; Mintzberg and Lampel, 1999; Rico, 2000). Bearing in mind this situation it will be necessary to identify which factors foster creativity in order to develop innovative products and services that make firms more competitive.

Different research studies have found a positive relationship between Human Resource Practices (HRP) and organizational performance (Becker and Gerhart, 1996; Delaney and Huselid, 1996; Gurbuz and Ibrahim, 2011; Huselid, 1995; Huselid, Jackson, and Schuler, 1997; Vlachos, 2008). On the other hand, innovation models express the need to implement tangible HRP for the development of skills, knowledge and innovation-oriented behaviours (Jackson, Schuler, and Rivero, 1989; Jackson and Schuler, 1995, 1987 b; 1988; Schuler and MacMillan, 1984; and Tang, 1998). So, we can conclude from these studies stating that is highly relevant the proper integration between HRP and the general strategy of the firm, particularly its necessary to have a real fit between HRP and innovation strategy.

According to these arguments, Beugeisdijk (2008) pointed out that the adoption of specific human resource practices (HRP) has a direct effect on innovation and the global performance of the firm. Chen and Huang (2009) also established that strategic HRP are positively related to knowledge management ability as well as innovation performance.

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Recently, Jiang, Wang and Zhao (2012) analysed the relationship between HRP, employee creativity and innovation, using creativity as a mediating variable. However, the study of the mediating effect of creativity on the link between HRP and organisational innovation remains quite unexplored, particularly in the specialist literature on management topics.

Taking into account the arguments exposed above, we can formulate two research goals. First of all, we want to deepen in the study of how HRP may facilitate creativity and innovation in organizational context. And secondly, we want to know which is the role of creativity in the relationship between HRP and innovation. In other words, our objective is also to analyse to which extent creativity becomes a necessary but not sufficient condition for organizational innovation to take place.

To achieve our research goals and given the nature of our research topics, we have employed a qualitative research methodology based on the case study strategy. We have deeply analysed a single Spanish case to explore the phenomenon, and used in-depth interviews and document analysis as our main means for information gathering.

Consequently, this paper is divided into the following sections. First, we review the literature which analyses creativity, innovation, and the facilitating role of HRP. As a result, we propose basic preliminary propositions. Then, we describe the research methods and tools underlying our research process, and analyse the results of the case we have analysed in depth. Following this analysis, we then present the main conclusions of our research, and implications for the academia and for practitioners based on our theoretical examination and empirical analysis. To end up with, we enumerate the limitations of the study and present possible paths for future research.

2. Creativity, innovation and Human Resource Practices

2.1. Conceptualization and differences between creativity and innovation.

Creativity and innovation have become key success factors for businesses today (Mumford, Connelly and Gaddis, 2003).

Determining the boundaries of the term ‘innovation’ based on literature is problematic, and the same applies to the concept or construct of ‘creativity’. When reviewing literature we found that many authors use the concept of creativity as a synonym for innovation, when in our view they are clearly differentiated terms. Consequently, we can define the concept of creativity as follows: Creativity has been defined for most theorists as the development of ideas about products, practices, services or procedures that are novel and potentially useful to the organization (Amabile et al., 1996; Zhou and Shalley, 2003).

Creativity can be analysed from a multilevel perspective: organizational, group and individual (Zhou and Shalley, 2003). The individual perspective has been broadly analysed by literature from the psychology field (Parjanen, 2012). The organizational creativity literature refers also to the collective creative processes –the team level– that often take place in organizations when developing creative outcomes (Hargadon & Bechky, 2006). So, teamwork turns into a key factor in order to facilitate the creative process. Organizational creativity has barely generated any interest among management researchers because it has traditionally been seen as a cognitive and individual process. However, although management research has been little interested in creativity, the latter has been studied to a much greater extent by other disciplines. The insufficient attention paid to creativity in our field seems to be linked to the belief that it has little influence on productivity or profits.

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Many of the studies about creativity have been conducted from a psychological perspective, largely in the subfields of social, environmental and organizational psychology. However, creativity has also been researched by other psychology subfields, including neurological, cognitive and experimental psychology (Borghini, 2005). Creativity needs to be studied in greater depth by other disciplines such as sociology, economics and management, and biology (Klijn and Tomic, 2010).

On the other hand, the concept of innovation has been further worked and defined by the specialist literature on management topics. As an example, Van de Ven (1986) defines innovation as a process that includes the generation, development and implementation of new ideas and behaviour. Many other authors have also defined innovation and established different categories or types of innovation. However, Martin, Orengo and Martinez (1997) recognize that all these typologies have not been analysed with the same degree of deepness and this fact may create confusion with regard to their empirical validity.

With these considerations in mind, in this research we have adopted the definition of innovation included in the 2005 Oslo Manual. According to it, innovation may be defined as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (OECD, 2005: 46).

As we have said before and according to Shalley, et al, (2004) it is important to distinguish creativity from innovation. West and Farr (1990) consider that creativity is related to the creation of the idea underlying the innovation, whereas the latter is the process encompassing the proposal and application of new ideas. In other words, creativity becomes the first step towards the development of innovation.

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According to Mumford and Gustafson (1988), Shalley et al. (2004), and Zhou and Shalley (2003), creativity refers to the generation of new ideas which are potentially useful to the organization but, “only when these ideas are successfully implemented at the organization or unit level would they be considered innovation” (Shalley et al., 2004:934). Therefore, this difference between the generation of novel and useful ideas and their implementation is crucial to evolve from the concept of creativity to innovation. Insisting on these arguments, Amabile (1988) states that individual creativity and organizational innovation are clearly linked systems

Hence creativity remains crucial for organizational innovation, though it is not enough on its own. Similarly, Martin et al. (1997) defend that innovation has a more social and applied component as its impact goes beyond the individual level, directly or indirectly affecting other individuals or the organization as a whole. These authors also state that innovation may involve creativity, though not all the innovations become creative.

In our opinion, creativity becomes an individual capability. Amabile (1988) deepens into this idea by stating that creativity is the interaction of three elements, namely, technical and intellectual knowledge, creative thinking and motivation. On the other hand, innovation becomes the result of an application or implementation of creative ideas and, in so doing, transcending the individual and group levels and turning into an organizational issue.

2.2. Human Resource Practices and innovation

The adoption of a particular competitive strategy (such as differentiation through innovation) involves the use of certain HRP or, as Schuler and Jackson (1987a) put it, certain specific roles or required behaviour. This means that implementing an innovation strategy has major implications for human resource management, as this type of strategy requires people to work differently and to develop specific behaviours and skills oriented to

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learning (Schuler and Jackson, 1987 a). Other studies (Jackson and Schuler, 1995; Jackson et al., 1989; Schuler and Jackson, 1987 a and b, 1988; Schuler and MacMillan 1984; Tang, 1998) suggest that innovation models express the need for specific human resource policies and practices for the development of innovation-oriented skills, knowledge and conduct as we pointed out before.

Given the importance of innovation for companies' competitiveness, various studies have sought to identify the possible antecedents of innovation. Literature has grouped these factors as being individual, organizational and contextual, and environmental (Damanpour, Szabat and Evan, 1989; Damanpour, 1991). In terms of organizational variables, literature has stressed the role of HRP as a crucial input for organizational innovation (Jiménez and Sanz, 2005; Shipton, Fay, West, Patterson and Birdi, 2005).

Strategic management literature has explicitly thought about the relationship between human resource management and innovation and the positive effect that a particular way of managing human resources can have on innovation (Lau and NGO, 2004; Laursen, 2002; Laursen and Foss 2003; Terrien and Léonard de 2003; Pini and Santangelo, 2005). Innovation requires the development of active learning processes in organizations (Shipton, et al., 2005; Shipton, West, Dawson, Birdi and Patterson, 2006 a, and Shipton, West, Parkes, and Dawson, 2006 b). And some HRP like specific recruitment and training processes can foster the adoption or development of specific skills oriented to continuous learning, which will lead to innovation (Perdomo, González and Galende 2009; Tang, 1998).

Terrien and Leonard (2003) develop a first approach to the subject of our analysis (HRP and innovation). In their study, they investigated the impact of HRP as an influential factor in the development of innovation in Canadian companies. They found that HRP

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affected the likelihood of being innovative as well as the launch of new products. Moreover, these authors argued that companies that utilize employee participation, training and reward systems are more likely to be “first innovators”. In addition, the grouping of these practices into coherent and hierarchical systems also increases the likelihood of being a relevant innovator.

Furthermore, Laursen and Foss (2003) contended that just as HRP complementarities influenced financial performance, they also had an impact on innovation performance. These authors examined the issue using an empirical study of Danish data and identified two HR systems that are innovation drivers.

Pini and Santangelo (2005) explored the impact of the use of vertical HR practices, the existence of different ways of organizing research and development, and the nature of employees’ skills on the likelihood of generating different types of innovation. The results of their empirical study of a sample of companies in an Italian province showed that developing innovation is a heterogeneous activity.

Authors such as Shipton *et al.* (2005, 2006 a and b) studied the relationship between policy and practice in terms of innovation. These studies suggested that innovation is promoted and supported when companies use human resource management to buttress the various stages of the innovation process. Specifically, the longitudinal study conducted in 2005 empirically tested the effect of the introduction of sophisticated approaches on recruitment, selection, training and assessment practices to predict product and production technology innovation outcomes, and discovered the existence of a positive relationship between HRP and product and production technology innovation. They also found that innovation is enhanced in a climate of learning and is inhibited when there is a link between appraisal and remuneration.

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The results of the 2006 (a) study showed that training, socialization, teamwork, appraisal and an exploratory approach to learning were the innovation predictors for the surveyed companies (22 manufacturing firms in the United Kingdom). Performance-based rewards combined with an exploratory learning-oriented approach were positively associated with innovation in technical systems.

In turn, the results of study (b) by Shipton et al. (2006) revealed that overall job satisfaction was a significant predictor of subsequent organizational innovation, even after controlling for the organization's previous innovation and profitability. In addition, the data suggested that the relationship between overall job satisfaction and innovation in production technology and processes was moderated by two factors: the variety of jobs and the "single status/harmonization" commitment (these terms refer to situations where working conditions and non-monetary aspects are seen to be fair).

In 2008, Sjoerd Beugelsdijk studied the relationship between some HRP (training and job rotation, autonomy, flexible working hours, a performance-based remuneration system, type of employment contract) and product innovation. The most relevant findings presented in this study included that while incremental innovation can be organized through incentive systems and training programmes, the best way of driving radical innovation is to give employees autonomy in tasks and their planning. As a result, there is a positive relationship between some HR practices and product innovation performance, using the theory of creativity as a framework. The results confirm the theoretical prediction that HR practices can be a valuable resource for companies that want to innovate.

That same year, Jiménez and Sanz (2008) empirically analysed the relationship between innovation and human resource management and the effect on a company's earnings. Their findings showed that innovation contributes positively to business

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performance and that human resource management (flexible job design, autonomy, teamwork, workforce planning, performance appraisal and reward systems) boost innovation.

Other research work, such as that by Ortín and Santamaría (2009), has used case studies to analyse HRP in R&D departments and the adaptation achieved in various companies. The data show that some practices, such as recruitment and work organization, have to be adapted when dealing with R&D department staff. The findings in this study support the idea that the maturity of R&D departments means that research and development activities call for better skilled and more enthusiastic workers together with the setting up of multidisciplinary networks and teams. These authors concluded that delegating HRP to R&D departments enhanced practice adaptation.

The work of Cheng and Huang (2009) showed that HRP are positively related to knowledge management capacity and at the same time these practices have a positive effect on innovation performance. Their results provide evidence of the mediating role of knowledge management capacity between strategic HRP planning and innovation.

As part of the same line of research, De Saá-Pérez and Díaz-Díaz (2010) conducted a study to identify the related HR internal factors (the existence of human resource plan and job stability) which might affect the innovation capacity of peripheral companies in the European Union. An empirical study of 127 Canary Island companies led to the conclusion that high commitment human resource management (promotion, appraisal for promotion, participation, a training plan, variable remuneration, job security) had a positive impact on innovation in the organization's processes. The findings also show that the formalization of HRP in a plan and job stability further increase process innovation.

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Cheng and Mohd (2010) examined the relationship between human resource management (HRM) (performance appraisal, professional development, training, reward systems and recruitment) and the organization's product, process and administrative innovation capacity. They noted the major role played by stimulating training in these three types of organizational innovation in Malaysian manufacturing companies.

Finally, the work of Wei, Li-Qun, Liu, Jun and Herndon (2011) explored the relationship between a human resource system and product innovation. Using a contextual approach, they analysed an interactive model in which corporate culture and structure were postulated as variables which moderate the relationship between HRP and product innovation. The empirical findings for 223 Chinese companies suggest that strategic human resource management (SHRM) has a positive impact on product innovation and that this relationship is stronger in the case of companies that have a development culture in companies' with a more horizontal structure.

2.3. HRP and Creativity

Research on creativity in the workplace is relatively limited. Researchers have mainly focused on the effects of contextual or organizational factors and individual differences on creativity (Zhou and Shalley, 2003).

With respect to the first set of works (those that relate organisational topics and contextual factors and creativity), the research of Shalley et al. (2004) states that an employee's personal characteristics (personality and cognitive style) and some contextual factors (coordination mechanisms, goal setting and special configuration of work settings) have a positive relationship with individual creativity and that this relationship is mediated by intrinsic motivation. Also, the works of Kalyar and Rafi, 2012; Martins and Terblanche, 2003; McLean, 2005 and Wilson and Stokes, 2005 focus on the importance that

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organisational climate and culture have on the employee's creativity. A culture that favours horizontal information flows will positively affect creativity. Additionally, culture should support autonomy and teamwork. Consequently, the level of interactions among employees will increase, and the creative process will be easily developed; and as a consequence, the level of innovations will increase.

Other factor that can have an influence on creativity is the leadership style. Particularly, the works of Zhang (Zhang and Bartol, 2010; Zhang, Kwan, Zhang and Wu, 2012) focus on the study of how leadership styles can boost creativity; and they also analyse the role of the leader in promoting individual creativity (Cardinal, 2001; Mumford et al., 2003; Sosik, Kahai and Avolio, 1998 and 1999). If the role of leadership becomes so relevant, a leadership style oriented to empowerment will have a positive impact on individual creativity through the effect of creative process engagement and intrinsic motivation (Zhang and Bartol, 2010).

With respect to organisational factors, different works focus on the degree of formalisation of the organisation and on the role that formalisation can have on creativity. Traditionally, it has been assumed that formalisation would inhibit creative and innovative processes. But some authors suggest that formalising some procedures can help to facilitate the emergence of creative ideas (Dougherty and Tolboom, 2008; Kollenscher, Romen and Farjoun, 2009; Ohly, Sonnentag and Pluntke, 2006). Particularly, the results of the work of Binyamin and Carmeli (2010) reveal that there is a positive link between the formalization and structuring of organisational processes and creativity.

Perhaps it is the degree of formalisation of the processes' content what may have a negative influence on creativity. If processes are very strictly defined and cannot be changed, the formalisation is restrictive with respect to creativity. But if you have processes

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broadly formalized, that facilitate the time and space in which ideas should emerge (for example, through formalising how team meetings should take place and be conducted), then formalisation can promote the development of creative processes.

Jiang, et al. (2012) examined how human resource management practices relate to employee creativity and organizational innovation. Their results showed that four HRM practices (hiring and selection, reward, job design and teamwork) were positively related to employee creativity, while training and performance appraisal were not. Employee creativity fully mediated the relationships between those four HRM practices and organizational innovation. Results suggest that HRM practices can play an important role in managing people to promote creativity and innovation in Chinese organizations.

The following table summarise the most important literature linking HRP with creativity and HRP with innovation.

Table 1: Human Resource Practices linked to innovation and/or creativity

PRACTICES	RELEVANT EMPIRICAL STUDIES
<i>AUTONOMY</i>	Shipton et al., 2006; Shalley, 1991; Zhou, 1998; Beugelsdijk, 2008; Jiménez and Sanz, 2008
<i>PARTICIPATION</i>	Cheng and Huang, 2009; Jiménez and Sanz, 2005; Laursen and Foss, 2003; Therrien and Leonard, 2003; Zhang and Bartol, 2010; Saá-Pérez and Díaz-Díaz, 2010; Camelo Garcia and Sousa, 2010
<i>TRAINING</i>	Cheng and Huang, 2009; Camelo Garcia and Sousa, 2010; Perdomo et al., 2006; Therrien and Leonard, 2003; Leede and Louise, 2005; Lau and Ngo, 2004; Shipton et al., 2005 and 2006 b; Staw, 1995; Perdomo, González and Galende 2006; Tang, 1998; Jiménez and Sanz, 2008; Saá-Pérez and Díaz-Díaz, 2010; Cheng and Mohd, 2010; Searle and Ball, 2003
<i>REWARD SYSTEMS</i>	Cheng and Huang, 2009; Jiménez and Sanz, 2005; Laursen and Foss, 2003; Perdomo and Ortiz, 2006; Abbey and Dickson, 1983; Searle and Ball, 2003; Shipton et al. 2006 a; Jiang, et al., 2012; Beugelsdijk, 2008; Cheng and Mohd, 2010
<i>PERFORMANCE APPRAISAL</i>	Cheng and Huang, 2009; Jiménez and Sanz, 2005; Laursen and Foss, 2003; Therrien and Leonard, 2003; Shipton et al, 2006 a; George and Zhou, 2001; Jiménez and Sanz, 2008; Saá-Pérez and Díaz-Díaz, 2010; Cheng and Mohd, 2010; Camelo Garcia and Sousa, 2010

Source: Own elaboration

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According to the literature review we suggest the following research question and propositions:

C1. Is creativity a mediating variable between HRP and innovation??

P1. The use of practices such as autonomy, participation and empowerment, training, the use of reward systems and performance appraisal increases the probability of generating innovation.

P2. The use of practices such as autonomy, participation and empowerment, training, the use of reward systems and performance appraisal increases or encourages creativity.

3. Research methodology

We have followed a qualitative research methodology in order to answer our research question and reach our goals. Specifically, we have carried out an exploratory research of an industrial Valencian company. Due to the nature of the phenomenon under study (the analysis of creative processes and their interactions with organizational and contextual variables) and to the limited theoretical body that examines the mediating role of creativity in the relationship between HRP and innovation, is suitable to use the case-study methodology, that permits the researcher to develop the study in the same context where the analysed phenomenon takes place (Balbastre, 2003; Pettigrew, 1990; Skinner, Tagg and Holloway, 2000; Yin, 1989 and 1993).

Several factors were taken into account when selecting the case. Firstly, we needed a firm where innovation will become a key success factor (i.e. its performance mostly depends on its ability to innovate). Secondly, another selection factor was the company's attitude to HR practices, and particularly its consideration of HR practices as a basic facilitator of creativity and innovation. Thirdly, a desirable (though not necessary)

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condition was that the firm had clearly structured and explicit policies on human resources and innovation. Finally, easiness of access to information and availability of organizational members to be interviewed were also considered criteria. As a result, we selected the case of Vossloh, one of Europe's leading rail industry manufacturers, and its subsidiary in Spain (Vossloh España, S.A.) whose production plant is located in Valencia (Spain).

We employed in-depth interviews as the basic technique for information gathering, and consulted other organizational documents (memorandums, organizational policies, organizational reports, etc.) to obtain evidences that could facilitate the triangulation process. Semi-structured individual interviews were conducted with employees belonging to different business areas. Particularly, we developed two interviews, lasting approximately 70 minutes each (see table 2 for details). All the interviews were recorded and later transcribed.

Table 2: Interviewed employees and duration

Participants	No. of interviews	Length
Head of Project	1	70
The Organizational Development Manager (HR Manager)	1	70

ATLAS.ti 5.0 software was applied for data analysis. Initial coding when analysing interview transcripts focused on HRP issues and their relationship with creativity and innovation. Furthermore, in order to provide more illustrative descriptions and in order to increase the reliability of this research we have included representative pieces of information (quotes) in the next section as examples that reveal the reasoning behind the interviewees' answers.

4. Case analysis and results

Vossloh operates globally in infrastructure and rail technology markets. With its flexible structure Vossloh has organized its operations into two divisions: Railway infrastructure, and Motor & Components. The selected firm is the Business Unit under this second division, Motor & Components, and is responsible of the design, construction and maintenance of railway vehicles.

The company selected for this research is the business unit locomotives under the division of Motor Components and it is responsible of the design, construction and maintenance of railway vehicles. From now on we will name the business unit located in Valencia only as Vossloh.

Currently, Vossloh group produces rail fastening systems and high quality via deviations, build new track sections and maintains the existing lines (such as the Euro-tunnel linking France and England). The new diesel locomotives from Vossloh towed countless trains each day, with the main advantages of the cost efficiency, flexibility and an attractive way of financing for both buyers and renters. In addition, Vossloh designs and manufactures passenger trains for regional and urban services and supplies electrical equipment for trams and trolleybuses. Vossloh engineering systems and its Information Technologies products ensures that carriers/transport companies operate economically and with the maximum customer benefit.

The Vossloh Engineering Center is committed with innovation. Top technology and optimum quality are the hallmarks of the entire range of products that are developed and produced at the Valencia plant. It is a leader in the Spanish market and is exporting to the

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U.S., UK, France, Switzerland, Israel, Algeria, Egypt, Brazil, Yugoslavia and other countries.

The most important survival strategy of Vossloh is based on technological innovation. Other industrial activities have been moved to emergent growing locations.

With regard to research and development, Vossloh is aware that the work of R & D + i takes a core stage in this new period of the company and cannot be the result of individual effort. This aspect is the reason why Vossloh has signed cooperation agreements with universities and research centres in order to develop new designs and solutions based on the latest technologies as well as improving the day to day existing products. And, not surprisingly, in the Valencia plant there are more than one hundred engineers dedicated to research and development of products and processes. The proof of the relevance that innovation has for the company is the ambitious challenge of Vossloh top management: Designing and building in Valencia the first locomotive in the world powered with hydrogen battery.

Traditionally, the Human Resources Department developed administrative tasks. However from about ten years ago Vossloh started to have an integrative, strategic and long-term vision. That is, when they opted for a strategic long term perspective, they created an integral formal plan which considered Human Resources department as key piece when developing their strategy. At that time, they created formal procedures linked to basic HRP (recruitment, training and motivation) and instrumental HRP (job design, workforce planning, career potential and performance evaluation, among others).

With regard to basic and instrumental policies we must highlight the emphasis given by the HR director to selection processes, training, job description and potential evaluation. Using his words literally:

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‘The selection process is essential; a good choice is the key. The more we detect the values, the basic knowledge of the person and their potential, the better results we will get’.

‘To have people prepared to innovate and create we have to develop a good selection process, and that’s what my experience has taught me. Good job descriptions need to be done, a good competency analysis is also relevant and to know where we have the talent is essential. If we know where we have the talent or the potential talent we are able to do an internal selection process but if it’s not the case, we know we should do an external selection process; so, this helps us to decide what kind of selection process we need to adopt.’

‘To be creative, to be leaders, apart from basic training we always have to train workers in specific areas: rail issues, negotiation techniques; and also we develop annual evaluations of potential and performance appraisal to know which the value individually provided to the company is. We try also to analyse the potential capabilities of our employees.’

Considering the aspects related to the relationship between HRP and innovation, and following the opinion of the HR manager, we can say that there are no specific HRP for each department. They are generally implemented (with particular adaptations) because of the high qualification of the major part of their employees.

Note that in Vossloh both kind of innovations (product and process) does take place; but there is a greater impact on process innovation, as the first is considered vital for continuous and incremental improvement.

Training, discussion and negotiation techniques and the culture of the company improve work processes and procedures. Product innovation is fostered by the internal and

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external policy of recruitment, and through a proper process of selection and retention of talent.

Analysing in deep the data gathered from the interviews we can observe both process and product innovations; due to the big size and maturity of the company, the firm can take advantage of greater investment opportunities for developing new and very expensive processes.

Regarding the description of the HRP-oriented to creativity and innovation, HR manager recognises that they are, in general, relevant for the innovation performance. Specifically we should highlight the role of the following practices: autonomy, commitment, participation, training, a formalised and structured selection process and the existence of a career plan.

Considering to the autonomy, the company is structured through self-directed teams thus commitment and autonomy are the key for the development of new products and processes. There is also a high level of the employee's participation, as there is a formalized process in terms of inter-departmental meetings and suggestions. The director of R + D + I noted that:

‘Creating innovations depends on several departments and formal meetings are organized where we discuss the aspects of that project. Sometimes at the end of the workday we meet to discuss possible improvements of the project in the group’.

Voslohh considers training as a key practice for the firm; so the organization dedicates a great amount of resources to it:

‘To be creative, to be leaders, apart from the basic training you always have to train workers in specific areas: railroad issues, negotiation techniques, leadership. There's the key to the development of talent, long term- thinking’.

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Having a formalized and structured selection process is an important part of successful innovative companies, according to the HR manager. Innovation results lie in achieving a good selection process.

‘It is important that everything will be structured and formalized to leave no margin of doubt in our managers. That is, it is relevant that all things will be well detailed because that way our employees know what they have to do and how. In the case of selection processes, it is important to consider the description of the job, competence analysis and to see where we have the talent as it is very important to know the potential talent in the firm if we are going to develop an internal recruitment process; or if it is an external recruitment, talent must be detected during the selection process’.

Another variable to consider corresponds to the existence of a career plan in which employees could be continuously trained and could have real aspirations for advancing; this fact will contribute to increase happiness at work, essential to the promotion of creativity and innovation.

‘We consider career plans of a great importance for employees. Nowadays it is very difficult to retain top talent; so, our company is committed to provide training in skills, behaviour, language etc. as a way to retain employees and avoid brain drain. We also believe that happiness at work is a prerequisite for the promotion of creativity’.

On the other hand, reward systems and performance evaluation are not carried out to improve the innovation performance; so, we can say that these practices are not considered as relevant variables for innovation, that is, from the managers’ point of view they are not seen as key factors to generate creativity and innovation.

With respect to creativity, it is seen as complementary to innovation, that is, a prerequisite and prior to innovation. In fact, the HR director commented:

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‘All our activity, not only in the HR area but throughout the organization, aims to promote knowledge, skills, behaviors ... which is what we believe will generate creativity and innovation in our engineers.’

Finally, is also relevant to highlight other organizational variables that could have an impact on creativity and innovation such as organizational culture focused on innovation and communication policy.

About the organizational culture we observed that is a variable which, in the opinion of respondents, affects positively innovation performance. We can affirm that in the present case there is a formalized process of socialization of employees through the transmission of this culture of innovation that guides their behaviour to generate added value.

‘In our company, when a worker joins the firm goes through different phases; first phase, ‘host’ (3 months) in which we check that our selection process has been the best, then comes the phase of training in aspects we consider necessary. Through this process we try to convey to our employees our strategy, mission, vision and values, so they know what behaviours and attitudes expected of them.’

Another important factor that we observed relates to communication policy; it is essential the existence of effective communication between employees both horizontally and vertically. In the present case there are formal meetings for discussing different aspects of their activity. Finally, another variable to consider is the degree in which HRP are structured or formalized. Following the HR Director, it is a prerequisite for the development of creativity and innovation.

The following table summarizes the contrast of propositions for Vossloh case:

Table 3: Vossloh Results

<i>Questions and Propositions</i>	<i>Results for Vossloh</i>
<i>P1</i>	Partially fulfilled. Is more important the consideration of variables such as employees employability and the retention of talent than the incentive schemes for increasing and fostering innovation
<i>P2</i>	Partially fulfilled. Compensation policies are not considered relevant to the promotion of creativity
<i>CI</i>	Understand creativity as a condition prior and complementary and innovative

5. Conclusions and implications

Results obtained show that some HRP such as autonomy, commitment, participation, training, formalised and structured selection process and the existence of a career plan (employability), have a clear positive impact on creativity and, as a consequence, on product and process innovation. Furthermore, in the case studied, practices such as reward systems and performance appraisal or potential appraisal, have not an effect on creativity or innovation. We also observed that these relationships are stronger if there is an organizational culture geared towards innovation (Wei et al., 2011) and an effective communication policy (horizontally and vertically). Furthermore, in the case studied creativity acts as a mediating variable between HRP and product and process innovation.

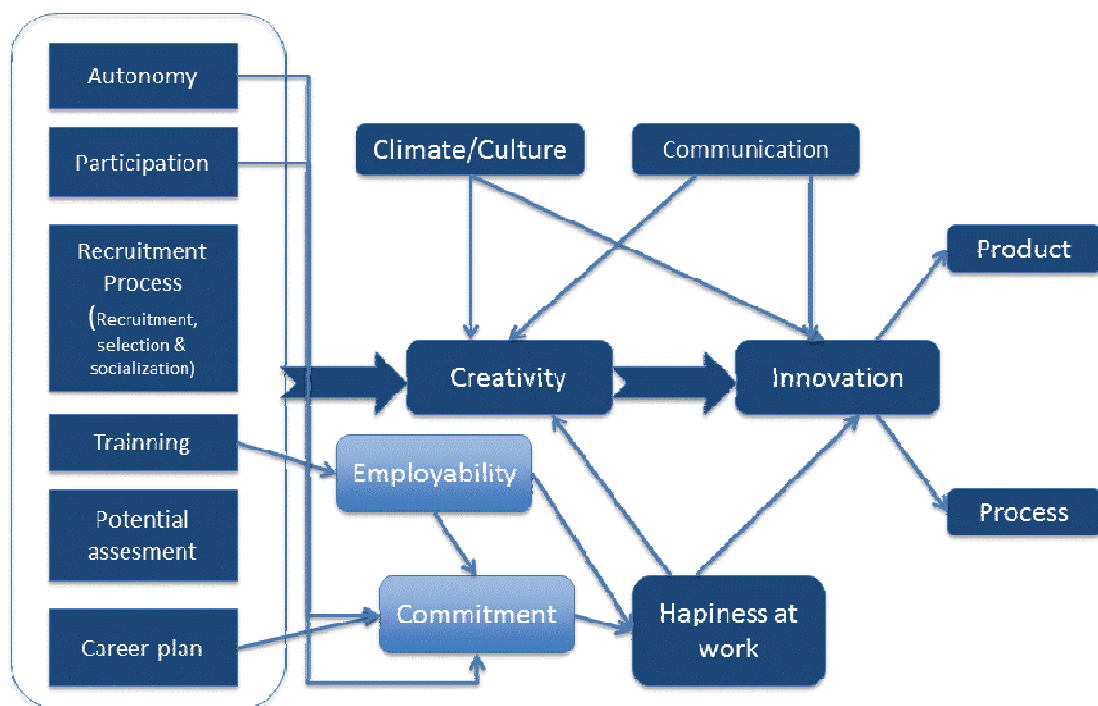
Moreover, we have observed in the studied case the existence of different variables that were not initially considered in our propositions. Some of these variables are referred to HRP such as: formalized selection process, socialization, the existence of a career plan

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(affecting commitment and happiness of the employees). Likewise, it is really interesting to note that the planned, systematic and formalised nature of the HRP have contributed to foster creativity and innovation. This result coincides with the arguments exposed by Binjamin and Carmelli (2010). From this viewpoint, creativity and innovation is fostered by the firm (as opposite to be considered the natural or chance outcome of these processes). Here, the deliberated decision making to top managers becomes crucial. On the other hand, there are several contextual or organisational variables that have arisen and we should include them in our final model. These variables are; the existence of a culture focused on innovation and also a developed communication policy.

According to the case analysis and to the new observed variables, we have developed an induced model that tries to include all those new observed relationships:

Figure 1: Induced Model



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Several previous studies related some HRP to innovation (Jimenez and Sanz, 2008, Laursen and Foss, 2003; Pini and Santangelo, 2005, Shipton et al., 2005 and 2006 b). Particularly, some of them (Beujeisdick, 2008, Jimenez and Sanz, 2008) propose a positive relationship between performance assessment and innovation performance. However, our research has revealed that when performance assessment is linked to the reward systems there is no effect or even this effect could be negative on innovation or employees creativity. This result is supported by the specialist literature (Shipton et al., 2005).

Concerning creativity, our work has revealed that creativity becomes a previous step for innovation to take place. Also, we have observed that creativity is an individual and collective activity (teamwork) whilst innovation becomes an organisational process. As we have seen, the firm analysed understands creativity in a similar way to Amabile (1988; 1996) or West and Farr (1990). Furthermore, other recent work such as Jiang et al (2012) study posted that creativity is necessary and comes before innovation, even though the interviewees see links between the two concepts. This leads to the conclusion that in the case studied, creativity is considered to be a mediating variable. The transition from the individual level of creativity to the organisational level of innovation needs to be further examined in future research.

To conclude with the results, we dare say that our conclusions follow the trend of previous studies (Dougherty and Tolboom, 2008; Kollenschner et al. 2009; Ohly et al, 2006). Specifically, different studies concluded by saying that creativity is greater in structured conditions such as the formalization of the selection process (Chen and Huang, 2009; Jiménez and Sanz, 2005; Saá and Diaz, 2010; among others)

This study suggests some practical implications for managers. Creativity has to be encouraged in order to generate innovation, based on autonomy, commitment, participation,

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training, formalised and structured selection process and on the existence of a career plan (employability). These processes must be oriented to retain people with heterogeneous and flexible capabilities, and are linked to a continuous learning process. Also, other factors that have come up as important variables in the relationship among, HRP, creativity and innovation are the organisational culture and an effective communication policy. With respect to the academic implications of the paper, they are based on the introduction of the variable creativity as a mediating factor between HRP and innovation, an issue that needs further attention, as conclusive results have not been found; only Jiang et al (2012) considered HRP as mediating variable between of creativity and innovation.

This topic has been scarcely analysed in the management area, so this study tries to make a contribution by identifying which variables can affect creativity and which is its relationship to innovation. Also, after the in depth analysis of this concept we will be closer to another future objective, that is to measure it with a quantitative scale oriented to management and not to psychological and individual aspects only.

The main limitations concern the research methodology used. We have tried to enhance the quality of the research by drawing up and following a research protocol involving information triangulation and sending the results to the interviewees so they can verify whether our interpretations based on the information we have gathered are correct or, if not, they can be amended. In addition, we have enhanced scientific rigor through a review of the literature that made it possible to establish a preliminary or initial theoretical framework for the object of analysis, ensuring logical consistency between the various stages of the research and thus achieving greater objectivity in the study. The selection of only one exploratory case when conducting fieldwork can be considered another limitation because its results cannot be extrapolated. But on the contrary, this fact permits the

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researcher to analyse the phenomenon in depth and to obtain rich and comprehensive information to establish a broad framework of analysis.

More research is required to analyse how turn creative ideas into innovation performance in organizations operating in turbulent and unstable environments. Additionally, we could analyse the relationship between HRP and innovation at different levels, i.e. the effect of HRP on different working groups and innovation performance. Finally, another future line of research would be to study whether or not adapting HRP to the different departments or to the different degrees of complexity of the tasks improves innovation results, as previous literature (Ortín and Santamaría, 2009) suggest that HRP should be adapted to innovation departments or tasks but the evidence obtained from our case study points out in another direction. The effects of the industry and the kind of tasks developed (product or services, degree of complexity of the tasks) could be also taken into account.

REFERENCES

- Amabile, T. M. (1988). A model of creativity and innovation in organizations. In B. M. Staw & L. L. Cummings (Eds.), *Research in Organizational Behaviour*, (10), (pp. 123-167). Greenwich, CT: IAI.
- Amabile, T. M., Conti, R., and Coon, H. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, 39, 292–339.
- Andersen, T. J. (2000). Strategic Planning, Autonomous Actions and Corporate Performance. *Long Range Planning*, 33, 184-200.
- Andersen, T. J. (2004). Integrating Decentralized Strategy Making and Strategic Planning Processes in Dynamic Environments?. *Journal of Management Studies*, 41(8), 1271-1299.
- Balbastre, F. (2003): *La Autoevaluación Según los Modelos de Gestión de Calidad Total y el Aprendizaje en la Organización: Una Investigación de Carácter Exploratorio*, Tesis doctoral, Universitat de València, Valencia.

ORGANIZATIONAL INNOVATION WORKSHOP

- Baumol, W. (2004). Entrepreneurial cultures and countercultures. *Academy of Management Learning and Education*, 3(3), 316-326
- Becker, B.E. and Gerhart, B. (1996). The Impact of Human Resource Management on Organizational Performance: Progress and Prospects. *The Academy of Management Journal*, 39(4), 779–801.
- Beugeisdijk, S. (2008). Strategic Human Resource Practices and Product innovation. *Organization Studies*, 29(6), 821-847.
- Binyamin, G., and Carmeli, A. (2010). Does structuring of human resource management processes enhance employee creativity? The mediating role of psychological availability. *Human Resource Management*, 49(6), 999-1024.
- Borghini, S. (2005). Organizational creativity: breaking equilibrium and order to innovate. *Journal of Knowledge Management*, 9 (4), 19-33.
- Brews, P. and M. Hunt (1999). Learning to Plan and Planning to Learn: Resolving the Planning School/Learning School Debate. *Strategic Management Journal*, 20, 889-913.
- Bueno, E., Ordoñez, P., (2004). Innovation and learning in the knowledge- based economy: challenges for the firm. *International Journal of Technology Management*, 27 (6/7), 531–533.
- Camelo, C., García, J., and Sousa, E. (2010). Facilitadores de los procesos de compartir conocimiento y su influencia sobre la innovación. *Cuadernos de Economía y Dirección de la Empresa*, (42), 113.
- Cardinal, L.B. (2001). Technological innovation in the pharmaceutical industry: The use of organizational control in managing research and development. *Organizational Science*, 12(1), 19-36.
- Chen, C. J., and Huang, J. W. (2009). Strategic Human Resource Practices and Innovation Performance – The Mediating Role of Knowledge Management Capacity. *Journal of Business Research*, 62(1), 104–114.
- Cheng, T. and Mohd, A (2010). Human Resource Management Practices and Organizational Innovations an empirical Study in Malaysia. *The journal of Applied Business Research*, 26(4), 105-115.
- Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 34, (3), 215-240.
- Damanpour, F., Szabat, K.A., and Evan, W.M. (1989). The Relationship Between Types of Innovation and Organizational Performance. *Journal of Management Studies*, 26(6), 587–601.
- Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal*, 23, 1095–1121.

ORGANIZATIONAL INNOVATION WORKSHOP

- De Saa-Pérez, P and Díaz-Díaz, N.L. (2010). Human resource Management and Innovation In The Canary Islands: an ultra peripheral region of European Union. *The International Journal of Human Resource Management*, 21(10), 1649-1666.
- Delaney, J.T. and Huselid, M.A. (1996). The impact of human resource management practices on perceptions of organizacional performance. *Academy of Management Journal*, 39(4), 949-969.
- Dougherty, D., and Tolboom, J. N. (2008). Creative organizing to enable organizational creativity. In J. Zhou & C.E. Shalley (Eds.), *Handbook of Organizational Creativity* (pp. 237–262). Mahwah, NJ: Lawrence Erlbaum Associates.
- George, J. M., and Zhou, J. (2001). When openness to experience and conscientiousness are related to creative behavior: An interactional approach. *Journal of Applied Psychology*, 86(3), 513-524.
- Gurbuz, S. and Ibrahim, S. (2011). Impact of the strategic human resource management on organizational performance: evidence from Turkey. *The International Journal of Human Resource Management*, 22(8), 1803–1822.
- Hargadon, A.B. and Bechky, B.A. (2006) When Collections of Creatives Become Creative Collectives: A Field Study of Problem Solving at Work. *Organization Science*, 17, 484–500.
- Hendry, J. (2000). Strategic Decision Making, Discourse, and Strategy as Social Practice. *Journal of Management Studies*, 37(7) 955-977.
- Huselid, M.A. (1995). The impact of human resource management practices on turnover, productivity and corporate financial performance. *Academy of Management Journal*, 38, 635-672.
- Huselid, M.A.; Jackson, S.E. and Schuler, R.S. (1997). Technical and Strategic Human Resources Management Effectiveness as Determinants of Firm Performance. *Academy of Management Journal*, 40, 171–188.
- Jackson, S. E., and Schuler, R.S. (1995). Understanding human resource Management in the context of organizations and their environments. *Annual review of Psychology*, 46, 237-264.
- Jackson, S. E.; Schuler, R.S. and Rivero, J. M. (1989). Organizational characteristics as predictors of personnel practices. *Personnel Psychology*, 42, 727-786.
- Jiang, J., Wang, S., and Zhao, S. (2012). Does HRM facilitate employee creativity and organizational innovation? A study of Chinese firms. *International Journal of Human Resource Management*, 23(19), 4025-4047.
- Jiménez, D. and Sanz, R. (2005). Innovation and Human Resource Management Fit: An Empirical study. *International Journal of Manpower*, 26 (4), 364-398.
- Jiménez-Jiménez, D., and Sanz-Valle, R. (2008). Could HRM Support Organizational Innovation? *International Journal of Human Resource Management*, 19(7), 1208–1221.

ORGANIZATIONAL INNOVATION WORKSHOP

- Kalyar, M.N. and Rafi, N. (2012). Organizational learning culture: an ingenious device for promoting firm's innovativeness. *The Service Industries Journal*, DOI:10.1080/02642069.2012.716828
- Klijn, M. and Tomic, W. (2010). A review of creativity within organizations from a psychological perspective. *Journal of Management Development*, 29 (4), 322-343.
- Kollenscher, E., Ronen, B., and Farjoun, M. (2009). Architectural leadership: Building a value enhancing infrastructure. *Human Systems Management*, 28(1/2), 35-45.
- Lau, C.M. and Ngo, H.Y. (2004). The HR System, Organizational Culture, and Product Innovation. *International Business Review*, 13, 685–703.
- Laursen, K. (2002). The Importance of Sectorial Differences in the Application of Complementary HRM Practices for Innovation Performance. *International Journal of Economics of Business*, 9, 139–156.
- Laursen, K. and Foss, N. (2003). New Human Resource Management Practices, Complementarities and the Impact on Innovation Performance. *Cambridge Journal of Economics*, 27, 243–263.
- Leede (De), J., and Looise, J. K. (2005). Innovation and HRM: Towards an integrated framework. *Creativity and Innovation Management*, 14(2), 108-117.
- Martin, P., Orengo, V., and Martinez, I. M. (1997). Innovación y creatividad en las organizaciones: Perspectivas de análisis. *Revista De Psicología Del Trabajo y Las Organizaciones*, 13(1), 99-118.
- Martins, E. C., and Terblanche, F. (2003). Building organisational culture that stimulates creativity and innovation. *European Journal of Innovation Management*, 6(1), 64-74.
- McLean, L. D. (2005). Organizational culture's influence on creativity and innovation: A review of the literature and implications for human resource development. *Advances in Developing Human Resources*, 7(2), 226-246.
- Mintzberg, H. and J. Lampel (1999). Reflecting on the Strategy Process, *Sloan Management Review*, Spring, pp. 21-30
- Mumford, M. D., Connelly, S., and Gaddis, B. (2003). How creative leaders think: Experimental findings and cases. *The Leadership Quarterly*, 14(4/5), 411-432.
- Mumford, M. D., Scott, G. M., Gaddis, B., and Strange, J. M. (2002). Leading creative people: Orchestrating expertise and relationships. *The Leadership Quarterly*, 13(6), 705-750.
- Mumford, M., and Gustafson, S. (1988). Creativity syndrome: integration, application, and innovation. *Psychological Bulletin*, 103(1), 27-43.
- Nonaka, I. 1991. The knowledge-creating company. *Harvard Business Review*, 69, 96–104.

ORGANIZATIONAL INNOVATION WORKSHOP

- OECD-EUROSTAT. Oslo Manual (2005). Guidelines for collecting and interpreting technological innovation data (3rd Edition). Paris: OECD Publishing.
- Ohly, S., Sonnentag, S., and Pluntke, F. (2006). Routinization, work characteristics and their relationship with creative and proactive behaviors. *Journal of Organizational Behavior*, 27(3), 257-279.
- Ortín, A. and Santamaría, L. (2009). R&D managers' adaptation of firms' HRM practices. *R&D Management*, 39(3), 271-290.
- Parjanen, S. (2012). Experiencing Creativity in the Organization: From Individual Creativity to Collective Creativity. *Interdisciplinary Journal of Information, Knowledge, and Management*, 7, 109-128.
- Perdomo-Ortiz, J., González-Benito, J., and Galende, J. (2006). Total quality management as a Forerunner of business innovation capability. *Technovation*, 26(10), 1170-1185.
- Pettigrew, A. M. (1990). Longitudinal Field on Change Theory and Practice. *Organization Science*, 1(3) 267-92.
- Pini, P., and Santangelo, G. (2005). Innovation Types and Labour Organisational Practices: A Comparison of Foreign and Domestic Firms in the Reggio Emilia Industrial Districts. *Economics of Innovation and New Technology*, 14, 251-276.
- Rico, G. (2000). Implicaciones del entorno como factor de contingencia para el diseño organizativo de las empresas multinacionales: una síntesis teórica. *Revista Dirección y Organización*, N° 24, 143-155.
- Sagiv, L., Arieli, S., Goldenberg, J. and Goldschmidt, A. (2009). Structure and freedom in creativity: The interplay between externally imposed structure and personal cognitive style. *Journal of Organizational Behavior*, 31(8), 1086-1110.
- Schuler, R. S. and MacMillan J. C. (1984). Gaining competitive advantage through human resource management practices. *Human resource Management*, 23(3), 241-255.
- Schuler, R.S. and Jackson, S. E. (1987) a. Linking competitive strategies with human resource management practices. *Academy of Management Executive*, 1(3), 207-219.
- Schuler, R.S. and Jackson, S. E. (1987) b. Organizational strategy and organizational level as determinants of human resource practices. *Human Resource Planning*, 10 (3), 125-141.
- Schuler, R.S. and Jackson, S. E. (1988). Linking remuneration practices to innovation as a competitive strategy. *Human resource Management Australia*, 10 (May), 6-21.
- Searle, R. H., and Ball, K. S. (2003). Supporting innovation through HR policy: evidence from the UK. *Creativity and Innovation Management*, 12(1), 50-62.
- Shalley, C. E. 1991. Effects of productivity goals, creativity goals, and personal discretion on individual creativity. *Journal of Applied Psychology*, 76, 179-185.

ORGANIZATIONAL INNOVATION WORKSHOP

- Shalley, C.E., Zhou, J. & Oldham, G.R. (2004). The Effects of Personal and Contextual Characteristics on Creativity: Where Should We Go from Here? *Journal of Management*, 30(6), 933-958.
- Shipton, H.J., Fay, D., West, M. A., Patterson, M., and Birdi, K. (2005). Managing people to promote innovation. *Creativity and Innovation Management*, 14(2), 118-128.
- Shipton, H.J., West, M.A., Dawson, J., Birdi, K., and Patterson, M. (2006a) HRM as a predictor of innovation. *Human Resource Management Journal*, 16(1), 3-27.
- Shipton, H.J., West, M.A., Parkes, C.L., and Dawson, J.F. (2006 b). When promoting positive feelings pays: Aggregate job satisfaction, work design features and innovation in manufacturing organizations. *European Journal of Work and Organizational Psychology*, 15(4), 404-430.
- Skinner, D.; Tagg, C. and Holloway J. (2000). Managers and Research. The Pros and Cons of Qualitative Approaches. *Management Learning*, 31(2), 163- 179.
- Sosik, J. J., Kahai, S. S. and Avolio, B. J. (1998). Inspiring group creativity. *Small Group Research*, 29(1), 3-31.
- Sosik, J.J., Kahai, S.S., and Avolio, B.J. (1999). Leadership style, anonymity, and creativity in group decision support systems: The mediating role of optimal flow. *Journal of Creative Behavior*, 33 (4), 1-30.
- Staw, B.M. (1995). Why no one really wants creativity. In: C.M. Ford and D.A. Gioia (Eds), *Creative action in organizations* (pp.161-166). Thousand Oaks, CA:Sage.
- Tang, H.K. (1998). An Integrative Model of Innovation in Organisations. *Technovation*, 18, 297–309.
- Therrien, P. and Leonard, A. (2003). *Empowering Employees: A Route to Innovation*?. Ottawa: Statistics Canada.
- Van de Ven, A.H. (1986). Central problems in the management of innovation. *Management Science*, 32(5), 590-607.
- Vlachos, I. (2008). The effect of human resource practices on organizational performance: evidence from Greece. *The International Journal of Human Resource Management*, 19(1), 74–97.
- Wei, Li-Qun, Jun L. and Herndon N.C. (2011). SHRM and product innovation: testing the moderating effects of organizational culture and structure in Chinese firms. *The International Journal of Human Resource Management*, 22(1), 19–33.
- West, M. A. and Farr, J. L. (1990). *Innovation at work: Psychological and Organizational Strategies*. Chichester. Willey.
- Wilson, N. C., and Stokes, D. (2005). Managing creativity and innovation: The challenge for cultural entrepreneurs. *Journal of Small Business and Enterprise Development*, 12(3), 366-378.

ORGANIZATIONAL INNOVATION WORKSHOP

Yin, R. K. (1989). *Case Study Research. Design and Methods*, Cuarta Impresión, Newbury Park, CA: Sage.

Yin, R. K. (1993). *Applications of Case Study Research*, Newbury Park, CA: Sage.

Zdunczyk, K, and Blenkinsopp, J. (2007). Do organisational factors support creativity and innovation in Polish firms? *European Journal of Innovation Management*, 10(1), 25-40.

Zhang, H., Kwan, H.K., Zhang, X. and Wu, L.Z. (2012). High Core Self-Evaluators Maintain Creativity: A Motivational Model of Abusive Supervision. *Journal of Management* 0149206312460681, first published on September 26, as doi:10.1177/0149206312460681.

Zhang, X., and Bartol, K. M. (2010). Linking empowering leadership and employee creativity: The influence of psychological empowerment, intrinsic motivation and creative process engagement. *Academy of Management Journal*, 53(1), 107-128.

Zhou, J. (1998). Feedback valence, feedback style, task autonomy, and achievement orientation: Interactive effects on creativity performance. *Journal of Applied Psychology*, 83, 261-276.

Zhou, J. and Shalley, C. E. (2003). Research on employee creativity: A critical review and directions for future research. In J. Martocchio (Ed.), *Research in personnel and human resource management* (pp.165–217). Oxford, England: Elsevier.

SYNCHRONOUS ADOPTION OF TECHNOLOGICAL AND NON-TECHNOLOGICAL INNOVATION STRATEGIES IN NON-R&D PERFORMERS: UNPACKING COMPLEMENTARITIES AND THEIR PERFORMANCE CONSEQUENCES.

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Abstract

This paper's goal consists of analysing the innovation patterns among non-R&D firms relating multiple and complex innovation modes co-adoption and their performance consequences. Beyond just predicting non-R&D performers or addressing solely technological innovation, this paper uses 5,878 non-R&D innovators with CIS data and shows that non-R&D innovation strategy pays off, unfolding its drivers and innovation performance from the combination of technological (product and process) and non-technological (organization and marketing) innovation modes defined in the Oslo Manual. Thus, the paper goes one step further from technological innovation and unpacks the synchronous adoption of specific complex innovative strategies (product-marketing innovation and process-organization innovation). Results indicate that these paired simultaneous adoptions bring *complementarities* which improve a firm's innovation performance.

1. Introduction

R&D indicators, and by extension, R&D innovators, are still the most commonly used indicators of innovation activity. In this vein, the literature has equated innovation with in-house R&D. How valid is this assessment? In our view, all the evidence generated constitutes a key repository of knowledge for innovation studies, yet it also represents a flawed bias which underestimates other innovation efforts and expenditures that account for innovative performance. In particular, the bias is related to the omission of other variables which can also represent innovative activities beyond R&D and also due to the fact that the samples are sometimes limited (see Cuervo-Cazurra and Annique Un, 2010) just to the firms which reported R&D expenditures (e.g Mañez-Castillejo et al., 2009), whereas the facts made available by the European Commission (2008) speak for themselves: almost half of the innovators in Europe, using CIS as the unit to measure innovation, do not perform R&D activities. The innovation patterns observed for those non-R&D performers involve the acquisition of advanced machinery and equipment, patents, licences or know-how, as well as the implementation of training or marketing activities in order to implement new or significant improved products and processes (European Commission, 2008). Correspondingly, the OECD (OECD, 2010) states that: “...*firms may introduce new products on the market without engaging in R&D. New indicators reveal that in Australia and Norway the propensity to introduce a new-to-market product innovation is similar whether or not the firm performs R&D.* For instance, it cites that in Luxemburg 52% of non-R&D performers introduced new-to-market innovations, which is comparable to the 63% found among in-house R&D performers (p. 23). All in all, the most important point is to understand that a failure to differentiate between non-R&D and R&D innovators reduces the effectiveness of both (academic) analyses of innovative firms and the effectiveness of public policies to stimulate innovation. Similarly, Harris and Halkett (2007) work on the concept of ‘hidden innovation’ – the innovation activities that are not reflected in traditional indicators such as investments in formal R&D or patents awarded, and it states that despite not being measured, hidden innovation often represents the innovation that matters, i.e. the innovation that most directly contributes to the real practice and performance of a sector. Thus, hidden innovation is more often about absorbing ideas than creating new ones in-house, and this matter is important for growth.

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Although there is a nascent effort to measure non-R&D innovation (Arundel et al., 2008; Hervas-Oliver et al., 2011; Huang et al., 2010; Rammer et al., 2009) ; Santamaria et al., 2009), evidence concerning the non-R&D pattern of innovation is limited and fragmented. All these limitations constitute the research gaps of this paper. On the one hand, most of the analysis concerning non-R&D performers has been aimed at predicting technological innovators (e.g. Barge-Gil, 2010; Hervas-Oliver et al., 2011) and there are no works which question whether non-R&D innovation strategy pays off: what is its performance? To put it differently, not much is known about the performance consequences from the adoption of non-R&D innovation strategy. Studies referred to non-R&D, on the other hand, are also fragmented and biased towards technological innovation, neglecting the non-technological innovation modes presented in the Oslo Manual (OECD, 2005). *Non-technological* or *organizational innovation* pertains to the policies of recruitment, allocation of resources, and the structuring of tasks, authority and reward (Evan, 1966) or marketing efforts (Mol and Birkinshaw, 2009; OECD, 2005). By *organizational innovation* in this paper we refer to “the implementation of a new organizational method in the firm’s business practices, workplace organization or external relations” (OECD, 2005: 177) , stressing the fact that is the result of *strategic decisions taken by management* (pp.179). According to Wengel et al., (2000) , there are two different kinds of organizational innovation, usually inter-related: structural innovations (organizational arrangement and division of labor within it) and managerial innovations (the way a firm organizes its activities or the personnel). Similarly, Birkinshaw et al., (2008) uses the term *management innovation* addressing the new organizational structures, administrative systems, management practices, processes and techniques. It is especially recognized that non-technological forms of innovation also contribute to upgrading a firm’s performance (Arundel et al., 2008; Mothe and Thi, 2010; OECD, 2005; Piva and Vivarelli, 2002; Schubert, 2010). Nevertheless, to the best of our knowledge, there is no evidence concerning the non-R&D patterns of innovation involving the combination of technological (product and process) and non-technological (organization and marketing) innovation in the case of non-R&D performers. In fact, this idea of *synchronous innovation* (Ettlie, 1988) or *organizational integration* (Ettlie and Reza, 1992) is referred to the fact that successful adoption of technologies depends on simultaneous administrative practices (see Nabseth and Ray, 1974, 1974:310) . Different perspectives have provided similar thoughts on the idea of the synchronous co-adoption of technological and organizational innovations. Milgrom and Roberts (1995: 81) presented “complements” in a broader sense as a *relation among groups of activities*, stating that “...if the levels of any subset of activities are increased, then the marginal return to increases in any or all of the remaining activities rises”. All in all, these complementarities or co-adoption are rarely measured using in large-scale dataset like the

CIS data. Overall, the paper's goal consists of analysing the innovation patterns among non-R&D firms relating multiple and complex innovation modes co-adoption and performance consequences. This paper offers insight based on 5,878 non-R&D performers, providing evidence about their pattern of innovation. The paper uses 2006 CIS data for Spain and controls potential selection bias using two-step Heckman procedures. The organization of this paper is as follows. Following this introduction, the paper will present a review of the empirical studies on innovation beyond R&D activities, whilst providing an explanation of innovation modes and theories in order to account for the selection of strategies aligned with either R&D or non-R&D forms of innovation. Then, in section three, the empirical exercise is presented, using CIS data for Spain. A discussion of this study's findings is presented in section four. Finally, the main conclusions are presented in the last section.

2. Theory

2.1 Non-R&D activities and innovation

Pavitt (1982) suggested that the R&D statistics generally underestimate the innovative performance of small firms. Indeed, following Pavitt (1984) it is claimed that R&D statistics do not account very well for two important sources of technological change: (1) the production function of the production-intensive firms' engineering departments, in which process technology is developed in-house in order to optimize processes and improve productivity and, (2) the design activities of specialized suppliers or equipment manufacturers, especially as regards the intensive use of their own resources for the improvement of their own process innovation, along with the product innovation dedicated to enhance their customer base across different industries.

Similarly, Griliches (1990) also suggested that some non-R&D innovation expenditures are important for SMEs, a fact evidenced by Kleinknecht and Reijnen (1991) and Santarelli and Sterlacchini (1990). These works evinced the existence of informal R&D practices not properly accounted for innovation in the traditional formal R&D expenditures account. In this vein, Asheim and Isaksen (1997) measure the innovation expenditures beyond R&D, such as patents, licences, design, prototypes, equipment, training, market research activities and so forth, showing that R&D only represents one quarter of the total innovation expenses. Similarly, Laestadius et al., (2005) propose equivalent indicators to measure the innovative activity beyond R&D expenditures, as follows: design activities, technological activities (equipment and machinery acquisition) and skills

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(training). Freel (2005) also demonstrated the key importance of training expenditures, while Marsili and Salter (2006) did the same with design activities in order to explain innovation performance. Sterlacchini (1999) find similar evidence, especially related to supplier-driven and specialized suppliers firms. In addition, the power networking and the possibility of sourcing knowledge from external sources through interactions with customers (e.g. Von Hippel, 1988) and the subsequent knowledge transfer was also found to be an effective R&D substitute (Love and Roper, 1999) useful in the measurement of innovation and to complement in-house capabilities, especially in SMEs.

As regards non high-tech industries, Santamaría et al. (2009) use non-R&D activities to measure innovation in low and medium technology industries, showing that the utilization of advanced machinery and training activities, along with design activities and search strategies to source external knowledge are key drivers in innovation performance in those firms. This is in line with the evidence provided by Heindenreich (2009), which shows a specific innovation pattern for firms in low and medium technology industries. In this particular case, the firms show a stronger inclination for process and organization innovation activities in order to improve production flexibility and reduce labour costs, showing poor internal innovation capabilities as well as a strong dependence on equipment, machinery and software suppliers.

Nevertheless, the fact that not all firms formally invest in R&D is an old debate in the literature on innovation economics. According to Smith (2005) there are some activities which are crucial to innovation but which are not part of R&D efforts: education and training, acquisition of product and licenses, product design, trial production, training and tooling up, acquisition of equipment or machinery related to innovation. Cohen et al. (1987) showed that 24% of large firms in the US did not invest in formal R&D, similar to the findings of Bound et al. (1984), which indicated that 40% of US firms did not report positive R&D expenditures. Similarly, many scholars have argued that innovation is not limited to R&D alone (Hirsch and Kreinsen, 2008; Kline and Rosenberg, 1986; Nelson, 2000; Nelson and Rosenberg, 1993).

Complementing this extensive body of empirical research, the European Innovation Scoreboard (EIS) developed by the European Union Commission to measure the achievements of the Lisbon Agenda (Celikel-Esser et al., 2008) is also following this line of thought and in the EIS for 2008 the methodology has been revised and new categories added (enablers, firm activities and outputs; displaying 7 dimensions and 29 indicators) (see Hollanders and van Cruysen, 2008) . These mainly focus on the prominent role developed by SMEs in Europe, introducing indicators

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such as the *Non-R&D innovation expenditures (% of turnover)*. Overall, there is a tendency to experiment with non-R&D innovators and also with non-R&D activities, fact which is in line with the idea that the EIS is currently combining indicators that reflect the *science, technology and innovation* mode (STI) with those referred to the *doing, using and interacting* (DUI) mode of innovation, in the sense of (Jensen et al., 2007). The latter has been traditionally less used. In this line, Jensen et al. (2007) distinguish between STI and DUI modes of innovation, as well as a hybrid mode which combines both modes of innovation. The DUI mode is considered a process which relies on processes and experience-based know-how and is mainly associated to low-medium technology sectors. DUI refers to learning by doing, using and interacting and the innovation drivers are based on tacit, experiential knowledge flows which benefit from observation, exchange and practice (Jensen et al., 2007). It is also based on collective collaboration, teamwork and effective bottom-up and top-down communication (see Parrilli and Elola, 2011), quality circles or integration of functions (Jensen et al., 2007). As a matter of facts, Albaladejo and Romijn (2000: 4-5) stressed that: *“A substantial part of the learning may not take the form of well-defined R&D programmes and other formalized technological effort. Informal and incremental problem solving and experimentation take place on the shop floor and are closely associated with production. This is the case in small companies that do not have the resources and organization to mount large R&D and human resource development programmes (pp. 4-5).* The STI mode, in contrast, is based on science and technology drivers mainly represented by R&D expenditures, licences, external collaboration agreements with technology and knowledge suppliers, technical alliances in formal innovation plans which also include collaboration with universities or research labs. Nevertheless, Jensen et al. (2007) reported that both models co-exist and complement each other, a fact stressed by Parrilli and Elola (2011) which showed that the hybrid DUI/STI mode is the best in terms of higher innovative output. Tidd (2000) classified the internal competences into three categories: (a) organizational competences (managerial systems, skills, etc.), (b) market competences, and (c) technological competences, mainly derived from in-house R&D activities. The latter type of resource is more linked to the STI mode of innovation, while the former two (organizational and marketing) are more related to the DUI mode of innovation.

2.2 Technological and non-technological innovation: synchronous adoption and complementarities ampliar con synchronous

Tackling the above mentioned idea of complementarities, Milgrom and Roberts (1990) points out that the activities which are mutually complementary need to be adopted together. If not, then the lack of coordination or integration may diminish returns. Similarly, in the *strategic management* literature, this idea is traced by the use of *complementary assets* and it is recognized its key influence on a firm's innovation (e.g. Stieglitz and Heine, 2007). Thus, Teece (1986) defines *complementary assets* as those which raise the value of a firm's technological innovations, due to the fact that the combinations of diverse complementary assets prevents imitation and facilitate appropriability. Dierickx and Cool (1989), using the *resource-based view* of the firm (RBV) refers to the complementary assets by highlighting the sustainable competitive advantage they offer by interconnecting assets to prevent imitation. The definition of management or non-tech innovation embraces the implementation of new organizational methods in the firm's business practices, workplace organization or external relations and the implementation of new marketing methods involving significant changes in product design or packaging, product placement, product promotion or pricing. The idea of complementarities referred to the combination of diverse innovation modes, or *simultaneous co-adoption* (Ettlie, (1988) , is based on the fact that the technical system of the organization should be coupled with changes in the social (administrative) system in order to optimize the organizational outcome (Cummings and Srivastva, 1977; Damanpour and Evan, 1984; Damanpour et al., 2009; Roberts and Amit, 2003; Trist et al., 1993) . All in all, a concurrent and *complementary co-adoption* requires that the introduction of new technological activities in industries depend on changes in structure and administrative practices. In particular, this fact is especially relevant for non-R&D innovators, as pointed out by the European Commission (2008: 8): "*R&D is important as a driver of productivity increases and has often been the focus, both by policy makers and academics, of measuring innovation. However, an analysis of European innovative firms shows that almost half of these innovate without doing any R&D, for example through organisational or marketing innovations*". Nevertheless, so far there is no work providing evidence on this fact.

Studies concerning the adoption of management innovation are scarce (Birkinshaw et al., 2008; Vaccaro et al., 2011; Walker et al., 2011). In addition, most of them have been developed in isolation from those exploring technological innovation (e.g Schmidt and Rammer, 2007). This omission cannot be overlooked; most firms do not engage solely in non-technological modes, but simultaneously adopt both technological and non-technological modes. Indeed, the Spanish CIS

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2006 data used in this study reveals that non-technological innovations were accompanied by technological innovations in more than 65% of the firms in the sample. Similarly, in Germany, about half of the innovators simultaneously adopted both technological and non-technological modes; about a third employed non-technological innovations exclusively and about a fifth made use of technical innovations alone (Schmidt and Rammer, 2007). So far, the evidence does not distinguish between R&D or non-R&D performers and the stylized facts can be summarized as follows: product is more related to marketing and process is more connected to organization. For instance, Luria (1987) showed that changes in organizational structure or process technology alone did not yield any significant cost reductions in automobile component plants, as corroborated by Womack et al., (1990). Similarly, Schubert (2010) suggested that marketing activities reinforce market-product innovation performance, and that organization activities complement production-process innovation performance. All in all, we expect that the product-related innovations complement marketing innovation adoption, whereas the process-related innovations require organizational innovation co-adoption. These specific complementarities or simultaneous co-adoption is investigated, with their performance consequences.

3. Empirical design

3.1 Sample of non-R&D performers

The data is sourced from the Spanish Innovation Survey (Technology Innovation Survey is the official name) administered by the Spanish National Statistics Institute (INE) and conducted in 2006. This survey is based on the core of Eurostat Community of Innovation Surveys (CIS). The method and question types used in CIS are described by the Organisation for Economic Co-operation and Development (OECD, 2010). CIS were widely piloted and tested before implementation, and their questions have been continuously revised since their first use in the early 1990s. CIS are often described as being “subject-oriented” because they ask firms whether they were able to produce an innovation directly. Stockdale (2002) contains an overview of the methodology and basic descriptive findings of the survey. CIS data are increasingly being seen as key data in the study of innovation at firm level in a large number of studies across countries in Europe, Canada, and Australia (Klevorick et al., 1995; Pavitt et al., 1987). In the Spanish Innovation Survey (based on CIS data for 2006) firms are asked about the types of innovation introduced over the two-year period covered by the survey (2004-2006, in this case). 11,137 firms were classed as technological innovators. The final sample was based on 5,878 non-R&D

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innovators, which are defined as being firms that have introduced at least one new or improved process or product in 2006. Robustness checks were conducted in order to avoid selection process, using two-step Heckman procedures (Heckman, 1979). In the sample, 52.8% of technological innovators were non-R&D. The selected sample covers NACE-92 2-digit industries from 14 to 74; 5,395 firms are SMEs (92% of the sample), and 4,982 (85% of the sample) belong to low and medium technology industries.

Overall, 52.8 % of the technological innovators did not carry out in-house R&D. 3,488 firms (59% of the sample) had fewer than 50 employees. 3,339 firms were in manufacturing industries; the rest of the firms provided services. The majority of firms innovated in processes (4,997; around 85% of the sample) and 2,278 (39%) innovated in product. In addition, 2,979 firms (51% of the sample) introduced new organizational (non-technology) practices and 1,513 (26%) introduced new marketing practices (non-technology).

Since our empirical analysis is focused on investigating the non-R&D innovators (5,878 firms) from the innovative active firms (11,137), the selected sample is based on a threshold and our results could suffer from a selection bias. Analysis of potential selection problems has been carried out applying two-step Heckman procedures (Heckman, 1979). In order to tackle this problem a Heckman's two-stage selection model is run where, in the first stage, the inverse Mills ratio is obtained from a *Probit* regression (to predict whether or not an innovate active firm is a non-R&D innovator) using all available innovate active firms observations (11,137 firms). For the second stage, the inverse Mill ratio is included, as an additional variable, so as to explain the variation in innovation performance of the selected samples in the OLS[1].

3.2 Model and variables

In this paper we assume that innovation is made up of inputs and outputs (Schumpeter, 1912). The output, referred to our paper, is related to the *perceived innovation performance* obtained from the innovative activities carried out by the non-R&D firms. In the Spanish CIS 2006 the question referred to this output, is the following: "*Please, indicate the **impact** or effect that your innovation activities have had on your enterprise in the period 2004-2006*". CIS 2006 data and perceived innovation performance of innovation activities are treated coherently as output from the innovation strategy, following the Spanish questionnaire [2]. It is a *perceived* measure because the output is measured in a scale from 0 to 3, being 0 equal to *none* and 3 the highest impact (1 means *low* and 2 means *medium*). The impact or effect addresses tree different groups of aspects:

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perceived production performance (labor cost reduction, production flexibility, improving capacity or the reduction of materials), perceived market performance (wider range of product or services, increasing the market share or obtaining a higher quality of products or services) and perceived environmental performance. This paper is focus at the innovative output from the technological innovation strategies carried out by non-R&D performers. Therefore, we focus primarily on the production (process) performance by process innovation adoption, and the market (product) performance by product innovators, although the evidence points out that, as Lager (2002) points out, one of the process innovation strategy goal is also prompted by the needs or the company's own product development. Therefore, the introduction of new processes not only improves the production-process performance but also impact on market-product innovation performance. Similarly, the product innovators can also improve their production-process performance. Therefore, in this paper we analyze the innovation performance (production and market oriented) from the introduction of new innovation activities.

The dependent variables used in this study capture the innovation performance from introducing new innovation activities. These dependent variables are based on factor analysis procedures (PCA, principal component analysis). For measuring *Production Performance*, the dependent variable is obtained from four variables which address "improved production flexibility," "reduced unit labour costs," "increased capacity," and "reduced materials and/or energy per produced unit", aspects which differs from a firm's overall performance or productivity. The resulting score from the factor analysis represent the final dependent variable and is obtained from these four different measures (variables) from the CIS questionnaire. The four original variables were ordered responses, represented on a scale from zero (absence, no effect) to 3 (maximum). Following this procedure, it was found that one single factor from the analysis, through its score, represents the dependent variable which explains 63.39% of the variance (KMO = 0.7290, $p < 0.01$). The exercise is exactly the same for *the Market Performance*: wider range of products or services, increased market share and higher quality of products or services. The scores for the single factor found explain 72.329% of the variance (KMO=0.689, $p < 0.01$). The next part of the analysis involves the ordinary least squares (OLS) method. See table 1 for descriptive statistics across different groups in the sample.

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Table 1. Main descriptive statistics for the groups of the sample

	ALL firms		SMEs		LOW & MEDIUM TECH firms	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Exp_ext_R&D	0.07*	0.001*	0.016*	0.042*	0.066*	0.017*
Exp_maq	0.990*	0.100*	1.072*	0.113*	1.025*	0.117*
Exp_support	0.130*	0.020*	0.137*	0.026*	0.010*	0.027*
Int_sources	1.89	0.014	1.870	0.015	1.863	0.015
External_sources_industrial	0.00	0.013	0.000	0.013	0.000	0.014
External_sources_science	0.00	0.013	0.000	0.013	0.000	0.014
Inno_organization	0.507	0.006	0.501	0.006	0.511	0.007
Inno_marketing	0.257	0.005	0.259	0.006	0.263	0.006
Group	0.224	0.005	0.187	0.005	0.220	0.005
SMALL	0.593	0.006	0.647	0.006	0.579	0.007
MED	0.324	0.006	0.353	0.006	0.331	0.006
LARGE	0.082	0.006	-	-	0.090	0.007
Export	0.442	0.006	0.440	0.006	0.415	0.007

Exp = expenditures (*) % of expenditures in thousands

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Table 2 contains the lists of variables used in the analysis, following the RBV and the relational view (Barney, 1991; Dyer and Singh, 1998, respectively) framework in order to capture the internal and external sources of knowledge for innovation, together with control variables, as usual.

Table 2. Table of variables for the analysis

Variable	Meaning	Codification
Dependent variable: innovation performance		
Dependent variable: Production_Performance	Effects on Production performance from innovation activities. Calculated from a PCA applied to the sample. Resulting from the following variables measuring the effect on firms of process innovation on: <ul style="list-style-type: none"> - Reduced unit labour costs - Increased capacity - Improved production flexibility - Materials and energy saving Each effect has been measured in a four range scale: No effect = 0; Low effect = 1; Medium effect =2; High effect = 3	Continuous, from punctuations from factor analysis
Dependent variable: Market_Performance	Effects on Market performance from innovation activities. Calculated from a PCA applied to the sample. Resulting from the following variables measuring the effect on firms of product innovation on: <ul style="list-style-type: none"> - Increasing range of goods or services - Entering new markets or increased market share - Improving quality of goods or services Each effect has been measured in a four range scale: No effect = 0; Low effect = 1; Medium effect =2; High effect = 3	Continuous, from punctuations from factor analysis
External and internal sources of knowledge		
Int_sources	The importance of the internal sources of information to innovate (by internal it is considered the firm's own departments, staff, firms from the same group, etc.). The importance of information of each source has to be in a four point scale: Not used = 0 ; Poor, value = 1; Medium, value = 2; High, value=3	0-3 interval.
Ext_sources_industrial Ext_sources_science	External sources factors Industry and Science are the result from a PCA applied to different variables corresponding with different sources of information to innovate -External_sources_industrial: corresponds to clients, suppliers, competitors, consultants, commercial events, scientific journals and magazines, and professional associations -External_sources_science: corresponds to consultants, commercial laboratories, private R&D firms, universities, technological centres, and public research centres. Each of information sources refer to the importance of the information in order to innovate from of each source and response to the question: "In the period 2004-2006, ¿how important has been the following information sources for the innovation activities of your enterprise? Clients, suppliers, competitors, consultants, commercial events, scientific journals and magazines	Continuous, from punctuations from the second factor analysis carried out

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	and papers, Professional associations, Consultants, commercial laboratories, private R&D firms, Universities, Technological centres, and Public research centres. The importance of information of each source has to be in a four point scale: Not used = 0 ; Poor, value = 1; Medium, value = 2; High, value=3	
Exp_ext_R&D	<i>Extramural R&D expenditure per sales: it</i> comprises the acquisition of R&D services, divided into the sales”, plus the acquisition of external knowledge “purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organizations	Continuous
Exp_maq	<i>Embodied technology expenditures per sales: it</i> comprises expenditure on the acquisition of machinery and equipment with improved technological performance, including major software, divided into the sales.	Continuous
Non-R&D organizational and market competencies to innovate		
Exp_Support	Total amount of support non-R&D technological activities expenditures divided into sales. The variables considered were added: training, design-support and marketing <i>Training internal or external training for your personnel specifically for the development and/or introduction of innovations;</i> <i>Design and Tooling up</i> expenditure on design functions for the development or implementation of new or improved goods, services processes and the improvement of production <i>Marketing activities</i> , activities for the market preparation and introduction of new or significantly improved goods and services, including market research and launch advertising	Continuous
Non-technological innovation		
Inno_organization	Indicates if the enterprise has introduced a new or improve <i>organizational change</i> during the research period	Dummy 0-1
Inno_marketing	Indicates if the enterprise has introduced <i>changes to marketing concepts or strategies</i> during the research period	Dummy 0-1
Control variables		
Group	Indicates if the firm is part of an industrial group of companies.	Dummy 0-1
Export	Indicates if the firm exports or not.	Dummy 0-1
Size	Logarithm of the annual average of full-time employees in 2006.	Continuous
Size dummies (3 dummies)		
LARGE (baseline criteria)	Size category for more than 250 employees	Dummy 0-1
MED	Size category for the range between 50 and 250 employees	Dummy 0-1
SMALL	Size category for less than 50 employees	Dummy 0-1
Industry_NACE_code	Industry classification by NACE-93 (2-digits, 59 sectors), from 15 to 74. 55 NACE is the baseline	Dummy 0-1

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The internal resources are measured by the extramural R&D expenditures per sales (*Exp_ext_R&D*): “extramural R&D, “R&D activities purchased by your enterprise and performed by other companies”; acquisition of external knowledge “purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organizations”. These represent the acquisition of external R&D services. Then embodied technology expenditures per sales (*Exp_maq*) is used, capturing the “acquisition of advanced machinery, equipment and computer hardware or software to produce new or significantly improved goods, services, production processes, or delivery methods”. In addition, the variables *training*, *design* and *marketing* activities reflect the non-R&D technological activities performed to support and complement the main technological efforts by training personnel (“*internal or external training for your personnel specifically for the development and/or introduction of innovations*”), design and production support (“expenditure on design functions for the development or implementation of new or improved goods, services processes and the improvement of production”), and marketing activities (“activities for the market preparation and introduction of new or significantly improved goods and services, including market research and launch advertising”). We add these three complementary variables (training, design and marketing) and form an added SUPPORT variable. Then, the internal sources of information for innovation (*Int_sources*) represent those which arise from the firm’s own departments, staff, firms from the same group, etc. The importance of this information was measured using a four-point scale (not used = 0; poor, value = 1; medium, value = 2; high, value=3). The external sources of knowledge which a firm taps into are captured from a wide range of external information sources: suppliers, customers, competitors, consultants, commercial laboratories, private R&D firms, universities, technological centres, public research centres, trade fairs, scientific journals and papers and professional associations. All of these variables have been reduced by applying PCA to two factors which represent the 59% of the variance (KMO of 0.856, $p < 0.01$), see Table 1. The first factor obtained from the latter PCA (*Ext_sources_industrial*), corresponds to the sources related to industrial agents in the value chain, such as customers, suppliers or competitors and other sources associated to industry, such as trade fairs, scientific journals and magazines and professional associations. The second factor (*Ext_sources_science*) corresponds to more scientific and specific pecuniary knowledge (commercial laboratories, private R&D firms, universities, technological centres and public research centres). See

Table 2 for details.

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The organizational or management innovation output (*Inno_organization*), as well as that associated to marketing (*Inno_marketing*) are also considered, in order to determine whether the firm has introduced a new or improve organizational or marketing changes during the research period (dummy variable 0-1). Regarding management innovation, the survey asked about the implementation of new procedures to organize work (e.g., lean, re-engineering), implementation of advanced management techniques (e.g. knowledge management systems), implementation of major changes to the organizational structure (e.g. introduction of cross-functional teams), implementation of new forms of managing external relationships (e.g., outsourcing, alliances); and marketing-associated changes, implementation of changes in marketing concepts or strategies, (e.g. packaging or presentational changes to a product to target new markets, new support services to open up new markets). Finally, the paper introduces a classification of sectors in order to control for industry differences (*Industry_NACE_code*), including 58 2-digit NACE-93 industry classification as dummies, ranging from the 14 to 74 2-digit NACE-93 codes (59 industries). NACE 55 was selected as baseline for dummy specification. The variable *Size* (control variable) is calculated as the logarithm of the annual average of full-time employees in 2006. See table 2. The sample contains manufacturing and service firms. Following Gallouj and Savona (2009), the way of measuring manufacturing and services innovation is similar and their differences blur. For instance, Forsman (2011) stated that there are only slight differences between those manufacturing and service industries that address innovation. We also conducted separation in the analysis (manufacturing and services) and findings are pretty similar (results available upon request, due to length problems). The correlation matrix is shown in Table 3.

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Table 3 Correlation matrix of the variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Production_Performance	1													
2	Market_Performance	.431*	1												
3	Exp_ext_R&D	.029*	-0.04	1											
4	Exp_maq	.050*	.070*	.003	1										
5	Exp_support	.037*	.023	.004	.031*	1									
6	Int_sources	.285*	.248*	.014	-.004	.015	1								
7	External_sources_industrial	.466*	.438*	.012	.019	-.003	.202*	1							
8	External_sources_science	.158*	.101*	.084*	-.023	.006	.076*	.000	1						
9	Inno_organization	.108*	.118*	.005	-.025	.004	.093*	.157*	.014	1					
10	Inno_mark	.165*	.060*	-.007	-.002	.009	.066*	.115*	.004	.307*	1				
11	Group	-.010	.007	-.008	-.047*	-.016	.120*	.005	.063*	.036*	-.021	1			
12	SMALL	.018	-.028*	.043*	.086*	.051*	-.078*	-.054*	-.058*	-.032*	.053*	-.329*	1		
13	MED	-.004	.020	-.034*	-.069*	-.042*	.042*	.037*	.064*	.011	-.049*	.171*	-.837*	1	
14	Export	.121*	.039*	-.018	-.036*	-.011	.059*	.061	.065*	-.036*	.0374*	.038*	-.111*	.111*	1

*significant at 1%

4. Results

4.1 Findings

Table 4 shows the market performance obtained from technological innovation (Market_Performance), that is, the effects on market/product achieved when new innovative activities are introduced.

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Table 4 Results from the OLS to capture the drivers of the innovation pattern and the Market performance

Dependent variable: Market performance	Stand. beta	Coef.	Std. Err.	t
Intercept	.	-0.593	0.069	-8.650
Exp_ext_R&D	0.001	0.896	10.511	0.090
Exp_maq	0.037***	4.638	1.370	3.390
Exp_support	0.022*	11.659	5.975	1.950
Int_sources	0.157***	0.142	0.014	9.950
External_sources_industrial	0.400***	0.408	0.015	27.940
External_sources_science	0.09***	0.117	0.021	5.670
Inno_organization	0.012	0.025	0.024	1.050
Inno_mark	0.092***	0.210	0.029	7.290
Group	-0.016	-0.039	0.029	-1.320
SMALL	0.057**	0.116	0.045	2.590
MED	0.025	0.054	0.044	1.220
Inv_Mill_ratio	0.067**	0.168	0.077	2.180
Industry_NACE_code		yes		
F		56.61		
R2		0.3225		
Adjusted R2		0.3168		
N		5878		

*** P<0.01 ** 0.01<=P<0.05 * 0.05<=P<0.1; VIF were controlled showing no problems with multicollinearity

The sample showed in table 4 consists of 5,878 non-R&D performers which have achieved technological innovation. Two-step Heckman procedure is applied in order to control for potential

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selection bias (from the innovative active firms). The inverse Mills ratio obtained when applying the *Probit* model turns out to be significant ($p < 0.05$) in the OLS (results available upon request) and thus the inverse Mill ratio is needed in order to correct the coefficients in the OLS. The overall adjustment is good (goodness of fit 0.3168; $F=56.61$). The acquisition of external R&D (Exp_ext-R&D) is not significant ($t= 0.09$; $p > 0.05$), which suggests that non-R&D performers do not obtain any benefit from investing in extramural R&D. Acquisition of machinery or equipment (Exp_maq) is positive and significant (Coefficient 0,037, $t=3.39$; $p < 0.01$), indicating that the acquisition of embodied knowledge significantly affects the introduction of new products by increasing the range of goods or services, entering new markets or increased market share and improving the quality of goods or services. Similarly, the complementary and supporting non-R&D technological activities represented by training, design and marketing (Exp_support) were found to be positive and significant (coefficient 0,022; $t=1.950$; $p < 0.1$), showing the key importance of using supporting activities as a complement to innovative activities. The variables representing the external (External_sources_industrial; External_sources_science) and the internal (Int_sources) sources of knowledge for innovation are also positive and significant, at $p < 0.01$. In fact, the strength of industry sources is much more relevant than the scientific sources (with coefficients of 0.40 versus 0.09, respectively), which shows that knowledge from industry is more effective in obtaining better effects on market innovation performance. The study yielded two expected results. First, the introduction of new management practices (Inno_organization) does not complement the market performance (non-significant, $p > 0.05$). Second, the introduction of new marketing practices (Inno_marketing) does improve the market performance ($p < 0.01$), reflecting the key complementary effect between marketing activities and the effects on product/market performance. The control variable size (SMALL) is significant, showing that for smaller firms they are positively related to the effects obtained in the introduction of new products (Large firms is the omitted baseline). The variable Group is not relevant ($p > 0.05$). In addition, the $n-1$ dummies capturing the industry effects are significant (results available upon request).

Table 5 shows the production performance from tech innovation, that is, the effects on production achieved when new innovative activities are introduced, again based on a sample of 5,878 non-R&D firms. In this case, the inverse Mills ratio is not significant ($p > 0.05$) when included in the OLS (results available upon request) so is released from the OLS model. The model adjustment is good (R^2 adjusted= 0.25; $F=41.91$) and the results are quite similar. The only noticeable variations are those mentioned below. First, the acquisition of embodied technology

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(Exp_maq) is higher for production performance than it was for market performance (a coefficient of 0.055 versus 0.037, respectively: both at $p < 0.01$) performance, which suggests a key relationship between process activities embodied knowledge acquisition. Second, the effects on production performance from supporting activities (Exp_support) are lower than those found in the market performance case (a coefficient of 0.019 versus 0.022). In fact, in this case the supporting activities variable is not significant, showing a weaker relationship between non-R&D technological activities that support innovation, compared to the above market innovation performance. Third, the introduction of new management practices is positively related (significant at $p < 0.01$) to the production performance. Also, the introduction of new marketing practices is not related to production performance (negative and also insignificant). The control variables are non-significant, that is, neither the size nor the export or group affects the production performance. Dummy variables capturing the industry are significant (results available upon request).

Other elements were explored by breaking down the sample into SMEs (fewer than 250 employees, $N=5,395$, Tables 6 and 7, R^2 0.317 and 0.253 for market and production performance, respectively) and firms in low and medium technology industries ($N=4,982$, Tables 8 and 9, R^2 0.315 and 0.254 for effects on market and production performance, respectively). In both cases (SMEs and low-medium tech firms) two-step Heckman procedures are applied. In both cases, the inverse Mills ratio is significant ($p < 0.05$) for the *Market_Performance* variable, but not for the *Production_Performance* variable ($p > 0.05$) for the SME firms (results available upon request). Interestingly, the results are quite similar to the ones from the general sample. Overall, there were significant and positive relationships observed among acquisition of embodied knowledge, support activities and the external and internal sources of knowledge for innovation performance. In addition, in all specifications, the acquisition of external R&D is non-significant and the industry effects matter. Market performance is complementary affected by the introduction of new marketing activities or marketing innovation adoption; the introduction of new organization practices improves production performance.

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Table 5 Results from the OLS to capture the drivers of the innovation pattern and the Production performance

Dependent variable: Production Performance	Standardized beta	Coef.	Std. Err.	t
Intercept		-0.280	0.069	-4.040
Exp_ext_R&D	-0.013	-11.845	10.117	-1.170
Exp_maq	0.055***	6.879	1.430	4.810
Exp_support	0.019	10.056	6.119	1.640
Int_sopurces	0.161***	0.146	0.011	13.710
External_sources_industrial	0.403***	0.411	0.012	34.000
External_sources_science	0.074***	0.096	0.015	6.440
Inno_organization	0.059***	0.118	0.024	4.840
Inno_mark	-0.013	-0.029	0.028	-1.050
Group	-0.009	-0.021	0.030	-0.690
SMALL	-0.025	-0.050	0.046	-1.090
MED	-0.027	-0.057	0.046	-1.250
Industry_NACE_code		yes		
F		41.91		
R2		0.2566		
Adjusted R2		0.2505		
N		5878		

*** P<0.01 ** 0.01<=P<0.05 * 0.05<=P<0.1 VIF were controlled showing no problems with multicollinearity

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Table 6 Results from the OLS to capture the driver of the innovation pattern and the Market Performance for SMEs

SMEs. Dependent variable: Market Performance	Standardized beta	Coef.	Std. Err.	t
Intercept		-0.502	0.061	-8.230
Exp_ext_R&D	0.002	1.414	10.406	0.140
Exp_maq	0.04***	4.785	1.366	3.500
Exp_support	0.024**	12.334	5.935	2.080
Int_sources	0.155***	0.140	0.015	9.530
External_sources_industrial	0.399***	0.408	0.015	27.360
Internal_sources_science	0.086***	0.110	0.020	5.470
Inno_organization	0.007	0.014	0.025	0.580
Inno_mark	0.095***	0.217	0.030	7.270
Group	-0.025**	-0.065	0.030	-2.150
Inv_Mill_ratio	0.07**	0.189	0.077	2.460
Industry_NACE_code		yes		
F		54.3		
R2		0.3231		
Adjusted R2		0.3171		
N		5395		

*** P<0.01 ** 0.01<=P<0.05 * 0.05<=P<0.1 VIF were controlled showing no problems with multicollinearity

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Table 7 Results from the OLS to capture the drivers of the innovation pattern and the production performance for SMEs

SMES				
Dependent variable: Production Performance	Standardized beta	Coef.	Std. Err.	t
Intercept		-0.311	0.064	-4.880
Exp_ext_R&D	-0.005	-4.203	10.879	-0.390
Exp_maq	0.055***	6.631	1.428	4.640
Exp_support	0.024**	12.327	6.205	1.990
Int_sources	0.180***	0.163	0.015	10.600
External_sources_industrial	0.424***	0.432	0.016	27.760
External_sources_science	0.093***	0.120	0.021	5.720
Inno_organization	0.067***	0.133	0.026	5.190
Inno_mark	-0.008	-0.019	0.031	-0.620
Group	-0.007	-0.019	0.032	-0.600
Inv-Mill_ratio	-0.058*	-0.146	0.080	-1.820
Industry_NACE_code		yes		
F		40.8		
R2 / Adjusted R2		0.2598 / 0.2534		
N		5395		

*** P<0.01 ** 0.01<=P<0.05 * 0.05<=P<0.1 VIF were controlled showing no problems with multicollinearity

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Table 8 Results from the OLS to capture the drivers of the innovation pattern and the effects on market performance for low and med tech industry firms

LOW&MED tech				
Dependent variable: Market performance	Standardized beta	Coef.	Std. Err.	t
Intercept		-0.489	0.068	-7.150
Exp_ext_rd	0.003	2.395	10.355	0.230
Exp_maq	0.039***	4.700	1.442	3.260
Exp_support	0.025**	12.819	6.178	2.070
Int_sources	0.150***	0.135	0.015	8.970
External_sources_industrial	0.406***	0.415	0.015	27.160
External_sources_science	0.093***	0.122	0.023	5.330
Inno_organization	0.008	0.016	0.026	0.610
Inno_mark	0.088***	0.201	0.031	6.470
Group	-0.019	-0.047	0.033	-1.450
SMALL	0.048**	0.098	0.047	2.080
MED	0.023	0.048	0.047	1.030
Inv_Mill_ratio	0.064**	0.189	0.088	2.140
Industry_NACE_code	yes			
F	61.03			
R2 / Adjusted R2	0.3198 / 0.3146			
N	4982			

*** P<0.01 ** 0.01<=P<0.05 * 0.05<=P<0.1 VIF were controlled showing no problems with multicollinearity

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Table 9 Results from the OLS to capture the drivers of the innovation pattern and the effects on production performance for low and med tech industry firms

LOW&MED tech Dependent variable: Production Performance	Standardized beta	Coef.	Std. Err.	t
Intercept		-0.271	0.071	-3.810
Exp_ext_R&D	-0.013	-11.135	10.223	-1.090
Exp_maq	0.049***	5.928	1.502	3.950
Exp_support	0.020	10.440	6.361	1.640
Int_sources	0.154***	0.139	0.011	12.140
External_sources_industrial	0.413***	0.423	0.013	32.080
External_sources_science	0.078***	0.103	0.016	6.270
Inno_org	0.044***	0.089	0.027	3.340
Inno_mark	-0.010	-0.024	0.030	-0.790
Group	-0.011	-0.026	0.033	-0.790
SMALL	-0.013	-0.026	0.049	-0.530
MED	-0.025	-0.054	0.048	-1.120
Industry_NACE_code	yes			
F	44.43			
R2	0.2596			
Adjusted R2	0.2538			
N	4982			

*** P<0.01 ** 0.01<=P<0.05 * 0.05<=P<0.1 VIF were controlled showing no problems with multicollinearity

4.2 Discussion

This paper contributes further to and is aligned with those scholars in the innovation management literature who have focused on aspects that go beyond traditional R&D indicators (Arundel et al., 2008; Bougrain and Haudeville, 2002; Freel, 2003; Freel, 2007; Muscio, 2007) confirming the generally accepted view that non-R&D activities also matter when innovating (Arundel et al., 2008; Barge-Gil et al., 2011; European Commission, 2008; Hervas-Oliver et al., 2011; Huang et al., 2010; OECD, 2005). Overall, the main points which deserve further discussion are the following: First, the study showed that non-R&D firms present a pattern of technological innovation composed of non-R&D variables capturing organizational and market technological competencies and a high dependence on external knowledge. These results confirm those of Hervas-Oliver et al., (2011) or Huang et al., (2010) which also showed a similar pattern of innovation by non-R&D performers. In addition, the results contradict other studies which claimed that R&D activities in SMEs are the most important driver behind innovative output (e.g Rammer et al., 2009) [3]. In this vein, the structure of innovation patterns is mainly formed by internal or external sources of knowledge. This structure confirms the RBV and the relational view (Barney, 1991; Dyer and Singh, 1998, respectively) and their predictions about a firms' repository of resources and its innovation performance. In particular, when relationships are all positive and significant, it is observed that higher investments in internal and external sources of knowledge bring about better performance in the technological innovation. Indeed, support activities (training, design and tooling up and marketing, *Exp_support* variable) are the key drivers, followed by the acquisition of embodied knowledge. Other key drivers are the external sources of knowledge accessed by search strategies, along with internal (vis-à-vis the firm) sources of knowledge; both explain innovation performance. Representing an internal source of knowledge, the *Exp_Support* variable is composed of three main indicators. *Training* has been recognized by some scholars as having a positive effect on innovation (e.g. Barge-Gil et al., 2011; Freel, 2003; Freel, 2005; Warner, 1996). *Marketing* is another indicator, and includes activities related to launching new or improved products on the market; studies have crucially emphasised the need to recognise the importance of market knowledge, and the notion that innovation is not a result of technological effort alone, but involves a strategic, market-driven perspective (Bessant and Tidd, 2007; e.g. Hervas-Oliver et al., 2011; Terziovski, 2010) in which technological and non-technological activities complement and mutually support each other (Damanpour and Evan, 1984; Damanpour, 1987). Lastly, *design and tooling up* is also recognized as a key non-R&D activity linked to technological innovation (Barge-Gil et al., 2011; e.g. Hervas-Oliver et al., 2011). As regards external knowledge sources, this study confirms that external assets are key drivers of the innovation process in firms, in line with other

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studies (Barge-Gil, 2010; Cabagnols, 1999; Escribano et al., 2009; Reichstein and Salter, 2006; Rouvinen, 2002; Vega-Jurado et al., 2008; Von Hippel, 1988). Thus, the greater the diversity of sources the firm has access to, the more likely that the insights gained from these sources are combined with internal sources in valuable new ways, forming new and valuable innovation capabilities. The particular networking or search strategies observed in the sourcing of external knowledge is in keeping with some studies (e.g. Nieto and Santamaría, 2007) which indicated that the specific characteristics and objectives of different partners would bring different results. This is complemented by evidence of some studies (e.g. Grimpe and Sofka, 2009) which show that in low and medium technology industries, the search pattern is mainly aimed towards customers and competitors, i.e., the industry, while in the high-tech industries they seem to be more related to linkages to scientific institutions.

Second, the innovation pattern shows a rather weak repository of internal resources and capabilities, along with an inclination towards exploitation rather than exploration strategies. Overall, a low internal capability was observed, mainly sustained by the support activities and offset by a high dependence on external sources of knowledge such as embodied knowledge and external of knowledge from different agents, the latter mainly from industry sources. In this case, the preference for the industrial sources of knowledge, along with the pattern of sourcing technological knowledge mainly restricted to the acquisition of embodied knowledge indicate a greater tendency towards exploitation than exploration, the latter being more related to R&D activities, while exploitation of current knowledge may be considered a way of refining and improving the firm's current technologies incrementally, in line with March (1991) or Winter (1971).

Third, it was found that the majority of non-R&D innovators prefer process innovation, confirming previous results from the European Commission (2008) and in line with previous findings by Hervas-Oliver et al. (2011), Huang et al. (2010), Barge-Gil et al. (2011) or Rouvinen (2002) which showed that most non-R&D performers are process innovators (in this case, 4997 firms, which represent 85% of the sample) and the notion that R&D activities do not explain process innovation performance (Arundel et al., 2008; Hervas-Oliver et al., 2011). The reason for this possible non-existing R&D relationship in the patterns of innovation among process innovators is based on the fact that firms innovate through activities which do not require R&D (Arundel et al., 2008), such as combining existing knowledge in new ways (e.g. Evangelista et al., 2002), imitation and reverse engineering (Kim and Nelson, 2000) or making incremental changes that rely on engineering knowledge (Kline and Rosenberg, 1986). In addition, these non-R&D performers were found to be small firms in low and medium technology sectors. In fact, there is a significant,

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negative relationship between the size of the firms and market performance; smaller non-R&D performers see stronger effects on market innovation, while effects on production performance are not size dependent. This finding contradicts a body of literature which has emphasized size as an important driver explaining inducements to technical innovation (Cohen and Klepper, 1996; Damanpour, 2010; Klepper, 1996; Nord and Tucker, 1987; Reichstein and Salter, 2006) predicting a positive relationship. Nevertheless, it is important to bear in mind that all the studies cited apply to all type of firms, and mainly to R&D performers. Our results are in line with Rammer et al. (2009) which pointed out that there are few, if any, size-related barriers to applying innovation management techniques successfully, and also to evidence showing that innovation performance is not clearly linked to size (Camisón-Zornoza et al., 2004).

Fourth, and going one step further in the findings of the European Commission (2008) and other studies (Arundel et al., 2008; Hervas-Oliver et al., 2011; Huang et al., 2010) , this study also shows that non-R&D performers also embrace non-technological (marketing and/or organization) innovation along with technological innovative output (market and/or production) and two key findings: the introduction of new marketing activities improve the market performance (complementary effect of technological and non-technological modes of innovation), while the introduction of new management or organization practices do the same with the production performance. These results confirm previous studies (Luria, 1987; Polder et al., 2009; Womack et al., 1990) which evidenced complementarities between process-production innovation and organization innovation. Similarly, our results also confirm Schubert's (2010) suggestion that marketing activities reinforce market performance and organization activities complement production innovation performance. In general, co-adopting technological and non-technological innovations yield higher returns upgrading a firm's performance (Arundel et al., 2008; Mothe and Thi, 2010; OECD, 2005; Piva and Vivarelli, 2002; Schubert, 2010) , corroborating the general ideas of synchronous adoption (e.g, Ettlíe, 1988; Womack et al., 1990; Ettlíe, 1988) and complementarities (Teece, 1986; Milgrom and Roberts (1990) . Thus, the results also offer key novel insights, as follows: (1) the introduction of new marketing innovations upgrades the market-product performance; (2) similarly, the introduction of new organizational innovations reinforces the production-process performance. These paired co-adoptions make use of non-technological innovative modes, along with non-R&D activities, in order to maximize technological innovative output.

In addition, these results confirmed those of Hervas-Oliver et al., (2011) and Arundel et al. (2008) which claim that non-R&D innovators: (1) show weak internal innovation capabilities,

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which are mainly based on the acquisition of embodied knowledge and the realization of support activities (training, marketing, design, among others); (2) non-R&D innovators are more likely to focus on process innovation; (3) size is not a necessary or threshold requirement for technological innovation by non-R&D performers.

Our results reflect what Lam (2005) refers to when the concept of *organizational innovation* is described as a precondition that ensures innovation in organizations through the study of the relevant and key organizational characteristics which enhance a firm's innovation (e.g. Hall, 1992; Hall, 1993; Henderson and Cockburn, 1994). In this vein, those key features are not, by any condition, restricted to only R&D activities. In particular, it should be stressed that 5,878 out of 11,137 (52.8%) innovative firms introduced technological innovations in 2006 without engaging in R&D activities: as has been shown, omitting this fact can represent a fatal bias which may hinder appropriate policy making for innovation in a country.

5. Conclusions

The goal of this paper consists of analysing the innovation patterns among non-R&D firms relating multiple and complex innovation modes simultaneous adoption and their performance consequences. This goal incorporates two main steps: (1) understanding the innovation patterns of non-R&D innovators, and (2) exploring the non-R&D innovation strategy involving the combination of technological and non-technological innovation modes and its performance. Using Spanish CIS data and two-step Heckman procedures in order to control for selection bias, this work contributes to the literature on innovation management by shedding light on a frequently omitted innovator segment: non-R&D performers. In addition, the paper introduces the emergent conversation about non-tech innovations (organization and marketing) into the realm of technological innovation management by linking the potential complementary strategies of innovation that combine technological and non-technological modes of innovation. For this purpose, the paper analyses technical strategy and management innovation literature in tandem, to build a more comprehensive framework that will aid understanding of innovation management in a more comprehensive manner. This paper provides an answer to the question posed. Are non-R&D performers combining technological and non-technological modes of innovation? Yes they do and its combination or synchronous adoption improves the technological returns through the creation of specific (product-marketing innovation and process-organization innovation) complementarities.

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Overall, the results strongly support the view that non-R&D activities are crucial to understanding the innovation process of any firm, at least in this (Spanish) low-medium technological context, confirming Santamaria's et al. (2009) results. Nevertheless, they also contradict previous studies which show a clear distinction between product and process innovations (Freel, 2003; Hervás-Oliver et al., 2011; Sternberg and Arndt, 2001) which are thought to follow different paths and do not necessarily have the same determinants. Our results show a rather common structure of drivers to explain the market and production innovation performance in the case of non-R&D performers. As mentioned earlier, this pattern of innovation is mainly based on weak internal capability, and is mainly sustained by support activities (design and tooling up, marketing or training in non-R&D technological activities), which is offset by a high dependence on external sources of knowledge such as embodied knowledge and external sources of knowledge, the latter mainly from the industry. These results show that innovation patterns addressing product and process innovation differ in terms of their drivers or determinants. Along these lines, the most important source of differences between market and production innovative performance is found in the combination of non-technological (marketing and/or organization) modes of innovation along with the technological innovative output (product and/or process) and two key findings: the introduction of new marketing activities, which enhances the effects on market and production performance (the complementary effect of the technological and non-technological modes of innovation) with the co-adoption of processes and the introduction of new management or organization practices. Similar results are also evidenced by SMEs (5,395 firms) or low and medium technology firms (4,982). These paired co-adoptions improve positively the technological innovative output, confirming complementarities and synchronous adoption (e.g., Milgrom and Roberts, 1990; Ettlie, 1988). All in all, concentrating on either the technical or the non-technical solely will result in a poorer performance level, as Herbst (1974) has stated.

Beyond intramural and extramural R&D, the results have shown that there is a hybrid mode of innovation used by firms which combines STI and DUI innovation modes (Jensen et al., 2007), although the latter seems more prominent. The combination of both modes confirms Parrilli and Elola (2011) and Jensen et al. (2007), supporting the use of STI technology indicators in policies to strengthen innovation capabilities from knowledge suppliers through embodied knowledge acquisition, while the DUI indicators are also evidenced in the search strategy for internal sources of knowledge and are used to improve the effects of technological innovation and the interactions from the external knowledge sources primarily from the industry agents. Thus, firms rely on some technological competences (embodied knowledge acquisition in this case) and on processes and experience-based know-how also found in downstream activities (marketing, design, etc.) as the

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OECD (2005) suggests. This pattern mainly refers to the low and medium technology sectors that use “...*incremental problem solving and experimentation [which]take[s] place on the shop floor and are closely associated with production beyond well-defined R&D programmes...*” (Albaladejo and Romijn, 2000: 4-5). Put differently, innovation is not an exclusive technological effort, but rather a strategic and market-driven perspective (e.g. Bessant and Tidd, 2007; Terziovski, 2010).

The paper presents certain implications for managers, scholars and policy makers. Yet we do not want readers to come away with the message that non-R&D activities are better investments or innovation drivers. Indeed, and as shown above, there is a pattern formed by weak innovation capabilities that are supported by a strong process dependence on external sources of knowledge. Nevertheless, a thorough interpretation of the results indicate that it is possible to innovate without conducting R&D activities, even without investing in external R&D, and it is this aspect of the overall picture which should not be overlooked by managers, scholars and policymakers.

Managers need to embark in innovation beyond traditional R&D activities and, especially, using also the non-tech activities (organizational and marketing) in order to complement and reinforce the technological effort. As Ennen and Richter (2010) suggests, therefore, the competitive advantage is not only the result from developing resources but the capability to integrate (tech and non-tech) them in a unique way. In this vein, establishing entire systems of mutually reinforcing design elements enhance performance and due to the complexity achieved imitation is prevented (e.g. Rivkin, 2000)

Policymakers should monitor the diversity of modes of innovation, which are also built upon non-technological innovation models (such as those involving marketing or organization improvement). In this vein, effective tools should also be made available in order to support those co-adoptions, enhancing overall support for those firms wishing to build their own capabilities without investing in R&D. Thus, effective policy-making can help them evolve towards the construction of a stronger repository of internal capabilities. The one-size-fits-all R&D policies and incentives will not effectively support the legion of non-R&D performers and, all things being equal, those policies will only work in firms that possess superior resources and thus tend to overlook an important part of the population. For SMEs and low-technology sectors, many of these policies hinder rather than enhance performance, as they foster R&D activities through R&D expenditure, when the lack of internal capabilities can be a deterrent. These firms are discouraged from accessing external knowledge which would help them achieve a virtuous circle of absorbing knowledge and learning. Put differently, R&D policy should be targeted at particular categories of firms, instead of a general-policy purpose, confirming other studies (e.g. Ortega-Argilés et al.,

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2009; Stam and Wennberg, 2009). Put differently, the neglected innovators themselves constitute *per se* a group of reference for policymaking which should not be neglected any more. Following this chain of thought, policymakers should ensure that non-R&D performers have access to other innovative inputs different from R&D activities, such as incorporating high-value activities such as marketing, design, training and other key resources. These efforts will upgrade a firm's internal capabilities needed to conduct the straight development of new product/process and the indirect mechanism of upgrading the firm's absorptive capacity (Cohen and Levinthal, 1990) in order to access innovative networking. The conclusions of this paper also matter for scholars. In fact, it suggests how important it is to widen our scope and include neglected innovators in our samples, in order to also capture non-R&D technological variables, together with complementarities, existing in the innovation patterns of our industries and countries. Again, omitting those firms from our studies will not contribute to a better understanding of technical change, or to the design and implementation of effective policy-making which may otherwise be constructed from incomplete samples.

This paper has some limitations. As Qian and Li (2003) pointed out, causality is impossible to determine at a single point in time, although this study makes the assumption that the independent variables have a causal relationship with the firm's innovative performance. For future studies, the role of non-R&D innovators should be further analyzed, by comparing countries of the European Union in particular.

Endnotes

[1] The specification used to predict the probability to be a non R&D innovator includes the following variables: expenses in innovation activities (Exp_ext_R&D, Exp_maq, Exp_support variables), non-technological innovations (Inno_Organization and Inno_mark), internal and external sources of innovations (Int_sources, External_sources_industrial, External_sources_science), and control variables like SIZE (small, med, large categories, as dummies), Group, Industry_NACE_codes and Export variable, the latter indicating whether the firm exports or not.

[2] The same apply for the UK questionnaire (CIS3 and CIS4). Nevertheless, since 2008, the Spanish questionnaire modified and changed the variable in order to capture the idea of objectives (similar to "innovation goals", related to technological trajectories in the sense of Dosi, 1982) or factors for the decision to innovate. The same approach is observed in the CIS for the UK questionnaire: CIS5 and CIS6 versions mentioned factors or objectives, while the previous third and fourth version mentioned effects.

[3] See Cuervo-Cazurra and Un (2010) for the findings and sample selection biases.

References

- Albaladejo M. and Romijn H., 2000. Determinants of innovation capability in small UK firms: An empirical analysis. Eindhoven Center for Innovation Studies (ECIS) Working Paper Series .
- Arundel A., Bordoy C., Kanerva M. ,2008. Neglected innovators: How do innovative firms that do not perform R&D innovate. results of an analysis of the innobarometer 2007.
- Asheim B. T. and Isaksen A., 1997. Location, agglomeration and innovation: Towards regional innovation systems in norway? *European Planning Studies* 5(3), 299-330.
- Barge-Gil A., 2010. Cooperation-based innovators and peripheral cooperators: An empirical analysis of their characteristics and behavior. *Technovation* 30(3), 195-206.
- Barge-Gil A., Nieto M. J., Santamaría L., 2011. Hidden innovators: The role of non-R&D activities. *Technology Analysis & Strategic Management* 23(4), 415-432.
- Barney J., 1991. Firm resources and sustained competitive advantage. *Journal of Management* 17(1), 99-120.
- Bessant J. and Tidd J.,2007. *Innovation and entrepreneurship*. Wiley.
- Birkinshaw J., Hamel G., Mol M., 2008. Management innovation. *The Academy of Management Review (AMR)* 33(4), 825-845.
- Bougrain F. and Haudeville B., 2002. Innovation, collaboration and SMEs internal research capacities. *Research Policy* 31(5), 735-747.
- Cabagnols A. 1999. The determinants of the continuity and consistency of the innovative behaviour of product and process innovators. ; 7-9 june 1999; Grenoble, France.
- Camisón-Zornoza C., Lapedra-Alcamí R., Segarra-Ciprés M., Boronat-Navarro M., 2004. A meta-analysis of innovation and organizational size. *Organ Stud* 25(3), 331-361.
- Celikel-Esser F, Villalba E, Tarantola S. 2008. The lisbon strategy and development of metrics to measure innovation in europe. *Statistics Sweden*, editor. Orebro: Statistics Sweden, 7 p.
- Cohen W. M. and Klepper S., 1996. Firm size and the nature of innovation within industries: The case of process and product R&D. *Rev Econ Stat* 78(2), 232-243.
- Cohen W. M. and Levinthal D. A., 1990. Absorptive capacity: A new perspective on learning and innovation. *Adm Sci Q* 35(1), 128-152.
- Cohen W. M., Levin R. C., Mowery D. C., 1987. Firm size and R&D intensity: A re-examination. *Journal of Industrial Economics* 35, 543-563.

ORGANIZATIONAL INNOVATION WORKSHOP

Cuervo□Cazurra A. and Annique Un C., 2010. Why some firms never invest in formal R&D. *Strategic Manage J* 31(7), 759-779.

Cummings T. G. and Srivastva S.,1977. *Management of work: A socio-technical systems approach*. University Associates.

Damanpour F., 2010. An integration of research findings of effects of firm size and market competition on product and process innovations. *Br J Manage* 21(4), 996-1010.

Damanpour F., 1987. The adoption of technological, administrative, and ancillary innovations: Impact of organizational factors. *Journal of Management* 13(4), 675.

Damanpour F. and Evan W. M., 1984. Organizational innovation and performance: The problem of organizational lag. *Adm Sci Q* , 392-409.

Damanpour F., Walker R. M., Avellaneda C. N., 2009. Combinative effects of innovation types and organizational performance: A longitudinal study of service organizations. *Journal of Management Studies* 46(4), 650-675.

Dierickx I. and Cool K., 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Science* , 1504-1511.

Dyer J. H. and Singh H., 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *The Academy of Management Review* 23(4), 660-679.

Ennen E. and Richter A., 2010. The whole is more than the sum of its parts or is it? A review of the empirical literature on complementarities in organizations. *Journal of Management* 36(1), 207-233.

Escribano A., Fosfuri A., Tribo J. A., 2009. Managing external knowledge flows: The moderating role of absorptive capacity. *Research Policy* 38(1), 96-105.

Ettlie J. E.,1988. *Taking charge of manufacturing: How companies are combining technological and organizational innovations to compete successfully*. Jossey-Bass Inc., Publishers.

Ettlie J. E. and Reza E. M., 1992. Organizational integration and process innovation. *Academy of Management Journal* , 795-827.

European Commission,2008. *European innovation scoreboard 2007. comparative analysis of innovation performance*.

Evan WM. 1966. The organization set: Toward a theory of interorganizational relations. In: *Approaches to organizational design*. Thompson JD, editor. Pittsburgh: University of Pittsburgh press.

ORGANIZATIONAL INNOVATION WORKSHOP

- Evangelista R., Lammarino S., Mastrostefano V., Silvani A., 2002. Looking for regional systems of innovation: Evidence from the Italian innovation survey. *Reg Stud* 36(2), 173-186.
- Forsman H. and Rantanen H., 2011. Small manufacturing and service enterprises as innovators: A comparison by size. *European Journal of Innovation Management* 14(1), 27-50.
- Freel M. S., 2007. Are small innovators credit rationed? *Small Business Economics* 28(1), 23-35.
- Freel M. S., 2005. Patterns of innovation and skills in small firms. *Technovation* 25(2), 123-134.
- Freel M. S., 2003. Sectoral patterns of small firm innovation, networking and proximity. *Research Policy* 32(5), 751-770.
- Gallouj F. and Savona M., 2009. Innovation in services: A review of the debate and a research agenda. *Journal of Evolutionary Economics* 19(2), 149-172.
- Griliches Z., 1990. Patent statistics as economic indicators: A survey. *Journal of Economic Literature* 28, 1661-1707.
- Grimpe C. and Sofka W., 2009. Search patterns and absorptive capacity: Low-and high-technology sectors in European countries. *Research Policy* 38(3), 495-506.
- Hall R., 1993. A framework linking intangible resources and capabilities to sustainable competitive advantage. *Strategic Manage J* 14(8), 607-618.
- Hall R., 1992. The strategic analysis of intangible resources. *Strategic Manage J* 13(2), 135-144.
- Harris D. M. and Halkett R., 2007. Hidden innovation: How innovation happens in six low innovation sectors. National Endowment for Science, Technology and the Arts (NESTA) ed. Great Britain: NESTA.
- Heckman J. J., 1979. Sample selection bias as a specification error. *Econometrica* 47(1), 53-161.
- Heidenreich M., 2009. Innovation patterns and location of European low-and medium-technology industries. *Research Policy* 38(3), 483-494.
- Henderson R. and Cockburn I., 1994. Measuring competence? exploring firm effects in pharmaceutical research. *Strategic Manage J* 15(S1), 63-84.
- Herbst P. G., 1974. Socio-technical design.

ORGANIZATIONAL INNOVATION WORKSHOP

- Hervas-Oliver J. L., Albors Garrigos J., Gil-Pechuan I., 2011. Making sense of innovation by R&D and non-R&D innovators in low technology contexts: A forgotten lesson for policymakers. *Technovation* .
- Hirsch Kreinsen H., 2008. “Low□Tech” innovations. *Industry and Innovation* 15(1), 19-43.
- Hollanders H. and van Cruysen A., 2008. Rethinking the european innovation scoreboard: A new methodology for 2008-2010. Inno-Metrics Publication.Brüssel .
- Huang C., Arundel A., Hollanders H., 2010. How firms innovate: R&D, non-R&D, and technology adoption.
- Jensen M. B., Johnson B., Lorenz E., Lundvall B., 2007. Forms of knowledge and modes of innovation. *Research Policy* 36(5), 680-693.
- Kim L. and Nelson R. R.,2000. *Technology, learning and innovation: Experiences of newly industrializing economies*. Cambridge Univ Pr.
- Kleinknecht A. and Reijnen J. O. N., 1991. More evidence on the undercounting of small firm R&D. *Research Policy* 20(6), 579-587.
- Klepper S., 1996. Entry, exit, growth, and innovation over the product life cycle. *Am Econ Rev* 86(3), 562-583.
- Klevorick A. K., Levin R. C., Nelson R. R., Winter S. G., 1995. On the sources and significance of interindustry differences in technological opportunities. *Research Policy* 24(2), 185-205.
- Kline S. J. and Rosenberg N., 1986. An overview of innovation. *The Positive Sum Strategy: Harnessing Technology for Economic Growth* 275, 305.
- Laestadius S, Pedersen T, Sandven T. 2005. More evidence on the undercounting of small firm R&D. In: *Non-research-intensive industries in the knowledge economy.perspectives on economic political and socio integration*. vol XI, n° 1-2. Bender G, Jacobson D,Robertson PL, editors. Lublin: , 20 p.
- Lager T., 2002. Product and process development intensity in process industry: A conceptual and empirical analysis of the allocation of company resources for the development of process technology. *International Journal of Innovation Management* 6, 105-130.
- Lam A. 2005. *Organizational innovation*. Fagerberg J, Mowery DC,Nelson RR, editors. Oxford: Oxford University Press, 115 p.
- Love J. H. and Roper S., 1999. The determinants of innovation: R & D, technology transfer and networking effects. *Review of Industrial Organization* 15(1), 43-64.

ORGANIZATIONAL INNOVATION WORKSHOP

- Luria D.,1987. Technology, work organization, and competitiveness: Automotive subsystem cost reduction, 1986-1992. Industrial Technology Institute, University of Michigan.
- Mañez-Castillejo J. A., Sanchis-Llopis A., Sanchis-Llopis J. A. S., Rochina-Barrachina M. E., 2009. Do process innovations boost SMEs productivity growth? Working Papers.Serie EC .
- March J. G., 1991. Exploration and exploitation in organizational learning. *Organization Science* , 71-87.
- Marsili O. and Salter A., 2006. The dark matter of innovation: Design and innovative performance in dutch manufacturing 1. *Technology Analysis & Strategic Management* 18(5), 515-534.
- Milgrom P. and Roberts J., 1995. Complementarities and fit strategy, structure, and organizational change in manufacturing. *J Account Econ* 19(2), 179-208.
- Milgrom P. and Roberts J., 1990. The economics of modern manufacturing: Technology, strategy, and organization. *Am Econ Rev* , 511-528.
- Mol M. and Birkinshaw J., 2009. The sources of management innovation: When firms introduce new management practices. *Journal of Business Research* 62(12), 1269-1280.
- Mothe C. and Thi T. U. N., 2010. The link between non-technological innovations and technological innovation. *European Journal of Innovation Management* 13(3), 313-332.
- Muscio A., 2007. The impact of absorptive capacity on SMEs' collaboration. *Economics of Innovation and New Technology* 16(8), 653-668.
- Nabseth L. and Ray G. F.,1974. The diffusion of new industrial processes: An international study. Cambridge University Press.
- Nelson R. 2000. National innovation systems. In: *Regional innovations, knowledge and global change*. Acs Z, editor. London: Pinter, 11 p.
- Nelson R. R. and Rosenberg N., 1993. Technical innovation and national systems. *National Innovation Systems: A Comparative Analysis* , 3-21.
- Nieto M. J. and Santamaría L., 2007. The importance of diverse collaborative networks for the novelty of product innovation. *Technovation* 27(6), 367-377.
- Nord W. and Tucker S., 1987. Implementing routine and radical innovations. New York . OECD,2010. Measuring innovation, a new perspective. Paris: OECD Publications.

ORGANIZATIONAL INNOVATION WORKSHOP

OECD, 2005. Oslo manual: Guidelines for collecting and interpreting innovation data. Publications de l'OCDE.

Ortega-Argilés R., Vivarelli M., Voigt P., 2009. R&D in SMEs: A paradox? *Small Business Economics* 33(1), 3-11.

Parrilli M. D. and Elola A., 2011. The strength of science and technology drivers for SME innovation. *Small Business Economics*, 1-11.

Pavitt K., 1984. Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy* 13(6), 343-373.

Pavitt K., 1982. R&D, patenting and innovative activities: A statistical exploration. *Research Policy* 11(1), 33-51.

Pavitt K., Robson M., Townsend J., 1987. The size distribution of innovating firms in the UK: 1945-1983. *The Journal of Industrial Economics*, 297-316.

Piva M. and Vivarelli M., 2002. The skill bias: Comparative evidence and an econometric test. *International Review of Applied Economics* 16(3), 347-357.

Polder M., Leeuwen G., Mohnen P., Raymond W., 2009. Productivity effects of innovation modes. .

Qian G. and Li L., 2003. Profitability of small and medium sized enterprises in high tech industries: The case of the biotechnology industry. *Strategic Manage J* 24(9), 881-887.

Rammer C., Czarnitzki D., Spielkamp A., 2009. Innovation success of non-R&D-performers: Substituting technology by management in SMEs. *Small Business Economics* 33(1), 35-58.

Reichstein T. and Salter A., 2006. Investigating the sources of process innovation among UK manufacturing firms. *Industrial and Corporate Change* 15(4), 653-682.

Rivkin J. W., 2000. Imitation of complex strategies. *Management Science* 46(6), 824-844.

Roberts P. W. and Amit R., 2003. The dynamics of innovative activity and competitive advantage: The case of Australian retail banking, 1981 to 1995. *Organization Science*, 107-122.

Rouvinen P., 2002. Characteristics of product and process innovators: Some evidence from the Finnish innovation survey. *Applied Economics Letters* 9(9), 575-580.

Santamaría L., Nieto M. J., Barge-Gil A., 2009. Beyond formal R&D: Taking advantage of other sources of innovation in low- and medium-technology industries. *Research Policy* 38(3), 507-517.

ORGANIZATIONAL INNOVATION WORKSHOP

Santarelli E. and Sterlacchini A., 1990. Innovation, formal vs. informal R&D, and firm size: Some evidence from Italian manufacturing firms. *Small Business Economics* 2(3), 223-228.

Schmidt T. and Rammer C., 2007. Non-technological and technological innovation: Strange bedfellows? ZEW, Zentrum für Europäische Wirtschaftsforschung.

Schubert T., 2010. Marketing and organisational innovations in entrepreneurial innovation processes and their relation to market structure and firm characteristics. *Review of Industrial Organization* 36(2), 189-212.

Smith KH, 2005. Measuring innovation. .

Stam E. and Wennberg K., 2009. The roles of R&D in new firm growth. *Small Business Economics* 33(1), 77-89.

Sterlacchini A., 1999. Do innovative activities matter to small firms in non-R&D-intensive industries? an application to export performance. *Research Policy* 28(8), 819-832.

Sternberg R. and Arndt O., 2001. The firm or the region: What determines the innovation behavior of European firms? *Economic Geography* 77(4), 364-382.

Stieglitz N. and Heine K., 2007. Innovations and the role of complementarities in a strategic theory of the firm. *Strategic Manage J* 28(1), 1-15.

Stockdale B., 2002. UK innovation survey 2001. *Economic Trends* 580, 36-42.

Teece D. J., 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy* 15(6), 285-305.

Terziovski M., 2010. Innovation practice and its performance implications in small and medium enterprises (SMEs) in the manufacturing sector: A resource-based view. *Strategic Manage J* 31(8), 892-902.

Tidd J., 2000. From knowledge management to strategic competence: Measuring technological, market and organisational innovation. Imperial College Press.

Trist E., Murray H., Trist B., 1993. The social engagement of social science: A Tavistock anthology, vol. II: The socio-technical perspective. University of Pennsylvania Press.

Vaccaro I. G., Jansen J. J. P., Van Den Bosch F. A. J., Volberda H. W., 2011. Management innovation and leadership: The moderating role of organizational size. *Journal of Management Studies* .

Vega-Jurado J., Gutiérrez-Gracia A., Fernández-de-Lucio I., Manjarrés-Henríquez L., 2008. The effect of external and internal factors on firm's product innovation. *Research Policy* 37(4), 616-632.

ORGANIZATIONAL INNOVATION WORKSHOP

Von Hippel E., 1988. The sources of innovation. Oxford University Press New York.

Walker R. M., Damanpour F., Devece C. A., 2011. Management innovation and organizational performance: The mediating effect of performance management. *Journal of Public Administration Research and Theory* 21(2), 367.

Warner M., 1996. Chinese enterprise reform, human resources and the 1994 labour law. *International Journal of Human Resource Management* 7(4), 779-796.

Wengel J., Lay G., Nylund A., Bager-Sjögren L., Stoneman P., Bellini N., Bonaccorsi A., Shapira P., 2000. Analysis of empirical surveys on organisational innovation and lessons for future community innovation surveys. *Scientific Follow-Up of the Community Innovation Survey (CIS) Project CIS 98(191)*, 483.

Winter S. G., 1971. Satisficing, selection, and the innovating remnant. *The Quarterly Journal of Economics* 85(2), 237-261.

Womack J. P., Jones D. T., Roos D., 1990. *The machine that changed the world: The story of lean production*. New York: Rawson Associates .

UNDERSTANDING ORGANIZATIONAL INNOVATION FROM ITS PRACTICE

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Abstract

Organizational innovation is currently studied an important source of competitive advantage both for firms and for territories. This relevance is related to the widening of the innovation concept, which is not anymore limited to technology. However, organizational innovation concept is still considered ambiguous and even Oslo Manual recognizes that its referential definition is still exploratory. Besides, innovation processes are no longer understood as lineal and predictive but complex and variable, so the analysis of organizational innovation becomes methodologically challenging.

Consequently, new studies and adapted methods are required to acquire deeper knowledge about organizational innovation practice and its consequences for competitiveness. This research is precisely intended to reach thorough understanding about how an organizational innovation process is developed and interpreted in practice; and to generate new theoretical insights about it for further future research.

Grounded theory is proposed as a suitable methodology for this inductive, longitudinal, field-based case study research. Preliminary results have helped reaching new theoretical insights about the suitability of Oslo Manual's definition with practice and about the application of innovation generation and adoption process perspective to the study of organizational innovation. Work is still in-progress to consolidate first results, to guarantee their confirmability and to facilitate their transfer.

Keywords

organizational innovation, competitiveness, innovation process, practice, grounded theory, case study

1. Introduction

Even if innovation research has mainly focused on product and process innovation in the past decades, it is now commonly acknowledged that innovation implies much more than technology and R&D. In fact, other types of non-technological innovation have become increasingly relevant for competitiveness, like organizational innovation, that is considered an important source of competitive advantage of firms, for knowledge development in companies and for enabling other forms of innovation (Damanpour *et al.*, 1989; Greenan, 2003; Armbruster *et al.*, 2006; Som *et al.*, 2012).

In accordance with this widening of the innovation concept, Oslo Manual (OECD/Eurostat, 2005) enlarged its innovation definition in its third edition and, taking up Schumpeter's broad vision of innovation, included organizational innovation on its innovation typologies, which in previous editions only recognized technological innovations.

However, by that time not only was the innovation concept widening, but the understanding of innovation generating processes within organizations also showed a paradigmatic shift. Leaving aside traditionally studied linear, sequential and predictable innovation processes, business practice were showing complex and self-referential cycle models, which account for multiple recursive feedback loops and other sources of innovation knowledge. This shift on innovation processes implies that not all innovations must be radical, but that they involve incremental social and organizational changes, apart from the potentially required technological advances (Kline and Rosenberg, 1986; Dodgson, 2000; Rothwell, 2003; Tidd y Bessant, 2009; quoted at Som *et al.*, 2012).

The innovation process is thus understood as complex and variable and, applied to organizational innovation, it makes its analysis methodologically challenging (Kirner *et al.*, 2008). Besides, organizational innovation concept is still considered ambiguous (Lam, 2005) and even Oslo Manual (OECD/Eurostat, 2005) recognizes that its definition is exploratory and recommends further research to reach deeper knowledge about its implementation and practice.

Consequently, the understanding, diffusion and potential to transfer organizational innovation is restricted, and new studies and adapted methods are required to acquire deeper insights into its practice and analyse its consequences for business competitiveness.

The purpose of this research is twofold: deeply understand how an organizational innovation process is developed and interpreted in practice; and to generate new theoretical insights about organizational innovation for further research on the topic.

2. Organizational innovation

Framework for studying organizational innovation

The relevance of organizational innovation for innovation theory and practice was officially assumed in 2005, when the latest edition of Oslo Manual of the European Commission and the OECD, which presents the methodological basis for major innovation studies, included it among its innovation typologies for the first time and proposed a standard definition for its analysis and diffusion. However, further research was also recommended, as it was published as an exploratory definition recognizing that thorough knowledge about its implementation and practice was still needed.

In fact, there are two different business aspects and literatures that get related in this concept: organizations and innovation. The existing literature about each of them is voluminous and diverse, showing that the relationship between organizations and innovation is complex, dynamic and multi-level. It was Lam (2005) who recognized this complexity and assumed the challenge of studying it from three different but related perspectives: the relationship between organizational structural forms and innovativeness; innovation as a process of organizational learning and knowledge creation; and organizational capacity for change and adaptation. Even if her study identified important overlaps and interconnections between these different aspects of the relationships, it became evident that the different strands of research have remained separate and had derived into a lack of consensus conceptual framework for understanding organizational innovation.

Lam (2005) linked this gap to the conceptual ambiguity and confusion surrounding organizational innovation concept. In fact, each of the three strands of research on

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organizational innovation has used the concept to name different phenomena: any innovation happening on an organizational context; the sum of innovations being developed by an organization; and the innovation applied to organizational methods.

There is still plenty of work to understand how these different research strands fit together, but the focus of this research will be on the third dimension, which coincides with Oslo Manual's definition: "the implementation of a new organizational method in the firm's business practices, workplace organization or external relations" (OECD/Eurostat, 2005).

As important for its framework as the standard definition, are also the two characteristics that the Oslo Manual (OECD/Eurostat, 2005) attributed to organizational innovation: the novelty of the organizational method implemented and the strategic reasons for its deployment. These two features help to differentiate organizational innovation from mere organizational change. Thus, for an organizational change to be considered organizational innovation, it must be completely new to the organization. Furthermore, the mere formulation of management strategies in a document cannot be considered organizational innovation, and its implementation on the firm's activity is a basic requirement. More recent studies have introduced new criteria of differentiation, specifying that the strategic motivation is needed to be considered innovation, orienting it to a considerable improvement of competitive advantage and economic performance for the organization (Som *et al.* 2012). However, this differentiation keeps being confusing since organizational and management literature also includes definitions and empirical research that shows strategic motivation on organizational change processes (Van de Ven, 1992; Poole, 2004).

Summarizing, this research frames organizational innovation under innovation studies, focusing on the innovations implemented into organizational methods, and going further from mere organizational change considering the processes that are strategically oriented towards broad competitiveness improvement.

Deepening into the process of organizational innovation

Following the increasing relevance of organizational innovation, many scholars have initiated empirical research to identify the effects and benefits that can be expected

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from it (Armbruster *et al.*, 2006; Kirner *et al.*, 2008; Arraut, 2009; Som *et al.*, 2012). Lately, the benefits of organizational innovation have been classified in three dimensions (Som *et al.*, 2012):

Organizational innovation as a distinct form of innovation, which could directly result in substantial improvements of organizational performance.

Organizational innovation as an enabler for other types of innovation, like product, process or marketing innovation.

Organizational innovation as a prerequisite for knowledge accumulation, enabling firms to increase the ability of its members to acquire, create and make the best use of competences, skills and knowledge.

Even if these three dimensions are extremely relevant for current firms' competitiveness, it is acknowledged that any attempt to further detail consequences or antecedents is for the moment of analytical nature only because, in reality, most organizational concepts address different aspects of business performance at the same time (Som *et al.*, 2012).

In fact, the empirical basis for measuring organizational innovation is still weak and scattered due to the lack of reliable scales and the intangibility of the goals of this type of innovation (Armbruster *et al.*, 2006). Furthermore, the measurement of organizational innovation effects is considered methodologically challenging for its different aggregation levels, long life cycles, internal differences on the extent of implementation, and due to the multidimensional relationship between organizational innovation and its outcomes (Kirner *et al.*, 2008).

Management theory is helpful at this point, since its literature about organizational change includes process theories and methods that might be applied to deepen into organizational innovation. Instead of understanding change by the variation perspective (change explained by the relationship of dependent or independent variables, studied by lineal statistical models), Van de Ven (1992) proposed to use process perspective in order to study change as a sequence of events happening, studied through narratives and longitudinal research. This approach encourages qualitative research designs versus quantitative ones.

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Focused on the process perspective, Van de Ven (1992) classified four different models of organizational change process based on two variables: change units (multiple units interacting and changing or single unit changing) and change mode (previously planned or built). The resulting models, later developed further by Poole (2004), are described at Table 1.

Table 1: Models of organizational change process

Name	Change unit	Change mode	Description
Life cycle	Simple	Planned	The change process in an organization as the progressing thorough a necessary sequence of stages that are prescribed by an institutional, natural or logical program.
Intentional	Simple	Built	The change process as a cycle of vision formulation, implementation, evaluation and modification based on what was learned by the organization.
Dialectical	Multiple	Built	The change process as the evolution of constant confrontation and conflict that generate a development cycle.
Evolutionary	Multiple	Planned	The change process as a repetitive sequence of variation, selection and retention events among entities in a defined environment, where competition for scarce resources generate evolution.

Source: Own elaboration based on Van de Ven (1992) and Poole (2004).

Nevertheless, the main value of this proposal for organizational innovation is not on the four models classification, since they lack the consideration of other elements like the degree of novelty, the strategic motivation and the three possible applications of organizational innovation (business practices, workplace organization or external relations). The aspects to be considered for organizational innovation process research are the innovation units (e.g. Organization wide or functionally limited, only business practices or also external relations) and the innovation mode.

In this last sense, there is also extensive innovation literature about different modes of innovation processes, and it is relevant for this research to consider Damanpour and

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Wischnevsky's (2006) contribution, as far as it shows similarities with the built or planned change mode variable used by Van de Ven (1992) and Poole (2004).

Damanpour and Wischnevsky's (2006) research was founded on the assumption that existing literature about innovation in organizations had not often distinguished between generation and adoption processes, naming both as innovation processes equally (Daft, 1982; Van de Ven, 1986; Kanter, 1988; Roberts, 1988 and Rogers, 1995 quoted at Damanpour and Wischnevsky, 2006). These authors differentiate both innovation processes in the following terms.

The generation of innovation is intended to contribute to the organization's effectiveness and competitiveness by creating a new opportunity or by making use of an existing opportunity in novel ways (Drucker, 1985). On the contrary, adoption of innovations means that the innovation is developed elsewhere, and when a second organization adopts it results in the assimilation of a product, service, or technology new to the adopting organization (Angle and Van de Ven, 2000).

Along their research, Damanpour and Wischnevsky's (2006) concluded that the processes themselves for generation and adoption of innovation differed considerably. Summarizing, they consider the generation process covers all efforts and activities aimed at creating new ideas, getting them to work and even to supplies them for transfer to other organizations. Generation is therefore a creative process in which new and existing ideas are combined in a novel way to produce an invention or a configuration that was previously unknown. Meanwhile, the adoption process is defined by two sub-processes: initiation, including all activities from recognizing a need, to becoming aware of a possible innovation, adapting this existing idea to address the recognized need, deciding to adopt it and planning it; and implementation, starting to practice the innovation and continuing to use it until it becomes a routine part of the organization.

Based on this process peculiarities, Damanpour and Wischnevsky's (2006) proposed that future research on any type of innovation process should further distinguish between these generation and adoption processes.

Nevertheless, their empirical research was limited to technological innovation cases. Consequently, there is still a gap to cover on distinction of generation and adoption

processes of organizational innovation. In fact, it is considered that developing innovation theory that takes into account these differences could help clarify the problem of inconsistent research results about broad innovation issues (Damanpour and Wischnevsky, 2006).

3. Methodology

Applying process perspective to study organizational innovation requires an appropriate research design that faces properly the methodological challenges posed by this phenomenon (Armbruster *et al.*, 2006; Kirner, *et al.*, 2008). In this study, the research design proposed is based on an inductive, longitudinal, field-based case study, that is well suited for developing grounded theory (Eisenhardt, 1989; Glaser and Strauss, 1967), since it pays attention to the reality and evolution of the field of study, without previous hypothesis, and looking for results along the collection and systematic analysis of the field data. This approach is considered particularly useful to examine feedback processes driving the change dynamics over time (Tripsas, 2009), like the ones that may happen on organizational innovation processes. Besides, grounded theory has been applied, considering it has been the basis for research design in similar studies of strategy, organizational change and innovation processes (Van de Ven *et al.*, 1989; Van de Ven and Huber, 1990; Van de Ven, 1992; Poole, 2004).

Grounded Theory

Grounded theory was designed as a methodology to develop theories based on data directly collected from the field. The theory obtained evolves along the research process and it is the result of a constant inter-relationship between data collection and analysis (Glaser and Strauss, 1967; Goulding, 2001). The emphasis is set on the importance of participants' behaviours as the engine of the meanings generated and interpreted to build the final theory (Glaser and Holton, 2004). The main novelty of this approach compared to other qualitative methods is its intention to go further from mere description to generation of new and innovative theories, with no intention to generate universal law (Goulding, 2001).

Although the use of grounded theory on business research remains generally elusive and misunderstood (O'Reilly *et al.*, 2012), there are already some significant references on innovation research that rely on its principles. As mentioned before, Van de Ven *et al.* (1989) resorted to the strategies of Glaser and Strauss (1967) as the starting point for the

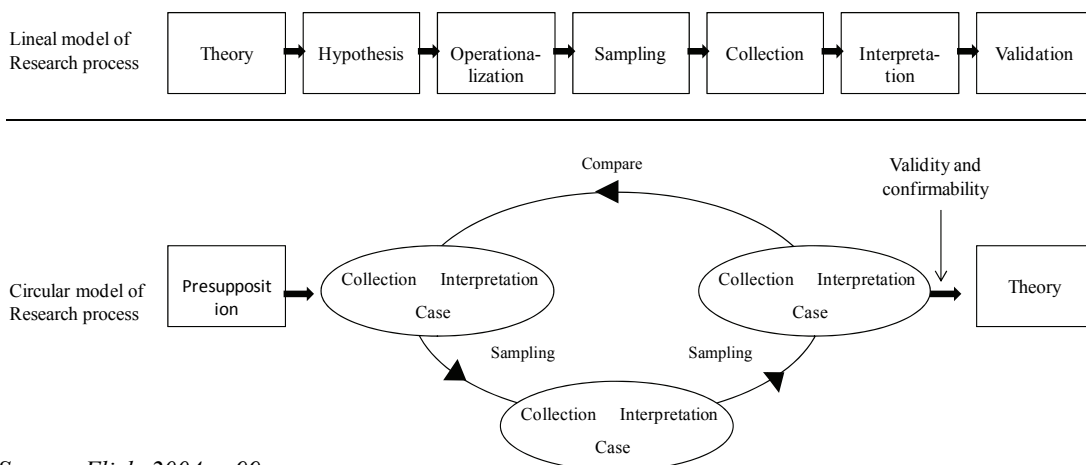
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research design on innovation process, concluding the first requirements to conduct this kind of innovation studies: (1) a clear set of concepts to select and describe the field under study; (2) systematic methods to observe the changes on the field over time; (3) methods to represent the data obtained from the field, to facilitate the identification of process guidelines; (4) a theoretical context that helps to explain the guidelines identified and conclude whether the existing theory fits this guidelines.

These four requirements are relevant for this research since they represent the steps to follow on the collection and analysis of data about innovation processes based on grounded theory (Nisbet, 1970; Pettigrew, 1985; Van de Ven *et al.*, 1989).

It is necessary to remark that on the design of grounded theory there is no assumption on the linearity of facts, not either on the stages of the study. For instance, the initial literature review is only used as overall context and guideline to define the concepts to study. The fieldwork alternates with data analysis, so that with the first conclusions obtained from data analysis, the researcher turns back to the field to obtain and analyse new data and review more suitable literature for it (Glaser, 1978; Goulding, 2001). This constant comparative cycle continues until information is saturated, so that confirmability can be checked and global conclusions are obtained, building a final theory (Trinidad *et al.*, 2006).

Figure 1: Lineal and circular models of the research process



Source: Flick, 2004, p.99

This process forms a circular model shown on Figure 1.

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Field settings

The research is conducted on an industrial small and medium enterprise (SME) of the Basque Country. This region offers a good context for research since from policy side there is growing monitoring of organizational innovation processes among local companies, promoted by the Competitiveness Plan 2010-2013 and the Technology, Science and Innovation Plan 2015 (Basque Government, 2010; 2011).

Following the principles of grounded theory, theoretical sampling has been applied for case election (Glaser and Strauss, 1967; Eisenhardt, 1989; Goulding, 2001; Glaser y Holton, 2004; Trinidad *et al.*, 2006). For this sampling, companies must show specific characteristics about the issue under study, in this case, (1) being a Basque company, (2) developing an organizational innovation process with one or various applications (practices, work organization and/or external relationship), (3) and ready to be studied under the objectives and design of this research. Coinciding with these characteristics, Ennera was selected as a case study; a renewable energies and sustainable mobility small company, subsidiary of Grupo CAF, settled in Ibarra (Gipuzkoa, Basque Country).

Data collection

Multiple data sources have been used to apply triangulation of data and conclusions (Miles and Huberman, 1984) as the basis for the validation of case studies (Yin, 2009) and the key to reach theoretical saturation on grounded theory and guarantee the quality and reliability of the research (Trinidad *et al.*, 2006). The following describe five data collecting methods used for the first fieldwork round at Ennera case study, conducted from February 2011 to May 2012 and covering the whole history of the company founded in 2007:

Documents based evidence: two types of documents have been collected, public general information (useful for case selection and preparation of interviews) and internal documents (organization chart, protocols on the use of internet, task distributions...).

Semi structured interviews: 22 interviews were conducted overall. The first 3 ones with the General Manager, used to decide on the case selection and prepare next steps. 16 more were done during participant observation with various members selected on snow-ball sampling, until saturation was reached. 3 more were done with external partners mentioned by Ennera employees. All the interviews were oriented to get particular narratives of

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interviewees about their experience on the organization, and then compliment them with guided questions related to the organizational innovation definition.

Participant observation: during three months (November 2011 to January 2012), and two days a week, the researcher lived a field immersion experience at Ennera's office sharing desk, meeting rooms, lunch and coffee times with all members, and participating as observant at internal meetings and at December's Board Director's Committee. Very precise field notes were taken constantly, paying special attention to the physical environment, social atmosphere, individual and collective activities, special events and human profiles.

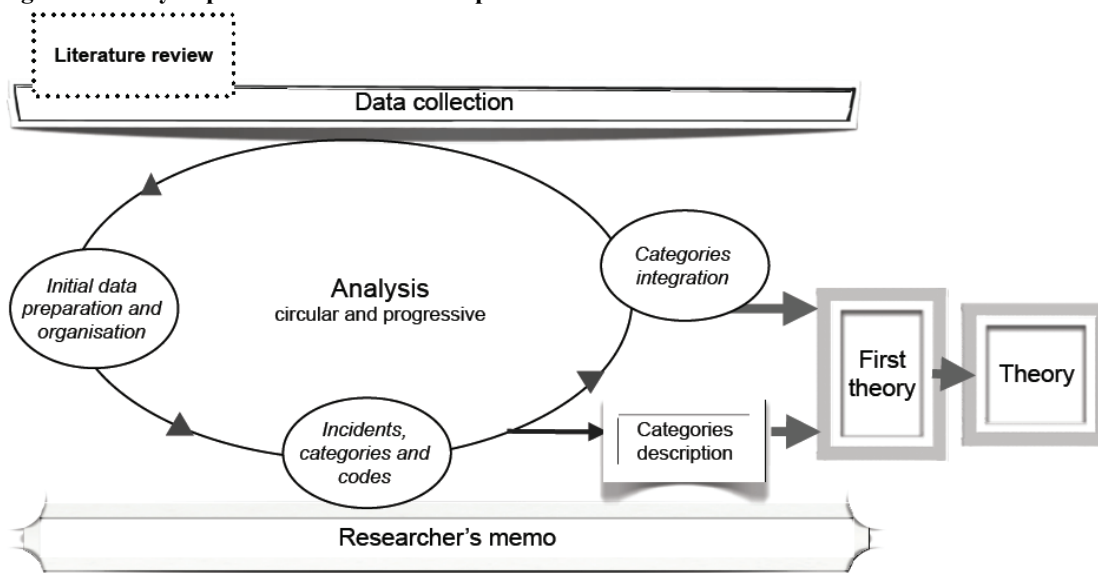
Graphic evidence: three types were collected along the fieldwork: (1) photographs of the office; (2) photographs selected by participants (considered relevant for their story); and (3) online graphic follow-up, based on their web and their image and interaction on social media platforms.

Devolution or member-checking: the first conclusions obtained were showed back to the participants with the aim of observing their behaviour and reaction, becoming useful as additional data gathering method.

4. Data analysis and preliminary results

Data analysis has been developed based on the constant comparative method associated to grounded theory (Glaser and Strauss, 1967; Glaser and Holton, 2004; Trinidad *et al.*, 2006) and used to build theory from the systematic comparison of incidents identified through the data, in parallel to its collection.

Figure 2: Analysis process on constant comparative method



Source: Own elaboration

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Figure 2 represents the process of this constant comparative method, showing the basic guidelines for analysis that were developed in the research with Ennera.

Initial data preparation and organization implied that, during fieldwork, all data was digitalized as audio, image or scanned documents, classified on physical and digital files, and precisely codified to represent the type data source, collection date and the participant (maintaining confidentiality). Each step was written at the researchers' memo.

Meanwhile, all portion of content showing symbols or topics somehow appropriate for the study were isolated as incidents. Each incident had a meaning, represented by the researcher with a category, as a classification element used for the theoretical explanation of each incident. Then, codes were associated to categories (as tags), facilitating the analysis by differentiating categories and their meanings. This process concluded in 1,904 incidents classified in 27 categories.

Abstract analysis started describing the meanings of each category based on the data (participant's behaviour as the engine for meaning generation and interpretation), using as reference researcher's memo, a graphical representation of codes assigned to categories (using tag clouds) and turning once and again to data for constant comparative.

As categories were described, connections among them were detected and represented in a timeline of events and on a conceptual map, integrating categories. Once description was finished, all connections in timeline and conceptual map were compared with data, and main topics arose (27 categories organised in 10 topics).

The first theory coming afterwards on the constant comparative method is a conceptual step aimed to make sense and meaning of the relationship among topics. In this case the timeline and conceptual map previously designed where used to connect topics and the narrative of the case was written down, describing the story of organizational innovation derived from data.

This story shows the evolution of Ennera from a project based workplace organization until 2010 to a functionally departmentalized model in 2011, which derived in further vertical decision-making processes. However, this hierarchical tendency was only partially developed, since it was kept embedded in deeply rooted horizontal business practices and communication processes. In fact, for almost five years, all the administrative

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tasks (reception, telephone answering, travel booking, lunch booking, office-kitchen cleaning, purchasing office material...) were done by the twenty members of Ennera team, no matter their profile, experience or role in the company. Similarly, any news about clients, partners, projects or proposal were communicated *ad hoc* by anyone in the team that informally could get together some people to explain it, without waiting for an official meeting to be called by a Manager or Director. Actually, the main challenge surfacing in 2012 was the need to formalize certain business practices in accordance with the departmentalized work organization, while keeping an informal and family-like organizational culture, that has indeed arisen as one of the key elements for the constant evolution of the organizational innovation process in Ennera.

Consequently, the work organization method implemented was new to the organization but not new to the market, but the business practices being developed were out-and-out self-generated and, as they had just started a creative process combining them with new commonly-known practices (like Committee of Directors meetings), the result could become also new to the market too. However, this aspect about novelty scope requires further fieldwork in order to analyse the evolution from 2011 onwards.

What is evident is that this organizational innovation process does not respond to a planned process, not either to a purely adopted one. Neither Manager nor employee has a defined idea of the organizational method to be deployed, and through the story there cannot be differentiated initiation and an implementation stages. It has all been a sequence of actions and decisions evolving on a trial and error dynamic.

The main driver arising is the strategic goal to gain a competitive advantage in the renewable energy market, offering a technology-based value-added service, mainly differentiated by the mode of approaching the market: honest, transparent and coherent. This means that the positioning that they constantly reinforce is grounded on the way they work and they behave, so it is something they have built themselves and that they transmit by their day-to-day behaviour.

As a matter of fact, in 2011, when the main organizational innovations were developed, the company also conducted a brand renaming process where all members participated in core decisions like vision and value statement. At that time, it was easy to

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understand that, from such participatory process, held in an office with totally open distribution, with flexible working schedules, where Management positions cannot be easily identified and all members have open access to the whole ERP system (except individual salaries), the three corporate pillars that they concluded were “transparency, credibility and honesty in all energy business activities”⁹.

However, when the first fieldwork round of this research finished in January 2012, Ennera was still immersed in this organizational innovation process, consolidating some of the innovations developed, and initiating new ones around business practices and external relationships.

Consequently, there has been a distant follow-up of the process along 2012 and a second fieldwork round of three months was started in November 2012. The data collected and analysed from this stage will be used to advance further on the constant comparative method for further confirmability and final theory proposal.

Grounded theory method states that the final theory emerges when theoretical explanation is found to the first theory. Currently this stage is being developed, turning to the definition of organizational innovation and to the process approach.

Initial results show that, attending to Oslo Manual’s definition of organizational innovation (OECD/Eurostat, 2005), Ennera is implementing organizational methods on business practices and work organization that are new to the company and are lead by a clear strategic motivation. Consequently, the real application fits with the theoretical definition, but further research would be needed if a clear differentiation from organizational change has to be proposed. Otherwise, the same case could perfectly fit with mere organizational change definition and the relevance of the innovation literature proposal would be questioned. It is indeed shown that, when the novelty level required for a change to be considered innovation is kept at “new to the organization”, many mere formalization or departmental change processes might be classified as organizational innovations, although the external diffusion and transfer potential expected from an innovation would be in their case greatly limited.

⁹ Source: www.ennera.com

From the process perspective, the preliminary results show that Ennera case corresponds with an innovation generation process and, consequently, it is shown that Damanpour and Wischnevsky's (2006) differentiation among innovation adoption and generation processes is not only applicable to technological innovation but also to organizational type. Therefore, knowledge on organizational innovation could be expanded if this distinction was applied when studying its antecedents, drivers, obstacles and overall process. However, it is expected that new advance on the longitudinal empirical research in Ennera can shade new light on these results.

5. Conclusions and implications

While the present study is ongoing, preliminary results have already shown the organizational innovation definition proposed by Oslo Manual on its last edition (OECD/Eurostat, 2005) is a relevant step towards the concept's clarification and to identify real applications that could further develop this definition for its consolidation. In this sense, this study proposes that future research should focus on the internal benefits and external diffusion potential of organizational innovations that, being developed as new to the organization, can strengthen organizational innovation relevance both for firm and territory-wide competitiveness.

Besides, the difference between innovation adoption and generation has also been shown along this study as suitable for organizational innovation processes, although further research is still needed to achieve a final theory for the process at the case studied. Moreover, it has been revealed that applying process perspective instead of variation perspective is useful to deepen into complex phenomenon like organizational innovation, and so to get thorough understanding of circular sequences of events lead by personal behaviours instead of previously planned lineal models.

Limitations of this study must be assumed too. As the researcher is the main research tool, there is a risk of bias to confront. Researcher's immersion is a must to understand the real meaning that participants attribute to the contexts and events happening, but it requires triangulation of data sources, rigour on field notes and own consciousness to minimize the bias risk and reach confirmability (Kawulich, 2005; Peñaloza and Cayla, 2006; Hernández Sampieri *et al.*, 2010). Moreover, loyal to qualitative research methods, no generalizability

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can be done from this research, so applicability will be found facilitating transference to other contexts (Williams, Unrau and Grinnell, 2005).

In conclusion, this study pretends to contribute to a deeper knowledge on organizational innovation, so that it can open future research tracks about its influence on competitiveness. Besides, it expects to provide an adapted research method based on grounded theory that can be applied to other innovation processes. Practical implications may also be obtained for Basque companies and policy makers, since they are working on an innovation based sustainable competitiveness model, and a thorough understanding of real organizational innovation processes can conclude on important drivers and obstacles to consider, showing also reference practices to promote.

References

- Angle, H.L. and Van de Ven, A.H. (2000): Suggestions for managing the innovation journey. In: Van de Ven, A.H., Angle, H.L., Poole, M.S. (Eds.), *Research on the Management of Innovation. The Minnesota Studies*. Oxford University Press, New York.
- Arraut Camargo, L. C. (2009): *Innovación Organizacional Para Mejorar La Productividad y Competitividad De Las Empresas Petroquímicas-Plásticas De Cartagena De Indias*. Tesis Doctoral. Mondragon Unibertsitatea.
- Armbruster, H.; Kirner, E.; Lay, G. et al. (2006): *Patterns of Organisational Change in European Industry (PORCH). Ways to Strengthen the Empirical Basis of Research and Policy*. European Communities.
- BASQUE GOVERNMENT / EUSKO JAURLARITZA (2010) [online]: Plan De Competitividad Empresarial 2010-2013. Available at: <http://www.euskadinnova.net/es/portada-euskadiinnova/politica-estrategia/plan-competitividad-empresarial-2010-2013/111.aspx>
- BASQUE GOVERNMENT / EUSKO JAURLARITZA (2011) [online]: Plan De Ciencia Tecnología e Innovación 2015. Available at: <http://www.euskadinnova.net/es/innovacion-tecnologica/ambitos-actuacion/pcti-2015/163.aspx>
- Damanpour, F.; Szabat, K.A. and Evan, W. M. (1989): "The relationship between types of innovation and organizational performance". *Journal of Management Studies*, vol. 26/6, pp. 587-601.
- Damanpour, F. and Wischnevsky, J.D. (2006): "Research on innovation in organizations: distinguishing innovation-generating from innovation-adopting organizations". *Journal of Engineering and Technology Management*, vol. 23, p. 269-291.
- Drucker, P.F. (1985): *The discipline of innovation*. Harvard Business Review 72–76.
- Eisenhardt, K. M. (1989): "Building Theories from Case Study Research". *Academy of Management Review*, vol. 14 (4), pp. 532-550.
- Flick, U. (2004): *Introducción a La Investigación Cualitativa*. Madrid: Ed. Morata.
- Glaser, B. G. (1978): *Theoretical Sensitivity: Advances in the Methodology of Grounded Theory*. Mill Valley, CA: Sociology Press.
- Glaser, B. G. and Straus, A. L. (1967): *The Discovery of Grounded Theory. Strategies for Qualitative Research*. London: Weidenfeld and Nicolson.
- Glaser, B. G. and Holton, J. (2004) [online]: *Remodeling Grounded Theory*. March 2004. Available at: <http://www.qualitative-research.net/index.php/fqs/article/view/607>.
- Goulding, C. (2001): "Grounded Theory: A Magical Formula Or a Potential Nightmare". *The Marketing Review* (2), pp. 21-34.
- Greenan, N. (2003): *Organisational change, technology, employment and skills: an empirical study of French manufacturing*. In: *Cambridge Journal of Economics*, vol. 27, pp. 287-316.
- Hernández Sampieri, R.; Fernández Collado, C. and Baptista Lucio, P.(2010): *Metodología De Investigación*. 5 ed. México: McGraw-Hill.
- Kawulich, B. B. (2005): "Participant Observation as a Data Collection Method". *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, vol. 6 (2), Art.43.

ORGANIZATIONAL INNOVATION WORKSHOP

- Kirner, E.; Som, O.; Armbruster, H.; Lay, G. and Zhou, W. (2008): Measuring organisational innovation – concepts, indicators and outcomes. 6CP Workshop Non-Technical Innovations. Fraunhofer Institute for Systems and Innovation Research. Karlsruhe, October 16-17, 2008.
- Lam, A. (2005): Organizational Innovation. In: Fagerberg, J.; Mowery, D. y Nelson, R. R. (eds.), *The Oxford Handbook of Innovation* Oxford: Oxford University Press.
- Miles, M. and Huberman, A. M. (1984): *Qualitative Data Analysis*. Beverly Hills, CA: SAGE Publications.
- Nisbet, R. A. (1970): Developmentalism: A critical analysis. In: McKinney, I. y Tiryakin, E. (eds.), *Theoretical Sociology: Perspectives and Developments* Meredith, New York: pp. 167-206.
- O'Reilly, K.; Paper, D. and Marx, S. (2012): "Demystifying Grounded Theory for Business Research". *Organizational Research Methods*, vol. 15 (2), pp. 247-262.
- OCDE and EUROSTAT (2005): *Oslo Manual, OECD Proposed Guidelines for Collecting and Interpreting Technological Innovation Data*. 3. ed. OECD/European Communities.
- Peñaloza, L. and Cayla, J. (2006) In: *Writing pictures/taking fieldnotes: towards a more visual and material ethnographic consumer research*. Belk, R. W. (ed.), *Handbook of qualitative research methods in marketing*, Cheltenham, UK: Edward Elgar, pp. 279-290.
- Pettigrew, A. (1985): *The Awakening Giant: Continuity and Change in ICI*. Oxford: Basil Blackwell.
- Poole, M. S. (2004): Central Issues in the Study of Change and Innovation. In: Poole, M. S. y Van de Ven, A. (eds.), *Handbook of Organizational Change and Innovation* New York: Oxford University Press.
- Som, O., Diekmann, J., Solberg, E., Schricke, E., Schubert, T., Jung-erceg, P., Stehnen, T., Daimer, S. (2012): *Organisational and Marketing Innovation - Promises and Pitfalls? PRO INNO Europe: INNO-Grips II report*, Brussels: European Commission, DG Enterprise and Industry.
- Trinidad, A.; Carrero, V. and Soriano, R. M. (2006): *Teoría Fundamentada "Grounded Theory"*. La Construcción De La Teoría a Través Del Análisis Interpretacional. Madrid: Centro de Investigaciones Sociológicas.
- Tripsas, M. (2009): "Technology, Identity, and Inertia through the Lens of "The Digital Photography Company". *Organization Science*, vol. 20 (2), pp. 441-460.
- Van de Ven, A. (1992): "Suggestions for Studying Strategy Process: A Research Note". *Strategic Management Journal*, vol. 13, pp. 169-188.
- Van de Ven, A. H.; Angle, H. L. and Poole, M.S. (1989): *Research on the Management of Innovation: The Minnesota Studies*. USA: Ballinger Publishing Company.
- Van de Ven, A. and Huber, G. P. (1990): "Longitudinal Field Research Methods for Studying Processes of Organizational Change". *Organization Science*, vol. 1 (3), pp. 213-219.
- Williams, M.; Unrau, Y. y Grinnell, R. (2005): *The Qualitative Research Approach*. New York: Oxford University Press.
- Yin, Robert K. (2009): *Case Study Research. Design and Methods*. 4ª edición. SAGE Publications.

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MANAGING RISK-TAKING TO ENHANCE INNOVATION IN ORGANIZATIONS

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Abstract

The link between risk taking and innovation has been analyzed from two disconnected perspectives. From a managerial perspective, the lenses of entrepreneurial orientation and leadership theories have provided useful insights to establish a direct relation between managers' risk taking and innovation. From an employee perspective, scholars have pointed that an organizational climate promoting risk taking will be effective in fostering innovative behaviors among employees. However, little empirical research has analyzed this link through a combined perspective.

This paper aims to cover this gap by analyzing both theoretically and empirically the relationship between managers' risk-taking propensity, employees' perceived risk-taking climate and innovation. For this, we test a model where the impact of the manager' risk-taking propensity on innovation is mediated by its effect over the employees' perceived risk-taking climate. Structural equation modeling was used to test the research hypotheses on a data set of 182 firms from the Spanish and Italian ceramic tile industry. As expected, results indicated that employees' perceived risk-taking climate plays a significant role in determining the effects of managerial risk taking on innovation.

Keywords: Innovation performance, managers' risk taking, organizational climate, perceived risk taking, signaling theory, social cognitive theory

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1. Introduction

The ability of firms to innovate is a primary factor in gaining and sustaining competitive advantage (Nelson & Winter, 1985). Hence, a widely supported idea is that innovative behaviors should be highly encouraged across all levels of the organization, given that such behaviors are likely to exert a positive influence in organizational effectiveness (Amabile, Barsade, Mueller, & Staw, 2005; Woodman, Sawyer, & Griffin, 1993). The focal point of our research is on the relationship between risk taking and innovation performance, from both a managerial and an employee perspective. The relationship between risk-taking and innovation performance is particularly fruitful. Substantial research from diverse fields have suggested a close link between risk-taking and innovative behaviors in organizational settings (March & Shapira, 1987). Risk-taking and innovation are intertwined due to the nature of creative behaviors in organizations.

From a managerial perspective, the link between risk-taking and innovation performance has been examined through a wide range of approaches, such as entrepreneurial orientation and leadership related literatures (Covin & Slevin, 1986; Wu, Levitas & Priem, 2005; Ling, Simsek, Lubatkin & Veiga ., 2008). Risk taking involves the engagement of significant resources to activities that have significant possibilities of failure, such as incurring heavy debt or making large resource commitments, with the objective of grasping potential high benefits (Lumpkin & Dess, 1996; Alegre & Chiva, 2010; Fernández-Mesa, Alegre-Vidal & Chiva-Gómez, 2012). Eventually, managers vary in their individual propensities to take risks. However, there is evidence showing the relevance of prone risk manager's in the attainment of innovation results (e.g. Ling et al., 2008). The achievement of innovation is based on a great deal of uncertainty, thus bold decisions and actions are many times a necessary condition. In this sense, often, managers need to embark themselves on this type of risky decisions in order to achieve innovation outcomes. In March (1987) words, "risk taking is valued, treated as essential to innovation and success".

The literature on creativity (e.g.: Amabile, Conti, Coon, Lazenby, & Herron, 1996) provides a different view of the relation between risk-taking and innovation by focusing on

how employees engage in innovative activities. A fundamental idea is that creative behaviors are about challenging the existing status quo of given aspect of the organization. From an employee' perspective, the consequences of such challenge are uncertain. In fact, those employees showing innovative behaviors may face negative consequences if they fail (Zhou & George, 2001). For instance, Janssen (2003) demonstrated that innovative employees are likely to fall into conflict with co-workers. The argument is that a worker promoting new ideas is challenging the established courses of action of their co-workers. Therefore, resistance in the form of work conflict will be likely to arise. To put it differently, those employees deciding to behave innovatively are implicitly assuming a certain amount of risk derived from the uncertainty of their outcomes and the potential reticence from their colleagues.

Although work from both views has significantly advanced in the understanding of the nature of the link between risk taking and innovation performance, little empirical research has analyzed this link through a combined perspective. We believe that much more can be learned if the causes and effects of risk taking over innovation performance are explored simultaneously at different levels of the organization. We argue that managers' risk taking behavior not only exerts a direct effect over innovation performance. Rather, the organizational risk-taking climate of the organization will be benefited due to the positive signaling effects derived from managers' risky behaviors.

2. Conceptual background

Innovation Performance

Innovation is central in establishing and sustaining competitive advantage of firms (Nelson, 1991; Teece, Pisano & Shuen, 1997). The evolution of an increasingly complex environment has placed innovation as an indispensable option when planning to increase firms' performance and assure its growth and ultimate survival (Damanpour, 1991; Daellenbach, McCarthy & Schoenecker, 1999). Innovation can be defined as the successful implementation of new ideas (Myers & Marquis, 1969; Amabile et al., 1996). This interpretation of innovation includes novelty and use as two conditions that must be

fulfilled. In this sense, innovation not only requires of new ways of solving problems but also involves use or achievement of commercial success.

Innovations can be classified as product and process innovations (OECD, 2005; Martínez-Ros & Labeaga, 2009). Product innovation is understood as the product or service introduced to meet the needs of the market or of an external user, and process innovation is understood as a new element introduced into production operations or functions (Damanpour & Gopalakrishnan, 2001). However, both types of innovations are closely related and, even though firms can be more dedicated to innovate in products, process innovations may be necessary for the successful implementation of product innovations (Utterback & Abernathy, 1975; Martínez-Ros & Labeaga, 2009).

Innovation has resulted to be a very complex process presenting high failure rates (Stevens & Burley, 1997; Wu et al., 2005). However, despite the difficulty in attaining innovation, it is definitely one of the driving forces behind organizational growth and thus, the study of its determinants is of vital importance.

Managers' Risk Taking Propensity

The determinants of innovation have been extensively researched and include from exogenous factors, such as the firm's external environment, to more malleable aspects such as organizational culture, structure and strategy (Papadakis, Lioukas & Chambers, 1998; Jansen, Van den Bosch & Volverda, 2006; Vega-Jurado, Gutiérrez-Gracia & Fernández-de-Lucio, 2008). In particular, leaders have been repeatedly recognized as strategic decision makers including among other domains, their critical role in recognizing opportunities and making decisions that affect innovation processes (Elenkov, Judge & Wright, 2005; Aleviev, Jansen, Van den Bosch & Volverda, 2010; Vaccaro, Jansen, Van den Bosch & Volverda, 2010). In this kind of decisions, managers confront the uncertainty intrinsic in innovation activities. Innovation needs the investment of time, effort and resources, such as, increases in R&D expenses or the allocation of management attention, even though the distribution of the returns is unknown (Wu et al., 2005; Ling et al., 2008). This uncertainty and the significant possibilities of failure often lead to risk adverse behaviors and under-

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investments in innovation (Finkelstein, 1992). Nevertheless, the expectancy of potential high returns drives seldom managers to decide themselves for risky solutions, focusing on the potential benefits of innovation instead of the potential losses (Sitkin & Weingardt, 1995, Ling et al., 2008).

Several streams of research propose that manager's risk-taking propensity can make a difference in defining the propensity of the firm to innovate. The entrepreneurial orientation literature, for instance, has conceptualized risk-taking as one of the dimensions integrating the strategic posture of the firm, that is, the extent to which top managers are inclined to take business related risks (Covin & Slevin, 1986). Generally, scholars in this tradition have examined how entrepreneurial orientation heightens performance (Zahra & Covin, 1995; Madsen, 2007), which can be considered a very close output of innovation results (Fernández-Mesa et al., 2012).

Anchored in strategic management research, scholars using the upper echelons perspective have also studied the risk taking propensity of managers and top managers' teams through characteristics such as tenure, age or diversity and their effect on innovation performance (Bantel and Jackson, 1989; Wu et al., 2005; Liu et al., 2012). Moreover, studies based on leadership literature have assessed in a more direct manner how the propensity of top management teams towards risk-taking has an influence on performance (Papadakis et al., 1998; Peterson, Smith, Martorana & Owens, 2003) and more specifically on innovative processes and outcomes (Ling et al., 2008). In general, results confirm that managers biased towards risk-taking behaviors are more likely to obtain better innovation results.

Although managers' risk taking propensity appears as a pivotal role in explaining innovation performance in organizations, the inner mechanism through which this is ultimately linked to the organization' innovative performance is obscured in the literature. Informal factors in the organization may play a significant function in approaching this question.

Employees' perceived risk-taking climate

Although there are a variety of ways to approach the different contextual features that organizations may have, researchers have often used the heading of organizational climate to assess those social features of the workplace that facilitate or inhibit certain behaviors (Schneider, 1975; Schneider, Smith, & Sipe, 2000). The organizational climate is a multidimensional construct that deals with a wide range of organizational realities (James & McIntyre, 1996). According to Denison (1996), the organizational climate is concerned with those aspects of the social environment that are consciously perceived by the organizational members.

The concept of organizational climate has become prominent among management scholars, and it is usually deconstructed into specific dimensions (Schneider & Reichers, 1983), depending on the particular phenomena under study. For instance, climate scholars have developed a construct to measure a climate for justice (Naumann & Bennett, 2000), creativity (Gilson & Shalley, 2004), innovation (Anderson & West, 1998; Pirola - Merlo & Mann, 2004), diversity (McKay, Avery, & Morris, 2008), or ethics (Ambrose, Arnaud, & Schminke, 2007), among other. It is worth to notice that many of these specific climates can be found simultaneously in the organization (Kuenzi & Schminke, 2009), since they are measuring different realities of the organizational environment.

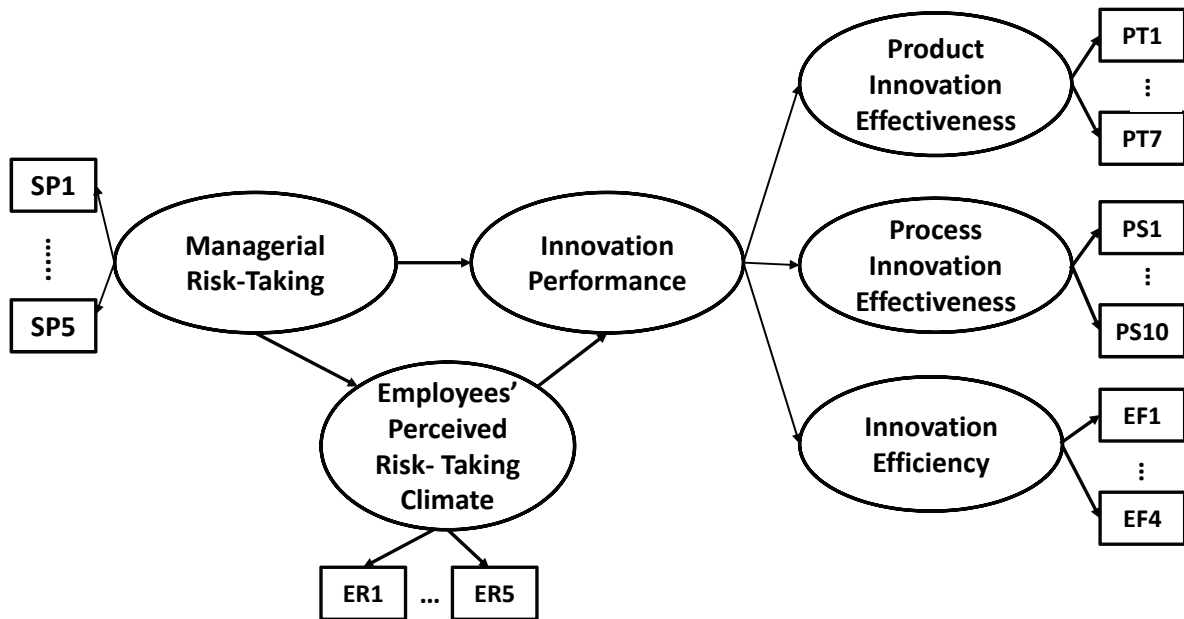
Employees conceive the climate of the organization as a source of specific cues about how to behave. Those cues are used as guidelines to behave in the organization (Ashkanasy et al., 2000) and therefore, help to exhibit or inhibit certain behaviors in the organizational setting. For instance, empirical studies have reflected that those employees perceiving a climate characterized by high fairness among employees will tend to behave in a fairly manner (Ehrhart 2004). In a similar vein, innovation and creativity scholars have linked some facets of the organizational climate to innovative behaviors and innovation performance. For instance, (Gilson & Shalley, 2004) discovered that those team members that were more engaged in creative processes reported that their team climate was more supportive of creativity. Similarly, (King, De Chermont, M. West, Dawson, & Hebl, 2007) found that a climate for innovation was positively linked to organizational performance.

A particular facet of the organizational climate that is likely to influence employees' innovative performance is the perceived risk-taking climate. Employees fear to fail (Zhou & George, 2001), and innovating in an organizational setting may be viewed as a risky behavior. Risk taking means uncertainty about the potential outcomes of one's decision (Sitkin & Pablo, 1992). Therefore, it is to be hoped that many employees are reluctant to engage in risk taking behaviors. This barrier may be overcome if employees perceive that the climate of the organization supports risk taking and innovation.

3. Hypotheses

Based on the discussion in the preceding section, we propose a conceptual model shown in Figure 1. The primary purpose of the model is to simultaneously integrate the effects of management risk-taking propensity and perceived risk-taking climate over innovation performance. Specifically, the main tenet is that managers' risk-taking propensity will better explain innovation performance if a mediating effect over the perceived risk-taking climate is considered. Managers' risk-taking propensity may not only exert a direct influence over innovation performance, but also an effect in creating and maintaining a particular facet of the organizational climate that helps employees to cope with the associated risks of engaging in innovative behaviors.

Figure 1: Theoretical model



Managers' Risk-Taking Propensity and Employees' Perceived Risk-Taking Climate

There has been a considerable collection of studies emphasizing the critical role of managers in shaping particular facets of the organizational climate (Grojean, Resick, Dickson, & Smith, 2004). The actions of the managers regarding risk-taking are likely to have a considerable influence over the perceived risk-taking climate of the organization. In this section we propose a series of mechanisms by which leaders' risk-taking propensity may influence the shared perception of risk taking in the organization and therefore, the risk-taking climate.

First, organizational behavior research indicates that managers' behaviors are a powerful communication mechanism that conveys the assumptions of the climate of the organization (Ashkanasy et al., 2000; Grojean et al., 2004). Managers' behaviors are role models of appropriate behaviors in particular situations. According to social cognitive theory (Bandura, 1986), individuals have the capacity to learn vicariously. Vicarious learning refers to the process of learning by observing the behavior of others and the consequences of it (Bandura, 2001) For instance, House & Shamir (1993) suggest that vicarious learning is an important mechanisms through which the values of the organization

are transmitted from the managers to the employees of the organization. We extend this rationale to argue that those managers more prone to take risks in their organizational decisions will shape the risk-taking climate of the organization. As a consequence, employees will perceive the climate as more tolerant with risk taking.

Another transmitting mechanism through which managers' risk-taking propensity may influence the perceived risk-taking climate is anchored in signaling theory (Spence, 1973). Signaling theory refers to behaviors that convey information about ones' intentions and abilities. Management scholars have applied signaling theory and argued that managers are powerful signalers of desirable behaviors in organizations (Connelly, Certo, Ireland, & Reutzel, 2011). The main rationale behind signaling theory is information asymmetry. Employees may not have fully information about how they are expected to behave under particular situations (e.g.: taking a risky decision versus being conservative). In order to reduce such information asymmetry, managers may consciously decide to emit signals to observers. In the particular case of risk-taking, managers' risk taking propensity may be a powerful signal to stress the importance of risk taking behaviors among employees. Signal receivers (here, employees), will receive the signal and use it to make more informed decisions (Cohen & Dean, 2005). This rationale may be extended to the risk-taking perception of organizational employees. Taken together, the above developed arguments allow us to state that:

Hypothesis 1: Managerial risk-taking propensity is positively related to employees' perceived risk-taking climate.

Employees' perceived risk-taking climate and innovation performance

Research on creativity and innovation indicates that creative efforts require a substantial investment of time and energy on the part of the individual (Redmond, Mumford, & Teach, 1993). The ultimate decision to perform innovative behaviors is coined to the individual, and the willingness and motivation to do so may be influenced by a number of organizational characteristics. According to (Yuan & Woodman, 2010), innovative behavior is defined as "as an employee's intentional introduction or application of new ideas, products, processes, and procedures to his or her work role, work unit, or

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organization” (2010 : 324). Employees deciding to search and apply new technologies for their daily work, or suggesting new ways to achieve objectives in their organization are examples of such behaviors. Those types of behaviors are likely to exert a positive effect on the organizations’ overall innovation performance.

However, innovative behaviors are closely linked to risk taking. Engaging in an innovative behavior require to feel comfortable with risk taking or at least, to tolerate a certain amount of it. Employees may lack the motivation to take risks in their organizations by a number of reasons. Engaging in innovative acts in the workplace brings benefits but also costs (Janssen, 2003). Given that employees guide their acts according to the expected consequences of their behaviors (Vroom, 1964), the perceived costs of introducing a new idea or procedure may overshadow its potential benefits. Among those costs, challenging the “status quo” of the organization is a prominent one. Implementing or suggesting a novel procedure or idea means that the old ones are challenged. Organizations are, however, “a stabilizing force” (Klein & Knight, 2005), and organizational norms and routines foster maintenance of the status quo. Innovative employees may encounter barriers to their new ideas from their colleagues when challenging those norms. In fact, one major reason people do not engage in innovative behaviors is to avoid conflict with their colleagues (Janssen, 2003).

A contextual factor that may help to overcome these potential costs of engaging in innovation performance is a favorable organizational climate towards risk-taking (James & McIntyre, 1996). The climate of the organization signals expectations for desirable behaviors and help to predict the returns of diverse behaviors. If employees perceive that a certain behavior is legitimated among the colleagues; their willingness to perform that particular behavior will be increased. For the case of innovation performance, it is reasonable to expect that an organizational climate supporting risk-taking will enhance the willingness of employees to engage in innovative behaviors (Ekvall, 1996). The underlying mechanism is that an organizational climate supporting risk taking serves to legitimate innovative behaviors. Organizational members will more likely understand that being innovative is a desirable behavior in the organization, and will feel more psychologically saved to perform trial and error attempts (Yuan & Woodman, 2010). It is reasonable to

expect that employees perceiving a favorable risk-taking climate will enable the integration of risk-taking behaviors and hence, the overall innovation performance of the organization will be benefited. To sum up, we propose that those organizations with higher levels of risk-taking climate will show higher levels of innovation performance, compared to those organizations with lower levels of perceived risk-taking climate.

Hypothesis 2: There is a positive relationship between employees' perceived risk-taking climate and innovation performance.

Manager's risk-taking propensity and innovation performance: a case for partial mediation

Scholars have extensively assumed that top manager's strategic purposes are synonymous from those at the organizational level and that top manager's personalities and behaviors can have a direct influence on organizational outcomes. However, despite the relevance of these leaders, real change emerges at lower levels within the organizational structure (Jelinek, 2003). In this sense learning and cognitive theories state that senior executives with strong convictions towards innovation contributions are not enough to generate the necessary organizational change driving novelty and enabling innovation. For this change to occur, a critical mass of shared belief must be generated (Sidhu, Commandeur & Volberda, 2007).

Specifically, risk-taking propensity should be a relevant characteristic in manager's personal schemata in order to induce an innovative logic but it will not be enough. The organizational climate is susceptible to managers' influences (Peterson et al., 2003) achieving that greater managers acceptance of risk cascades down the organizational hierarchy in order to further enhance the firm's innovative proclivity (Ling et al., 2008).

Hence, we argue that managers have the power of shaping climate towards risk-taking and once achieved, innovation has more chances to emerge. In this sense, we enrich prior studies analyzing the direct link between managers' risk-taking and innovation by arguing that innovation is also a function of employees' perceived risk-taking climate. In particular, we argue that managers' risk-taking will not only exert a direct effect on innovation performance but it will also impact innovation through employees' perceived

risk-taking climate. In this sense, risk-taking climate will mediate the relationship between manager's risk propensity and innovation performance.

Hypothesis 3: The relationship between managerial risk-taking and innovation performance is mediated by employees' perceived risk-taking climate.

4. Research methods

Data Collection

Our research hypothesis is tested on a single industry: ceramic tiles production in Italy and Spain. Italian and Spanish ceramic tile producers have several things in common. Most are SMEs with a maximum of 250 workers on average, and are generally geographically concentrated in industrial districts (Enright & Tenti, 1990). The Italian ceramic tile industrial district is located in Sassuolo (Northern Italy) and the Spanish district is in Castellón (Eastern Spain). Aggregate production on these two districts is similar.

Several studies have analyzed innovation in the ceramic tile industry and find enamels and design to be the most important areas of product improvement (Meyer-Stamer, Maggi & Seibel, 2004; Hervas-Oliver, Jackson & Tomlinson, 2011).

Our focus on the ceramic tile industry reduces the range of extraneous variations in the data which could influence the constructs of interest. Analyzing a single sector has the advantage that it avoids a problem common to inter-sectoral studies, of technological and economic diversity of products (Coombs, Narandren & Richards, 1996; Santarelli & Piergiovanni, 1996). We acknowledge the disadvantages of this sampling in terms of limiting generalizability but believe that they are outweighed by the advantages offered by this approach.

The field work was conducted in June to November 2004. Pre-testing was carried out on four technicians from ALICER, the Spanish Center for Innovation and Technology in Ceramic Industrial Design, to ensure comprehensibility of the questions in the context of the ceramic tile industry. The questionnaire used a 7-point Likert scale.

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We received a total of 182 completed questionnaires, 101 from Spanish firms and 81 from Italian firms, which represents around 50% of the population under study for both the Italian and the Spanish subsamples (Chamber of Commerce of Valencia, 2004). The number of responses and the response rate can be considered satisfactory (Spector, 1992; Williams, Gavin & Hartman, 2004). To check for non-response bias, sales turnover and number of employees in respondent and non-respondent firms were compared. The comparison did not reveal any significant differences.

Measures

Managerial risk-taking. We use the dimension of risk taking of the Covin & Slevins' (1986) EO scale. This scale has been developed to reflect "*the organizational processes, methods and styles that firms use to act entrepreneurially*" (Lumpkin & Dess, 1996, p. 139). Risk taking is one of the original three dimensions forming the EO scale, together with innovativeness and proactiveness. Specifically, risk taking involves taking bold actions by venturing into the unknown, borrowing heavily, and/or committing significant resources to ventures in uncertain environments. Although all three dimensions are highly related, empirical evidence shows that each dimension is conceptually different and partly independent from the other dimensions (Lyon, Lumpkin & Dess, ., 2000; Naldi, Nordqvist, Sjöberg, & Wiklund, 2007). These items were applied using a 7-point Likert scale (see appendix).

To measure *employees' perceived risk-taking climate* we use the items proposed by the literature using a 7 point Likert scale. Isaksen et al. (1999) proposed different items to measure employees' risk-taking climate. On the other hand, Amabile et al. (1996) also measure how to reinforce creativity through employees risk taking. Our proposed scale is presented in an annex.

Innovation performance was measured using the scale provided in the OECD's (2005) Oslo Manual for the assessment of the economic objectives of innovation. This scale was proposed by the OECD in order to achieve greater homogeneity and comparability among innovation studies. We asked the innovation performance in compared with competitors with regard to the following items (see appendix) with a 7 point Likert scale.

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We operationalized innovation performance as a second-order factor construction, integrated by three different dimensions: product innovation efficacy, process innovation efficacy and innovation projects efficiency. Product and process innovation efficacy reflects the degree of success of an innovation. Innovation projects efficiency reflects the effort carried out achieve that degree of success. These dimensions have been widely discussed in innovation research (Brown & Eisenhardt 1995; Chiesa, Coughlan & Voss, 1996).

5. Results

Psychometric Properties

The psychometric properties of the measurement scales were assessed in accordance with accepted practice (Gerbing & Anderson 1988; Tippins & Sohi 2003), including content validity, reliability, discriminant validity, convergent validity, and scale dimensionality. Table 1 presents the factor correlations, means, and standard deviations.

Content validity was established through a review of the literature and interviews with ceramic tile industry experts (four ALICER technicians). We computed the coefficient alpha and composite reliability indicator to assess scale reliability (Fornell & Larker 1981; Bou-Llugar, Escrig_Tena, Roca-Puig & Beltrán-Martin, 2009). All scales achieved acceptable coefficient alphas and composite reliability indicators of at least 0.70 (Table 1).

TABLE 1. Factor correlations, means, standard deviations, Cronbach's alphas and Composite Reliabilities

	Mean	s.d.	CR	1	2	3	4	5
1.- Employees' perceived risk taking climate	4.84	1.13	0.83	(0.83)				
2.- Managerial risk taking	3.89	1.31	0.74	0.313**	(0.74)			
3.- Product innovaton effectiveness	5.07	1.11	0.91	0.471**	0.485**	(0.92)		
4.- Process innovation effectiveness	4.9	1.12	0.94	0.462**	0.366**	0.846**	(0.94)	
5.- Process innovation efficiency	4.69	1.22	0.92	0.563**	0.489**	0.797**	0.782**	(0.92)

** Statistically significant correlation coefficient ($p < 0.01$).

Cronbach's alpha are shown on the diagonal. Composite reliabilities are shown in the CR column

To calculate the correlation coefficients, we worked with the means of the items that make up each dimension.

Discriminant validity was assessed through confirmatory factor analysis by comparing the χ^2 differences between a constrained confirmatory factor model and an

interfactor correlation set at 1 (indicating they are the same construct) and an unconstrained model with an interfactor correlation set free. All χ^2 differences were significant, providing evidence of discriminant validity (Anderson & Gerbing 1988; Gatignon, Tushman, Smith & Anderson, 2002; Tippins & Sohi 2003). Confirmatory factor analysis was used also to establish convergent validity by confirming that all scale items loaded significantly on their construct factors (Anderson & Gerbing 1988). Convergent validity was also confirmed by comparing the χ^2 differences between a constrained confirmatory factor model with an interfactor correlation set at 0 (indicating no relationship between the two constructs) and an unconstrained model with an interfactor correlation set free. All χ^2 differences were significant, providing evidence of convergent validity (Gatignon et al. 2002).

We checked the dimensionality of the constructs through the loadings of the measurement items on first-order factors, and the loadings of the first-order factors on second-order factors. All loadings were above 0.40 and significant at $p < 0.001$. No cross-loadings emerged.

Before testing our hypotheses, we assessed the extent of common method variance by conducting a Harman's single-factor test (Podsakoff & Organ 1986; Podsakoff, MacKenzie, Lee & Podsakoff, 2003; Bou-Llusar et al., 2009). Common method variance is a problem that can arise when the dependent and independent variables are collected from a single informant. In our study, we used two different key informants to minimize this problem.

Test of the Research Hypotheses

We tested for the presence of a mediating effect by performing competing model analysis. The first model (direct effect) examines the direct relationship between managerial risk taking and innovation performance. The χ^2 statistic for each model is significant, and the other relevant indices suggest a good overall fit (Tippins & Sohi, 2003).

Figure 2: Direct Model

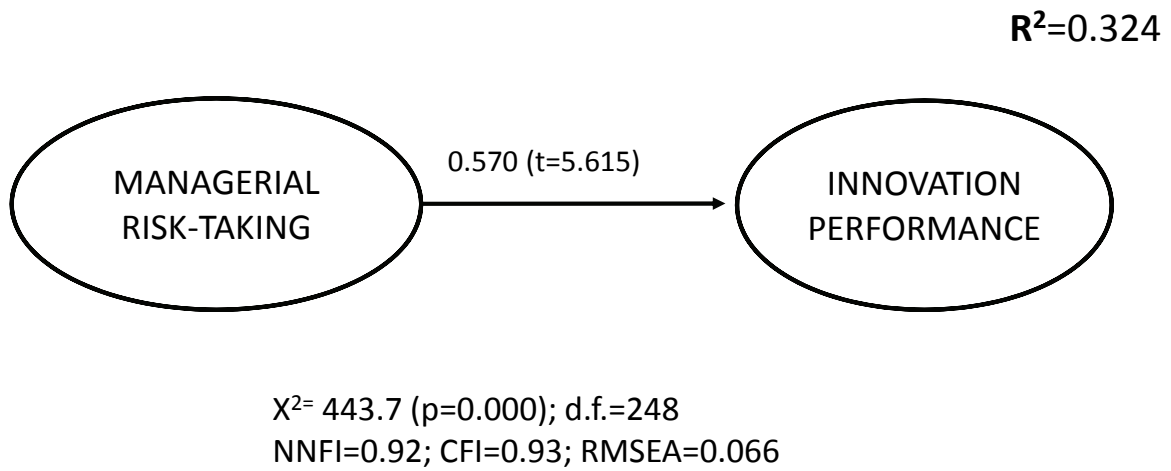
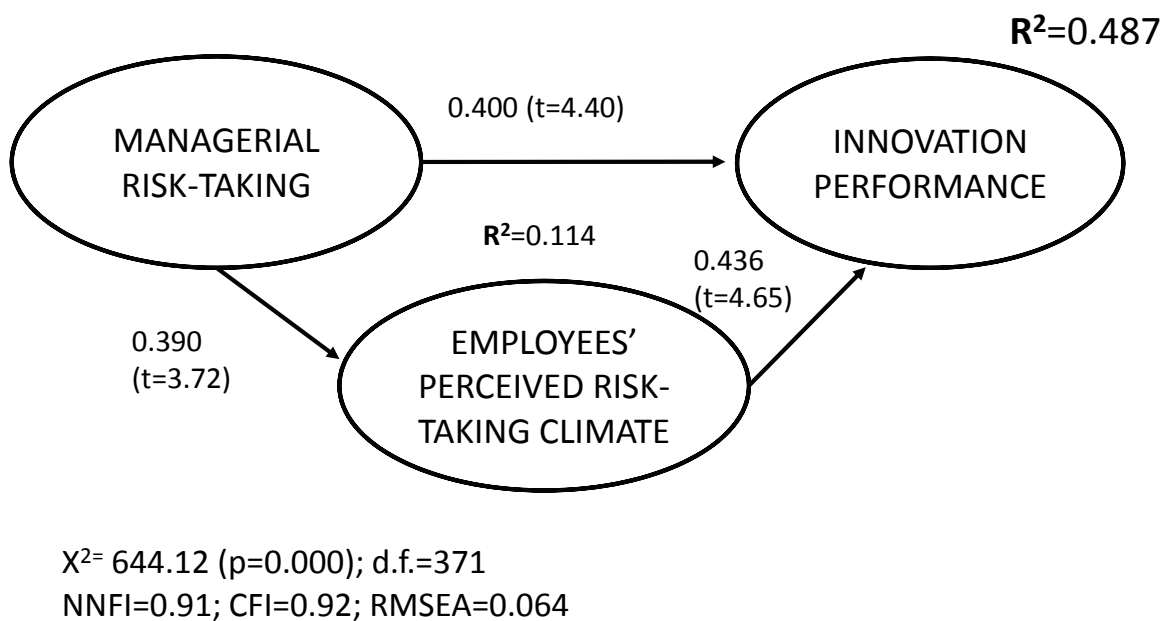


Figure 3: Mediating Model



First, the direct effect model was tested and found to be satisfactory. There is evidence of a positive link between managerial risk-taking propensity and innovation

performance. Second, the inclusion of employees' perceived risk-taking climate in the analysis helps to explain this positive link: employees' perceived risk-taking climate acts as a mediating variable that boosts the positive effect (Grewal & Slotegraaf, 2007). The mediating effect of it on the relationship between managerial risk-taking propensity and innovation performance is demonstrated by the following sequence, suggested by Tippins & Sohi (2003): (1) the partial mediation model explains more of the variance of the dependent variable than the direct model ($R^2=0,487$ vs. $R^2=0,324$); (2) there is a positive relationship between managerial risk-taking and employees' perceived risk-taking climate; (3) there is a positive relationship between employees' perceived risk-taking climate and innovation performance; and (4) the significant relationship between managerial risk-taking and innovation performance indicated in the direct effect model becomes lower in the partial mediation model. Statements (1)–(4) provide compelling evidence of a clear mediating effect of employees' perceived risk-taking climate on the relationship between managerial risk-taking and innovation performance. Thus, the partial mediation model represents a significant contribution to our understanding of the positive influence—supported by the theory and previous empirical research—of managerial risk-taking on innovation performance. The positive impact of managerial risk-taking propensity on innovation performance is mediated by the firm's employees' perceived risk-taking climate. These results provide support for our research hypothesis.

6. Discussion

The attitude of managers towards risk taking has received considerable attention within the literature. In part the significance of risk taking is due to its noteworthy effects on innovation performance. Generally, managers characterized by risk taking behavior do not constrain their actions by the unpredictable consequences of innovation decisions. When deciding whether to allocate resources or to direct processes towards the development of new products and processes, risk taking prone managers are more willing to do so. This idea chimes with prior empirical studies analyzing the relationship between managerial risk taking and innovative results (e.g. Ling et al., 2008).

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However, these studies have focused on the direct link between managerial risk and innovation, even though there are reasons to believe that they do not fully capture the complexness involved in this relationship. Studies anchored in organizational climate literature have suggested that organizations where risk taking is encouraged can influence employees' behaviors towards innovation, thus, benefiting the organizations overall innovation performance (Gilson & Shalley, 2004; Yuan & Woodman, 2010). Thus, this paper takes this literature into consideration and ultimately shows the relationship between managers' risk-taking propensity, organizational climate and innovation.

First, the present research provides empirical evidence that managerial risk taking is positively related to employee's perceived risk taking climate. In the development of our theoretical framework we considered social cognitive and signaling theory as two theories that explain the mechanisms through which risk taking can be transmitted from upper to lower echelons. While the former, expects that individuals learn vicariously, the latter assumes information asymmetry and expects managers to consciously emit signals to employees. Though based in distinct assumptions, both theories support the relevance of manager's role in generating a climate where risk-taking is supported.

Second, this study also provides empirical evidence that employee's perceived risk taking climate enhances innovation performance. Scholars dealing with organizational climate have paid attention to the distinct dimensions integrating this concept, such as innovation climate. For instance, King et al. (2007) showed that a climate for innovation exerted a positive effect on organizational performance. However, even though some studies have theoretically reasoned that risk taking climate can affect innovative behavior and outcomes (Ekvall, 1996; Yuan & Woodman, 2010) empirical tests analyzing the relationship between risk-taking climate and innovation performance are surprisingly still lacking.

Third, we show that manager's risk taking propensity has an indirect positive effect on firm's innovation performance, which is mediated by risk-taking climate. Hence, risk-taking climate plays a pivotal role in ultimately explaining the effect of manager's tendency towards risk on innovation outputs. Companies counting with managers that are able to

translate their risk taking propensity towards the rest of employees within the organization are able to perform better in contrast to those firms that fail.

In brief, this study shows that the role of employees' risk taking climate is determinant in mediating the relationship of manager's risk taking and innovation performance. On the one hand, the results of this study contribute to upper echelon and other leadership behavior theories by demonstrating that the effect of manager's risk taking on innovation is not direct but it is rather mediated by a relevant contextual factor: risk-taking climate. On the other hand, this study contributes to the literature of organizational climate. In this case, we empirically validate that risk-taking climate has a significant effect on innovation performance.

Managerial implications

This study has implications for practitioners. Risk has been continuously described as an essential ingredient if willing to achieve innovation. However, the acknowledgement by managers of risk relevance is not sufficient to achieve organizational innovation. Managers should be able to translate their proactiveness towards risk to other employees creating a creative and biased climate with potential to generate innovative behaviors. In this sense, this paper underlines the relevance of supporting risk-taking climates and its effects on innovation performance.

Moreover, this investigation is particularly relevant for solving the problem many organizations face in relation to manager's turnover. Organizations relying in key managers for relevant decisions happen to enter in uncertainty in the case of their departure. For instance, consider a manager characterized for its affinity towards decisions involving high risks. If this input is significant for the pursuit of the organizations innovation results it would be a great lose if the manager exits the firm. That is why it would be in the interest of the company to arouse risk taking behavior among the rest of the. In particular, firms in the ceramic tile industry are many times family owned, being especially vulnerable to this situation (Fernández-Mesa et al. 2012).

Limitations and further research

Limitations need to be necessarily taken into account. One of the study's main limitations makes reference to the nature of the data, collected in one moment in time. This type of research, understood as cross-sectional, presents inconveniences when data changes over time. However, our aim is perform future longitudinal studies in order to evaluate possible variations in time and solve endogeneity problems.

Another important limitation is that the study has been pursued within the boundaries of an industry: the ceramic tile industry. This means that the extrapolation of results to other sectors should be performed with extreme foresight. Additional research in other industries will be definitely advisable. Moreover, the ceramic tile industry is characterized by mostly integrating small and medium firms. In this case, managers have a major degree of discretion over innovation outcomes. However, future research could focus on large enterprises, in which manager's influence on innovation is usually lower and the creation of a risk climate could have greater implications.

The use of self-reported innovation performance can also be considered as a limitation (Venkatraman, 1989). It would be very interesting to collect additional objective dependent measures to avoid possible biases and add robustness to our results. Moreover, pursuing qualitative research could also improve our research by providing a deeper understanding of the object of study (Chiva & Alegre, 2009).

Lastly, it would be interesting to open further the black box. Decentralization in decision making has been advanced as a managerial practice that empowers employees and leaves them more room to reach novel and disruptive ideas entailing higher degrees of risk (Jansen et al., 2006). Also, dynamic environments have been described as pushing firms towards the generation of innovations because of the heightened possibility of product obsolescence (Sidhu, Volberda & Commandeur, 2004). Hence, further research could benefit from analyzing in depth the contingent effect of these practices in the relationship between manager's risk taking propensity, risk-taking climate and innovation performance.

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References

- Aleviev, A.S., Jansen, J.J.P., Van den Bosch, F.A.J. and Volberda, H.W. (2010). “Top Management Team Advice Seeking and Exploratory Innovation: The Moderating Role of TMT Heterogeneity”, *Journal of Management Studies*, 47(7): 1343-1364.
- Amabile, T. M, Barsade, S. G., Mueller, J. S., & Staw, B. M. (2005). Affect and creativity at work. *Administrative Science Quarterly*, 50(3): 367–403.
- Amabile, T.M., Conti, R., Coon, H., Lazenby, J. and Herron, M. (1996). “Assessing the work environment for creativity”, *Academy of Management Journal*, 39(5):1154-1184.
- Ambrose, M. L., Arnaud, A., & Schminke, M. (2007). “Individual Moral Development and Ethical Climate: The Influence of Person–Organization Fit on Job Attitudes”. *Journal of Business Ethics*, 77(3): 323-333.
- Anderson, J.C. and Gerbing, D.W. (1988). “Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach”, *Psychological bulletin*, 103(3): 411-423.
- Anderson, N. R., & West, M. A. (1998). “Measuring climate for work group innovation: development and validation of the team climate inventory”. *Journal of Organizational Behavior*, 19(3): 235-258.
- Ashkanasy, N. M., Wilderom, C., & Peterson, M. (2000). *Handbook of Organizational Culture and Climate*.
- Bandura, A.. (1986). *Social Foundations of Thought and Action: A Social Cognitive Theory* (1st ed.). Prentice Hall.

ORGANIZATIONAL INNOVATION WORKSHOP

- Bandura, A. (2001). "Social cognitive theory: an agentic perspective". *Annual Review of Psychology*, 52: 1-26.
- Bantel, K. and Jackson, S.E. (1989). "Top management and innovations in banking: Does the demography of the top team make a difference?", *Strategic Management Journal*, 10: 107-124.
- Bou-Llusar, J.C., Escrig-Tena, A.B., Roca-Puig, V. and Beltrán-Martin, I. (2009). "An empirical assessment of the EFQM Excellence Model: Evaluation as a TQM framework relative to the MBNQA Model", *Journal of Operations Management*, 27(1): 1-22.
- Brown, S.L. and Eisenhardt, K.M. (1995). 'Product development: past research, present findings, and future directions,' *Academy of Management Review*, 20: 343-378.
- Chamber of Commerce of Valencia (2004). "Informe de la nueva economía global y su incidencia en los sectores tradicionales de la Comunidad Valenciana". Valencia: Chamber of Commerce of Valencia.
- Chiesa, V. Coughlan, P. and Voss, C.A. (1996). 'Development of a technological innovation audit,' *R&D Management*, 13, 105-136.
- Chiva, C. and Alegre, J. (2009). "Investment in Design and Firm Performance: The Mediating Role of Design Management". *Journal of Product Innovation Management*, 26:424-440.
- Cohen, B. D., & Dean, T. J. (2005). "Information asymmetry and investor valuation of IPOs: top management team legitimacy as a capital market signal". *Strategic Management Journal*, 26(7): 683-690.
- Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2011). "Signaling Theory: A Review and Assessment". *Journal of Management*, 37(1): 39-67.
- Coombs, R., Narandren, P. and Richards, A. (1996). "A literature-based innovation output indicator", *Research Policy*, 25(3): 403-413.
- Covin, J. G., and Slevin, D. P. (1986). The development and testing of an organizational-level entrepreneurship scale. *Frontiers of Entrepreneurship Research*. MA: Wellesley.

ORGANIZATIONAL INNOVATION WORKSHOP

- Daellenbach, U.S., McCarthy, A.M., Schoenecker, T.S. (1999). "Commitment to innovation: the impact of top management team characteristics", *R&D Management*, 29 (3): 199-208.
- Damanpour, F. (1991). "Organizational innovation: a meta-analysis of effects of determinants and moderators". *Academy of Management Journal*, 34(3): 555-590.
- Damanpour, F. and Gopalakrishnan, G. (2001). "The Dynamics of the Adoption of Product and Process Innovations in Organizations". *Journal of Management Studies*, 38(1): 45-65.
- Denison, D. R. (1996). "What is the Difference between Organizational Culture and Organizational Climate? A Native's Point of View on a Decade of Paradigm Wars. *Academy of Management Review*", 21(3): 619-654.
- Ehrhart, M. G. (2004). "Leadership and Procedural Justice Climate as Antecedents of Unit-level Organizational Citizenship Behavior". *Personnel Psychology*, 57(1): 61-94.
- Elenkov, D.S, Judge, W., Wright, P. (2005). "Strategic leadership and executive innovation influence: an international multi-cluster comparative study". *Strategic Management Journal*, 26: 665-682.
- Ekvall, G. (1996). "Organizational climate for creativity and innovation". *European Journal of Work and Organizational Psychology*, 5(1): 105-123.
- Enright, M.J. and Tenti, P. (1990). "How the diamond works: The Italian ceramic tile industry". *Harvard Business Review*, 68: 90-91.
- Finkelstein, S. (1992). "Power in top management teams: dimensions, measurement, and validation". *Academy of Management Journal*, 35 (3): 505-538.
- Fernández-Mesa, A., Alegre-Vidal, J. and Chiva-Gómez, R. (2012). "Orientación emprendedora, capacidad de aprendizaje organizativo y desempeño innovador". *Journal of Technology Management and Innovation*, 7(2): 157-170.

ORGANIZATIONAL INNOVATION WORKSHOP

- Fornell, C. and Larcker, D. (1981). "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error," *Journal of Marketing Research*, 18: 39-50.
- Gatignon, H., Tushman, M.L., Smith, W. and Anderson, P. (2002). "A structural approach to assessing innovation: Construct development of innovation locus, type, and characteristics", *Management Science*, 48(9): 1103-1122.
- Gerbing, D.W. and Anderson, J.C. (1988). "An Updated Paradigm for Scale Development Incorporating Uni", *Journal of Marketing Research*, 25(2): 186-192.
- Gilson, L. L., and Shalley, C. E. (2004). "A Little Creativity Goes a Long Way: An Examination of Teams' Engagement in Creative Processes". *Journal of Management*, 30(4): 453 -470.
- Grewal, Rajdeep and Rebecca J. Slotegraaf (2007), "Embeddedness of Organizational Capabilities," *Decision Sciences*, 38: 451-488.
- Grojean, M. W., Resick, C. J., Dickson, M. W., & Smith, D. B. (2004). "Leaders, Values, and Organizational Climate: Examining Leadership Strategies for Establishing an Organizational Climate Regarding Ethics". *Journal of Business Ethics*, 55(3): 223-241.
- Hervas-Oliver, J.L.; Jackson, I. and Tomlinson, P.R. (2011). "May the ovens never grow cold: regional resilience and industrial policy in the North Staffordshire ceramic industrial district – with lessons from Sassuolo and Castellon". *Policy Studies*, 32(4): 377-395.
- House, R. J., & Shamir, B. (1993). Toward the integration of transformational, charismatic, and visionary theories. En M. M. Chemers & R. Ayman (Eds.), *Leadership theory and research: Perspectives and directions*: 81-107. San Diego, CA, US: Academic Press.
- Isaksen, S.G., Lauer, K.J. and Ekvall, G. (1999), "Situational outlook questionnaire: a measure of the climate for creativity and change", *Psychological Reports*, 85: 665-674.
- James, L. R., & McIntyre, M. D. (1996). *Perceptions of organizational climate. Individual differences and behavior in organizations*. San Francisco: Jossey-Bass.

ORGANIZATIONAL INNOVATION WORKSHOP

Jansen, J., Van den Bosch, F.A.J. and Volberda, H.W. (2006). "Exploratory innovation, exploitative innovation, and performance: effects of organizational antecedents and environmental moderators". *Management Science*, 52 (11), 1661-1674.

Janssen, O. (2003). Innovative behaviour and job involvement at the price of conflict and less satisfactory relations with co-workers. *Journal of Occupational and Organizational Psychology*, 76(3): 347–364.

Jelinek, M. (2003). "Making sense of strategic change: a problem of learning and levels". In *Multi-Level Issues in Organizational Behavior and Strategy (Research in Multi Level Issues, Volume 2)*, Ed. Emerald Group Publishing Limited, pp. 373 – 390.

King, E.B.K., Chermont, K.D., West, M., Dawson, J.F., Hebl, M.R. (2007). "How innovation can alleviate negative consequences of demanding work contexts: The influence of climate for innovation on organizational outcomes". *Journal of Occupational and Organizational Psychology*, 80(4): 631-645.

Klein, K. J., & Knight, A. P. (2005). Innovation Implementation Overcoming the Challenge. *Current Directions in Psychological Science*, 14(5): 243-246.

Kuenzi, M., & Schminke, M. (2009). "Assembling Fragments Into a Lens: A Review, Critique, and Proposed Research Agenda for the Organizational Work Climate Literature". *Journal of Management*, 35(3): 634 -717.

Ling, Y., Simsek, Z., Lubatkin, M., and Veiga, J. (2008). "Transformational leadership's role in promoting corporate entrepreneurship: examining the CEO-TMT interface". *Academy of Management Journal*, 21 (3): 557-576.

Liu, K., Li, J., Hesterly, W., and Cannella, A. (2012). "Top management team tenure and technological inventions at post-IPO biotechnology firms". *Journal of Business Research*, 65: 1349–1356.

Lumpkin, G. T., and Dess, G.G. (1996). "Clarifying the Entrepreneurial Orientation Construct and Linking It to Performance". *Academy of Management Review*, 21(1): 135-172.

ORGANIZATIONAL INNOVATION WORKSHOP

- Lyon, D.W., Lumpkin, G.T. and Dess, G.G. (2000). "Enhancing entrepreneurial orientation research: Operationalizing and measuring a key strategic decision making process". *Journal of Management*, 26(5), 1055–1085.
- Madsen, E.L. (2007). "The significance of sustained entrepreneurial orientation on performance of firms – A longitudinal analysis". *Entrepreneurship and Regional Development*, 19(1): 185-204.
- March, J.G. (1987). "Learning to be risk adverse". *Psychological Review*, 103(2): 309-319.
- Martínez-Ros, E. and Labeaga, J.M. (2009). "Product and process innovation: Persistence and complementarities". *European Management Review*, 6:64-75.
- March, J. G., & Shapira, Z. (1987). "Managerial perspectives on risk and risk taking". *Management science*, 33(11): 1404–1418.
- McKay, P. F., Avery, D. R., & Morris, M. A. (2008). "Mean Racial-ethnic Differences in Employee Sales Performance: The Moderating Role of Diversity Climate". *Personnel Psychology*, 61(2): 349-374.
- Meyer-Stamer, J., Maggi, C. and Seibel, S. (2004). "Upgrading the tile industry of Italy, Spain, and Brazil: Insights from cluster and value chain analysis". In *Local Enterprises in the Global Economy*, Ed. Schmitz, H., Edward Elgar.
- Myers, S. and Marquis, D.G. (1969). "Successful industrial innovations: a study of factors underlying innovation in selected firms". Washington: National Science Foundation.
- Naldi, L., Nordqvist, M., Sjöberg, K., & Wiklund, J. (2007). "Entrepreneurial orientation, Risk taking, and performance in family firms". *Family Business Review*, 20, 33–48.
- Naumann, S. E., & Bennett, N. (2000). "A Case for Procedural Justice Climate: Development and Test of a Multilevel Model". *Academy of Management Journal*, 43(5): 881-889.
- Nelson, R.R. (1991). "Why do firms differ, and how does it matter?" *Strategic*

ORGANIZATIONAL INNOVATION WORKSHOP

Management Journal, 12 (S2): 61–74.

Nelson, R. R., & Winter, S. G. (1985). *An Evolutionary Theory of Economic Change*. Belknap Press of Harvard University Press.

OECD (2005). *The measurement of scientific and technological activities. Proposed guidelines for collecting and interpreting technological data*. Paris: OECD.

Papadakis, V.M., Lioukas, S. and Chambers, D. (1998). “Strategic decision-making process: the role of management and context”. *Strategic Management Journal*, 19(2): 115-147.

Peterson, R.S., Smith, D.B., Martorana, P.V. and Owens, P.D. (2003). “The impact of chief executive officer personality on top management team dynamics: one mechanism by which leadership affects organizational performance”. *Journal of Applied Psychology*, 88(5): 795-808.

Pirola-Merlo, A., & Mann, L. (2004). “The relationship between individual creativity and team creativity: aggregating across people and time”. *Journal of Organizational Behavior*, 25(2): 235-257.

Podsakoff, P.M., MacKenzie, S.B., Lee, J. and Podsakoff, N.P. (2003). “Common method biases in behavioral research: A critical review of the literature and recommended remedies”, *Journal of Applied Psychology*, 88(5): 879-903.

Podsakoff, P.M. and Organ, D.W. (1986). “Self-Reports in Organizational Research: Problems and Prospects”, *Journal of Management*, 12(4): 531-544.

Redmond, M. R., Mumford, M. D., & Teach, R. (1993). “Putting Creativity to Work: Effects of Leader Behavior on Subordinate Creativity”. *Organizational Behavior and Human Decision Processes*, 55(1): 120-151.

Santarelli, E. and Piergiovanni, R. (1996). “Analysing literature-based output indicators: the Italian experience”. *Research Policy*, 25: 689-711.

Schneider, B. (1975). *Organizational Climates: An Essay*. *Personnel Psychology*, 28(4): 447-479.

ORGANIZATIONAL INNOVATION WORKSHOP

Schneider, B., & Reichers, A. E. (1983). On the Etiology of Climates. *Personnel Psychology*, 36(1): 19-39.

Schneider, B., Smith, D. B., & Sipe, W. P. (2000). Personnel selection psychology: Multilevel considerations. Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions. 91-120. San Francisco, CA, US: Jossey-Bass.

Sidhu, J.S., Volberda, H.R. and Commandeur, H.W. (2004). "Exploring Exploration Orientation and its Determinants: Some Empirical Evidence". *Journal of Management Studies*, 41(6): 913-932.

Sidhu, J.S., Commandeur, H.W. and Volberda, H.R. (2007) . "The Multifaceted Nature of Exploration and Exploitation: Value of Supply, Demand, and Spatial Search for Innovation". *Organization Science*, 18(1): 20-38.

Sitkin, S. B., & Pablo, A. L. (1992). "Reconceptualizing the Determinants of Risk Behavior". *Academy of Management Review*, 17(1): 9-38.

Sitkin, S. and Weingardt, L.R. (1995). "Determinants of risky decision-making behaviour: A test of the mediating role of risk perceptions and propensity". *Academy of Management Journal*, 38: 1573-1592.

Spector, P.E. (1992). "Summated rating scale construction: an introduction". Sage University. California.

Spence, M. (1973). "Job Market Signaling". *The Quarterly Journal of Economics*, 87(3): 355-374.

Stevens, G.A. and Burley, J. (1997). "3,000 raw ideas = 1 commercial success!". *Research Technology Management*, 40(3): 16-27.

Teece, D., Pisano, G. and Shuen, A. (1997). "Dynamic capabilities and strategic management". *Strategic Management Journal*, 18 (7): 509-533.

Tippins M.J., and Sohi, R.S. (2003). IT competency and firm performance: is organizational learning a missing link? *Strategic Management Journal*, 24: 745-761.

ORGANIZATIONAL INNOVATION WORKSHOP

Utterback, J.M. and Abernathy, W.J. (1975). "A dynamic model of process and product innovation". *Omega*, 3(6): 639-656.

Vaccaro, I.G., Jansen, J.J.P., Van den Bosch, F.A.J. and Volberda, H.W. (2010). "Management Innovation and Leadership: The Moderating Role of Organizational Size". *Journal of Management Studies*, 49(1): 28-51.

Vega-Jurado, J., Gutiérrez-Gracia, A. and Fernández-de-Lucio, I. (2008). "Analyzing the determinants of firm's absorptive capacity: beyond R&D". *R&D Management*, 38 (4): 392-405.

Venkatraman, N. (1989). "Strategic Orientation of Business Enterprises: The Construct, Dimensionality, and Measurement". *Management Science*, 35(8): 942-62.

Vroom, V. H. (1964). *Work and motivation*. Oxford, England: Wiley.

Williams, L.J., Gavin, M.B. and Hartman, N.S. (2004). "Structural equation modeling methods in strategy research: Applications and issues". In Ketchen, D.J. Jr and Bergh; D.D. (Eds.) *Research Methodology in Strategy and Management*, Vol. 1, pp. 303-46. Oxford: Elsevier.

Woodman, R. W., Sawyer, J. E., & Griffin, R. W. (1993). Toward a Theory of Organizational Creativity. *Academy of Management Review*, 18(2): 293.

Wu,S., Levitas, E. and Priem, R.L. (2005). "CEO Tenure and Company Invention under Differing Levels of Technological Dynamism". *Academy of Management Journal*, 48 (5): 859-873.

Yuan, F., and Woodman, R. W. (2010). "Innovative Behavior in the Workplace: The Role of Performance and Image Outcome Expectations". *Academy of Management Journal*, 53(2): 323-342.

Zahra, S.A. and Covin, J.G. (1995). "Contextual influences on the corporate entrepreneurship-performance relationship: A longitudinal analysis". *Journal of Business Venturing*, 10,43-58.

ORGANIZATIONAL INNOVATION WORKSHOP

Zhou, J., & George, J. M. (2001). "When job dissatisfaction leads to creativity: encouraging the expression of voice". *Academy of Management Journal*, 44(4): 682-696.

ORGANIZATIONAL INNOVATION: LEARNING THROUGH INTER-FIRM NETWORKS

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Abstract

This study untangles the impact on firm's innovation output of inter-firm knowledge interactions regarding network exchanges of managerial (organizational and administrative) knowledge. Specifically, we address how population-level mechanisms of exchange link with organizational-level mechanisms of implementation that lead to the adoption of innovations. The research questions serve to advance understanding of implementation of organizational innovation activities by means of participating in flows of managerial knowledge between firms under contractual relationships and in the absence of formal relationships. The study analyzes data from a complete network of 50 high-technology firms located in a science and technology park. The findings from this social network analysis show that the firms in the study actively engage in the sharing of organizational knowledge. Specifically, the results indicate the positive relationship between firm participation in networks of managerial knowledge and firm's innovation output. Participation in inter-firm knowledge networks appears to be an effective tool for obtaining organizational knowledge as well as for enhancing innovation outcomes.

Keywords: Antecedents of organizational innovation; managerial knowledge; knowledge acquisition; inter-firm networks; social network analysis

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1. Introduction

By participating in knowledge networks, firms are exposed, acquire and share knowledge relevant to their business. Through these knowledge interactions firms introduce different kinds of innovations (Tödtling et al., 2009). One of such forms of knowledge being shared is managerial (organizational or administrative) knowledge. This type of knowledge is critical for organizational learning and innovation (Uzzi & Lancaster 2003). Yet, to this date literature in organization has not analyzed specifically its role in fostering innovation in organizational systems, structures, and practices. Most research on innovation has been traditionally linked to the acquisition and deployment of knowledge related to new technologies, products or services and focused on large, manufacturing firms and, not until recently, have scholars explored non-technological sources of knowledge (Sammarra & Biggiero, 2008) and their relevance on non-technological innovation outcomes in entrepreneurial, high-tech activities (Hipp and Grupp, 2005).

This lack of research on the topic may be explained, in part, because of the recent interest on aspects related to organizational innovation, conceptualized as *the introduction of a new management practice, process, structure, or technique into the organization that tends to improve the effectiveness or performance of the adopting organization* (Birkinshaw et al., 2008; Birkinshaw and Mol, 2006; Damanpour, 1991). Research has yet begun to uncover the antecedents, nature, and direction of organizational innovation dynamics. Despite substantial recent progress, it is evident that the relationship between managerial knowledge and organizational innovation is a complex, multifactorial process and that many important questions remain unanswered. Specifically: By what means do firms obtain

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managerial knowledge? How does its acquisition relate to organizational innovation outcomes?

This research intends to assess the relationship between the acquisition of managerial knowledge by means of firm participation in knowledge networks and firm innovation outcomes in the form of implementing organizational innovation initiatives. We intend to contribute to the innovation and social networks fields. Recently, this stream of research has developed a new line of inquiry, applying social network theory and analytical tools to the investigation of inter-firm knowledge flows and innovation decision-making, activities, and outcomes (Martin-Rios, 2012; Sammarra & Biggiero, 2008). We expect that firms taking part in both formal and informal knowledge networks will obtain higher knowledge returns in aspects related to management issues, which in turn will have a positive impact on the firm's ability to organizationally innovate.

We then adopt the social network perspective to analyze empirically how these factors favor inter-firm management knowledge sharing. Furthermore, we look into the relationship between managerial knowledge acquisition and implementation of innovative organizational initiatives by means of a survey questionnaire on organizational innovation practices. This analysis is especially relevant for the successful management of knowledge flows, particularly with respect to the levels of collaboration that are required for independent firms to actually exchange management knowledge with each other and the expected positive impact of such exchanges on further implementation of organizational innovations.

The organization of this paper is as follows. The first section discusses the conceptual background for inter-firm knowledge networks and provides the analytical framework to be tested in this study. Next is an explanation of the social network research methods, followed by a report detailing the setting in which data on inter-firm knowledge were collected. The results section tests hypotheses regarding the consequences for firms of participating in collaborative inter-firm knowledge networks in terms of both knowledge acquisition and implementation of innovations. I collected complete network data from high-tech firms located in a science and technology park managed by a public university. These data set the stage for general observations on the managerial knowledge exchange dynamics between firms and firms' innovative activity. The final section provides concluding remarks and lines of future inquiry.

2. Literature Review

To date, few researchers have delved specifically into inter-firm flow of managerial knowledge and consistent research aimed at elucidating the effect on innovation outcomes for firms taking part in networks where management knowledge sharing may take place is still lacking (Martin-Rios, 2013). The paper's conceptual model addresses the transactional (formal) and embedded (collaborative) components of management knowledge sharing (see Figure 1). This model proposes that managerial knowledge flows across organizational boundaries for various reasons. It identifies potentially positive consequences for firms that participate in inter-firm managerial knowledge networks. Our study suggests that by participating in knowledge networks, firms try to satisfy certain knowledge needs related to their business activity, which in turn drive their organizational innovative initiatives.



Figure 1 Theoretical model

We propose that acquiring organizational knowledge is essential for organizational innovation initiatives to happen. One way firms can reap the required knowledge is by establishing relationships with other firms. The nature of those relationships can be either formal (i.e., contract mediated) or informal (i.e., collaborative, non-contract mediated). Collaborative interactions may lead to opportunities of multiple knowledge exchanges (Oliver, 2004). Thus, collaborative dynamics are associated with the establishment of interactive ties that potentially foster knowledge exchange, and specifically organizational knowledge. Therefore, this paper proposes that firms are more likely to engage in exchanging organizational knowledge with those firms with whom they have formal ties, as in the case of commercial agreements, and collaborative agreements. Accordingly,

H1. Ceteris paribus, the existence of formal agreements between independent firms is positively associated with managerial knowledge exchange and acquisition.

H2. Ceteris paribus, the level of collaborative interaction among independent firms is positively associated with managerial knowledge exchange and acquisition.

Organizational innovation (also labeled managerial, management, or administrative) is an important source of innovation with potential impact on the success of firms. By its very nature, this is the less discrete, more intangible, and organization-specific part of processes innovation (Damanpour, 1991). Its relevance is revealed in the growing amount of research on the subject (Mol & Birkinshaw, 2006; Vaccaro et al., 2012; Armbruster et al., 2008). Scholars contend that implementing organizational innovations is difficult as it questions existing practices and processes, as well as ingrained assumptions on the way things are (Birkinshaw et al., 2008). For this reason it is important to identify the way firms obtain knowledge about new organizational aspects, which in turn, may result in innovation initiatives (Sammorra & Biggiero, 2008). Accordingly,

H3. Firms that obtained managerial knowledge via participation in formal or informal knowledge networks are more likely to implement management innovation activities.

3. Methods

The relational nature of the research questions under study determines this paper's focus on social network data. In this study, network data aims to capture the actual inter-organizational dynamics of HRM knowledge flows. Social networks have proven to be a powerful tool for understanding social dynamics and social structures tied to one or more types of interdependency. A network consists of a set of nodes (individuals, groups, organizations) with links representing specific types of relationships between them (Wellman, 1983). Links between pairs of nodes may represent a wide range of connections with one or multiple objectives (e.g., information acquisition and knowledge exchange).

Social network analysis studies either *whole networks* (also known as *complete networks*) or *personal networks* (also known as *egocentric networks*). While the former of these refers to all ties that contain specific relations within a defined population, the latter indicates any ties that an agent may have—such as "personal communities". One of the main challenges when studying networks is to adequately specify their boundaries (Gulati, 1995). For the purposes of this study, I chose a complete network of firms, and the network I selected was not based solely on formal contractual relations (e.g., strategic alliances or subcontracting relationships). Rather, the focus is on a network based on multiple ties and a common affiliation within a technological community.

4. Research Setting

Science and technology clusters or “parks” emerged in the US in the 1950s in an attempt to increase the productivity of high-tech firms. The assumption behind this attempt was that the physical proximity or territorial agglomeration of firms, public administrations, R&D centers, and universities would provide potential benefits for firms. Following their success in the US, clusters spread to Europe in the 1960s and 1970s (e.g., Cambridge in the UK, Sophia-Antipolis in France, or Medicon Valley in Denmark-Sweden), and to Southern Asia in the 1980s and 1990s (e.g., A*START in Singapore). The science and technology park selected for this research is located in the metropolitan area of Madrid, Spain. Established in the year 2000 by a public university in conjunction with local, regional and national public agencies, the Park serves as a good example of a university park. It not only acts as a business incubator, but has also provided both institutional support for high-tech start-ups and basic services for long-established firms. Overall, the park comprises 38 firms, including start-ups, established firms, and branches of multinational firms, 12

university spin-offs and developing business ventures, and six R&D centers including publicly funded research institutes, university funded research institutes and R&D consortiums between firms and the university.

5. Data Collection

We drew up a questionnaire to map knowledge flow among those people responsible for maintaining relationships with other firms. Assessment of implementation of innovative initiatives was performed with a second questionnaire. By administering two different questionnaires at two different points of time, we avoid response bias. We relied on accepted instrument development guidelines for the social network survey instrument (in particular Wasserman & Faust 1994). Surveys included a complete list of all firms in the Park (a total of 50). This roster method facilitates individuals' recall of typical patterns of interaction and has shown itself to be reliable. We asked each participating firm to mention the organizations with which they had exchanged information during the last year, what was important to them, and how. Relationships within the actual network between actors (firms) i , j and k can be transactional (based all or in part, on a formal agreement) or embedded (relational ties embedded in social attachments) (Friedman & Podolny, 1992; Uzzi & Lancaster, 2003).

We attempted to call each CEO in the sample by phone so that every organization had a 100% probability of being sampled. After explaining the overall aim of the study, we asked to interview and collect social network data from the most knowledgeable informant (Kumar et al., 1993) who could best assess the type of knowledge diffused and how. In several cases, the CEO referred us to another senior manager who was either formally or informally responsible for managing the firm's day-to-day relationships with other firms. In

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order to secure this sensitive information, the survey efforts required sponsorship and support from both the regulatory agent and firms located in the park. This survey procedure successfully ensured contact with all of the firms in the park, including spin-offs and consolidated firms.

Fieldwork lasted eight weeks and a total of 41 firms responded to the social network questionnaire, which represents a response rate of 82%. The remaining 9 firms either refused to participate after several telephone calls or could not be contacted. Since the study reports on the dyadic level, respondent firms were asked to report knowledge exchanges with any of the 50 firms of the whole population (by means of census, rather than by sample). Knowledge exchanges can be asymmetric; a firm may report exchanging knowledge with another firm that may not answer the survey. We chose to focus on the knowledge seeker's perception—the non-missing value (when A answered that exchanged with B although B did not mention A). This was based on the assumption that knowledge exchanges between firms may involve several actors from each firm; so not every instance respondent may recall or be aware of certain exchange instances. The 2,450 ties (50x49) between these firms constitute the network data for the analyses. The firms have existed for an average of 17 years. Ninety per cent are small to medium-sized enterprises (SMEs), while 10 per cent are large enterprises with more than 200 employees and sales exceeding 15 million euros. Twenty-seven of the interviewed firms (74.3%) are in high-technology services, and thirteen (25.7%) are in high- or medium-high technology manufacturing industries.

Dependent Variables

Management innovation: Respondents were asked to indicate the extent to which their firms had been actively involved in any of the following innovation initiatives, as defined from previous research (Armbruster et al., 2008; Birkinshaw et al., 2008; Vaccaro et al., 2012):

- High performance work systems, which includes innovation initiatives in the following human resource practices: mission and corporate values, performance management systems, employee voice, training and development, intranet (employee portal), compensation and rewards, and career and promotion systems.
- Leadership and social responsibility initiatives.
- Business model innovation.
- Reorganization of work processes and structures (e.g. from hierarchical to flat, team-based structure).

The management innovation level of each firm was calculated by taking the average of the 4 items. The management innovation scale is assumed to measure the innovation effort in management or organizational initiatives. Cronbach's coefficient Alpha of this scale was 0.717. Because we used QAP regression analysis, which requires a square matrix, each firm in an implementation level was assigned the value of the group, so a 50x50 matrix was formed. We used this matrix as the dependent variable in the MRQAP analysis. It represents firms' level of implementation of management innovation initiatives between their own group and each external group.

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Organizational knowledge: To investigate the patterns of managerial knowledge exchange in inter-firm networks, we asked each respondent to indicate “among firms included in the roster, those with whom your firm has shared information on management, organizational or administrative practices and processes in the previous six months”. Examples of the type of managerial knowledge included the following:

- Project management
- Total quality management
- Human resource management
- Finance and budgeting management
- Innovation management
- Production management

A “roster” question format was used. Respondents had to select their answers from a list containing all 50 firms in the Park. There was no constraint on the maximum number of selections that each respondent could make. We then input these data in matrix format to create an *inter-firm organizational knowledge sharing matrix*.

Independent Variables

Formal agreement. The firms had to indicate the extent to which they had formal agreements with other firms in the Park. These agreements could include commercial contracts, co-production, joint contracts or technology exchange agreements; the relationship thus had to be characterized by some formal agreement and to hold some specified right over the result of cooperation (Grandori & Soda, 1995). We then input these data in matrix format to create a formal agreement matrix.

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Collaborative Interaction. The firms had to indicate the frequency of inter-firm collaboration with which they exchanged managerial-related knowledge with other firms in the Park. We then entered these data in matrix format to form a collaboration matrix.

Control Variables

Industry: We based the control variables on innovation and inter-firm literature (Mol et al., 2007; Sammarra & Biggiero, 2008), which assumes that similarity between firms increases the probability of establishing ties, engaging in certain exchanges of knowledge, and resulting in innovative outputs. We controlled for the possibility that firms in the same industry may engage in more collaborative ties and more exchange of managerial knowledge than firms in other industries. We split *Industry* into two big groups: first into high-technology services (Industry 1) and secondly, into firms in high-to-medium-high technology manufacturing (Industry 2). Then, we operationalized *Industry* creating a 50x50 matrix, coding each firm as “1” if both organizations in the dyad were in the same industry and “0” if they were in different industries.

Internationalization: Since several firms in the sample were international from start-up, they may be inclined to use partners to overcome obstacles to internationalization. We used internationalization to assess the extent to which firms engage in informal sharing of managerial knowledge. As in the case of Industry, we created a 50x50 matrix, coding each firm to be a “1” if both organizations in the dyad were operating internationally and “0” if they were operating in different markets.

6. Analysis and Hypothesis Testing

We then processed the network data using the UCINET software package (Borgatti et al., 2002). To test the hypotheses statistically we used network regression, specifically the quadratic assignment procedure (QAP) multiple regression technique. This approach permits an analysis of relational data (in sociomatrices) and the results of this analysis can be interpreted in a similar way to the results of ordinary multiple regression. Network data do not satisfy assumptions of statistical inference, because relational data are systematically interdependent and autocorrelation is an inherent problem in this data; therefore, classical regression techniques, like ordinary least square, are not appropriate here. MRQAP provides a better alternative, as it allows direct comparison of matrix-level data and corrects the autocorrelation problem (Krackhardt 1987) and has been applied extensively in previous social network research. QAP is a nonparametric statistical algorithm that regresses a dependent matrix on one or several independent matrices. This algorithm first performs a standard multiple regression across corresponding cells of the dependent and independent matrices. Then it randomly permutes rows and columns of the dependent matrix and recomputes the regression. The algorithm then repeats the permutation regression process a high number of times (in this case, 12,000 times) to estimate the standard error for the statistics of interests. This procedure determines whether the association between two matrices is a random occurrence and helps adjust for the autocorrelation problem.

7. Results

As an introduction to the results, Table 1 shows the matrix of correlations among all of the variables in the model. Correlations with the managerial knowledge sharing involving

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the control variables are virtually nonexistent. Also, several independent variables are correlated with the dependent variable, but within acceptable limits in social networks for their inclusion in a regression model (see for example, Borgatti & Cross, 2003).

Table 1 QAP Correlation Matrix

Variable	mean	s.d	1	2	3	4	5	6
1 Organizational innovation	1.62	.64						
2 Industry (hi-tech services)	.28	.45	.022					
3 Industry (hi-tech manuf.)	.06	.24	.027	-.158*				
4 Internationalization	.26	.44	.052	-.137*	.121			
5 Formal agreement	.03	.18	.316**	-.003	-.028	-.005		
6 Collaborative interaction	.16	.51	.336**	.026	-.013	.010	.404*	
7 Managerial knowledge	.22	.89	.382**	-.050	.023	.063*	.359*	.408*

* $p \leq .05$

** $p \leq .01$

We then tested hypotheses 1 to 3 by conducting a Multiple Regression QAP (MRQAP) analysis. The coefficients presented in the table are standardized regression coefficients. In Model 1 we only entered the three control variables. The results in Table 2 show that, all alone, the controls have no direct effect on managerial knowledge acquisition. With reference to Model 2, the existence of previous formal agreements between firms ($\beta = 0.102$; $p < .001$) significantly affects managerial knowledge acquisition after controlling for

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industry and internationalization. Hence, we find full support for hypothesis 1. Furthermore, Model 3 suggests that informal collaborative interactions ($\beta = 0.064$; $p < .001$) are related to managerial knowledge acquisition after controlling for industry and internationalization. These results provide full support for hypothesis 2. The amount of variance explained in Model 4 (39 percent of the variance) indicates that formal and embedded dimensions explain a substantial portion of the variance in the probability of inter-firm flow of managerial knowledge.

Table 2 Results of Quadratic Assignment Procedure Regression Analysis for Predicting Managerial Knowledge Acquisition

Predictors	H1: Partnershi p		H2 Relation al		Complete model
	Model 1	Model 2	Model 3	Model 4	Model 4
Control Variables					
Industry (serv)	.015	.021	.009	.014	.014
Industry (man)	.021	.015	.008	.005	.005
International	.022	.015	.007	.004	.004
Network Variables					
Formal agreement		.325**			.167**
Collaborative interaction			.554**		.502**
<i>P</i>	.167	.000	.000	.000	.000
<i>N</i>	2450	2450	2450	2450	2450
<i>Adjusted R²</i>	.003	.108	.309	.334	.334

* $p \leq .05$

** $p \leq .01$

Next, we examined the relationship between managerial knowledge acquisition and organizational innovation implementation (see Table 3). Model 6 reveals that the standardized regression coefficients of managerial knowledge acquisition are significant. The amount of variance explained in Model 6 (33.4 percent of the variance) indicates that managerial knowledge exchanges explain a substantial portion of the variance in the probability of implementation of innovative initiatives in organizational aspects.

Table 3 Results of Quadratic Assignment Procedure Regression Analysis for Predicting Implementation of Organizational Innovations

Predictors	H3: Organization al innovation	
	Model 5	Model 6
Control Variables		
Industry (serv)	-.007	.003
Industry (man)	-.001	-.006
International	.022	.008
Network Variables		
Managerial knowledge		.105**
<i>P</i>	.000	.000
<i>N</i>	2450	2450
<i>Adjusted R²</i>	.064	.338

* $p \leq .05$

** $p \leq .01$

8. Conclusion

This study aims to disentangle the effect of inter-firm knowledge flow in innovation outcomes related to organizational innovation. We argue that two key properties of inter-firm networks – formal agreements and social embeddedness – play important roles in acquiring organizational knowledge, which is essential for organizational innovation activities to happen. As summary of hypotheses testing for inter-firm managerial knowledge sharing, all our hypotheses are fully supported. They mainly depict how strategic and embedded dimensions, which are relational and instrumental, provide insights into factors determining inter-firm knowledge sharing and implementation of organizational innovation initiatives.

9. References

- Armbruster, H., Bikfalvi, A., Kinkel, S., Luy, G. 2008. Organizational innovation: The challenge of measuring non-technical innovation in large-scale surveys. *Technovation* 28, 644-657.
- Birkinshaw, J., Hamel, G., Mol, M.J. 2008. Management innovation. *Academy of Management Review* 33, 825-945.
- Birkinshaw, J., Mol, M. J. 2006. How management innovation happens. *MIT Sloan Management Review*, 47: 81-88.
- Borgatti S, Cross R. 2003. A relational view of information seeking and learning in social networks. *Management Science*, 49: 432-445.
- Borgatti, S.P., Everet, M., Freeman, L., 2002. UCINET for Windows: Software for social network analysis. Analytic Technologies, Harvard.
- Damanpour, F. 1991. Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 555-590.

ORGANIZATIONAL INNOVATION WORKSHOP

- Doeringer, P., Lorenz, E., Terkla, D. (2003). The adoption and diffusion of high-performance management: Lessons from Japanese multinationals in the West. *Cambridge Journal of Economics*, 27: 265-286.
- Gulati, R., 1995. Social structure and alliance formation patterns: A longitudinal analysis. *Administrative Science Quarterly* 40: 619-652.
- Hipp, C. Grupp, H. 2005. Innovation in the service sector: the demand for service-specific innovation measurement concepts and typologies. *Research Policy*, 34: 517-535.
- Krackhardt D. 1987. QAP partialling as a test of spuriousness. *Social Networks*, 9: 171-186
- Martin-Rios, C., 2012. Why do firms seek to share human resource management knowledge? The importance of inter-firm networks. *Journal of Business Research*, <http://dx.doi.org/10.1016/j.jbusres.2012.10.004>
- Martin-Rios, C. 2013. Determining the nature of knowledge flows in informal inter-firm networks Working Paper in Social Science Research Network.
- Oliver A.L. 2004. On the duality of competition and collaboration: Network-based knowledge relations in the biotechnology industry. *Scandinavian Journal of Management*, 20: 151–171
- Parker, H. 2012. *Knowledge acquisition and leakage in inter-firm relationships involving new technology-based firms. Management Decision*, 50: 1618-1633.
- Sammarra, A., Biggiero, L., 2008. Heterogeneity and specificity of inter-firm knowledge flows in innovation networks. *Journal of Management Studies*, 45: 800-829.
- Tödtling, F., Lehner, P., Kaufmann, A. 2009. Do different types of innovation rely on specific kinds of knowledge interactions? *Technovation*, 29: 59-71
- Uzzi B., Lancaster, R. 2003. The role of relationships in interfirm knowledge transfer and learning: The case of corporate debt markets. *Management Science* 49: 383–399.

ORGANIZATIONAL INNOVATION WORKSHOP

Westphal, J., Gulati, R., Shortell, S. 1997. Customization or conformity? An institutional and network perspective on the content and consequences of TQM adoption. *Administrative Science Quarterly*, 366-394.

Wasserman, S., Faust, K., 1994. *Social Network Analysis: Methods and Applications*. Cambridge University Press, New York.

DRIVERS OF ORGANIZATIONAL INNOVATIONS

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Abstract

There is a solid consensus in the need to improve innovation in organizations. Despite the fact that there has been significant improvement, inefficiency still exists and little accomplished in understanding how to overcome those inefficiencies using innovation. Present research focuses on organizational innovations closely related to knowledge management. According to Oslo Manual, organizational innovations may involve the implementation of significant changes in practices for knowledge management. More precisely we analyze organizational innovations' objectives and adoption. Analysis is based on a sample of 10796 Spanish businesses. Measures of organizational innovations and objectives of innovation are based on Oslo Manual. Statistical tests find a dynamic behavior in organizations, since 41.5% have developed an organizational innovation in 2007-2009 period. New organizational methods in business practices are adopted by 34,3% of companies. Main objectives pursued are related to increasing quality of products and reducing response time to customers or providers needs. Results reveal a close relationship between objectives and organizational adoption, improving innovation skills is the most influential organizational innovation objective.

Keywords: business practices, external relation, knowledge management, organizational innovation, workplace organization

1. Introduction

Within advanced economies, production and consumption have shifted away from mere physical objects towards information and services, turning the services sector into a key driver in the creation of competitiveness, employment and economic growth. Innovation is an important contributor to productivity and economic performance for service firms and in recent years, scholarship on innovation has started to cover services under its research scope (Rubalcaba, Gallego & Hertog, 2010). Value is now created by productivity and innovation, and knowledge has become the most valuable resource (Hwang, Chang, Chen and Wu, 2008).

An organizational innovation is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations (OECD, 2005). Organizational innovation is a critical output for companies [4], a source of value creation (Hwang et al., 2008) and an indicator for the intrafirm diffusion of different organizational practices (Armbruster et al., 2008). Enterprises may engage in innovation activity for a number of reasons, namely, to increase a firm's performance by reducing administrative costs or transaction costs, improving workplace satisfaction (and thus labor productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies. Identifying enterprises' motives for innovating and their importance is helpful when examining the forces that drive innovation activity, such as competition and opportunities for entering new markets (OECD, 2005).

We develop a model to understand the reasons and objectives for implementing different types of organizational innovations. The present paper aims at predicting the adoption of organizational innovations by analyzing the impact of diverse drivers. The remaining manuscript is structured as follows. Next, salient literature on organizational innovation and the determinants of adopting them is reviewed. In the third section, the method to collect data from 10.796 Spanish organizations is explained. After presenting the data analyses used, the results are discussed. The overall canonical correlation analysis provided an overview of the relationship between the goals variables and the process innovation variables. Finally, conclusions are summarized and managerial implications are presented

2. Literature Review

Organizational Innovation

According to Oslo Manual (OECD, 2005), 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. This broad definition of an innovation encompasses a wide range of possible innovations. Past research has argued that different types of innovation are necessary for understanding and identifying in organizations (Liao & Wu, 2010). However, in practice, most innovative organizational concepts address different types of innovations at the same time (Armsbruster et al., 2008).

An organizational innovation is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations (OECD, 2005). Literature states that organizational innovation is a critical output for companies (Liao & Wu, 2010), a source of value creation (Hwang et al., 2008) and an indicator for the intrafirm diffusion of different organizational practices (Armbuster et al., 2008). The distinguishing features of an organizational innovation compared to other organizational changes in a firm is the implementation of an organizational method (in business practices, workplace organization or external relations) that has not been used before in the firm and is the result of strategic decisions taken by management.

Distinguishing between process and organizational innovations is challenging sometimes since both types of innovation attempt – among other things – to decrease costs through new and more efficient concepts of production, delivery and internal organization. Many innovations thus contain aspects of both types of innovation. For example, the introduction of new processes may also involve the first use of new organizational methods such as group working (OECD, 2005). A starting point for distinguishing process and/or organizational innovations is the type of activity: process innovations deal mainly with the implementation of new equipment, software and specific techniques or procedures, while organizational innovations deal primarily with people and the organization of work, thus being often called structural organizational innovations. They consist of changing

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responsibilities, accountability, command lines and information flows as well as the number of hierarchical levels or the divisional structure of functions.

Organizational innovation can be further differentiated along an intra-organizational and inter-organizational dimension. While intra-organizational innovations occur within an organization (such as implementation of teamwork, quality circles, continuous improvement processes or the certification of a company under ISO 9000, thus affecting departments and functions within the company), inter-organizational innovations include new organizational structures or procedures beyond a company's boundaries (Armsburster et al., 2008), like new organizational structures in an organization's environment (suppliers, customers, or competitors). Following OECD (2005) definition of organizational innovation, the focus here is on the implementation of a new organizational method in the firm's business practices, workplace organization or external relations. Therefore, we analyze intra-organizational innovations as well as the inter-organizational dimension.

Innovation Objectives

Enterprises may engage in innovation activity for a number of reasons, which should be identified via its economic objectives (Guan et al., 2009). Their objectives may relate to products, markets, efficiency, quality or the ability to learn and to implement changes (OECD, 2005). How the firm rates a number of goals that innovation (in its diverse versions) can bring within its reach relates to all its innovation activities, and should therefore be measured (Guan et al., 2009). Organizational innovations can be intended to increase a firm's performance by reducing administrative costs or transaction costs, improving workplace satisfaction (and thus labor productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies. Identifying enterprises' motives for innovating and their importance is helpful when examining the forces that drive innovation activity, such as competition and opportunities for entering new markets (OECD, 2005).

Literature on innovation objectives suggests that different types of firms may have different primary innovation objectives (Yang & Hsiao, 2009; Leiponen & Helfat, 2010)

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due to variations in innovation patterns and the operating environment. Specifically, Guan et al. (2009) shows significant differences in the importance of innovation objectives based on status (high-tech companies versus general), ownership (State-owned enterprises (SOEs) versus non- SOEs), resources for innovation (has R&D department versus no R&D department) and size (SMEs versus large enterprises). As literature often distinguishes between product and process innovation, Leiponen & Helfat (2010) recently state that firms also are likely to have specific objectives for each type of innovations. For instance, process innovation objectives include goals such as reduction of labor costs, use of materials and use of energy, as well as improved manufacturing flexibility, while product innovation objectives are to replace outdated products, improve product quality, expand product assortment and enter new markets or increase market share (Leiponen & Helfat, 2010).

Together with quality and cost, other innovation objectives have been proposed by extant literature. Examples of them include shortened response time, improved innovation skills and enhanced knowledge sharing. Kotabe & Murray (1990) suggested that both product and also process innovations, as sources of long-term competitive advantage, aim to shorten innovational lead time. Companies need not only turn their attention to improving efficiency and productivity, but also to develop innovation mechanisms to stimulate knowledge creation, sharing, and integration (Albers & Brewer, 2003). This means that innovation activities aim to enhance knowledge sharing thus considering the latter as an innovation objective.

Since the maintenance, acquisition and evolution of an enterprise's capabilities depend on its innovation objectives and the resultant innovation strategy (Burgelman et al., 2001), innovation objectives may determine innovation activities and performance. For instance, Wang and Chien (2006) present a forecasting model for predicting innovation performance using technical informational resources (such as external seminar resource, external nonprofit resource, company resource and patent disclosers) and clear innovation objectives (such as improve production flexibility, reduce costs and consumption, or open up new market).

An understanding of the factors that drive companies to become IT innovators (Leidner et al., 2010) or innovators in general, remains an important phenomenon of interest. We focus on enablers of organizational innovations related to knowledge management implemented by organizations. To date, few studies have been, however, devoted to understanding the drivers for the adoption of organizational innovations.

To understand the relationship between innovation objectives and innovation adoption we investigate two major questions:

1. What organizational innovation objectives do organizations pursue?
2. What innovation objectives influence the different types of organizational innovation adopted?

Figure 1 shows the research model:

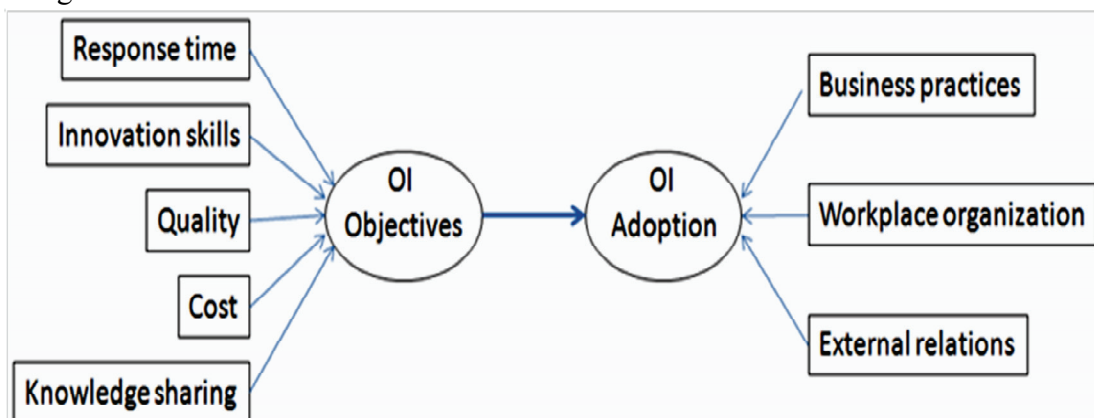


Fig.1. Research Model

3. Methodology

Data and Variables

Our dataset comes from the Innovation in Companies Survey for 2009 conducted by the Spanish National Statistics Institute which aims at providing information on the structure of the innovation process and showing the relationships between the aforementioned process and companies' technological strategy, the factors influencing their capability to innovate and the economic performance of companies. This survey follows the methodological guidelines defined in Oslo Manual by OECD (2005) having a mandatory nature.

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Questionnaires are sent via ordinary mail to a selected and representative sample of companies in terms of size and activity. There is a deadline of 15 days to fulfill the survey and each company is required to provide true information. Answer rate rises to 91.8% and there is no information of respondents' position. The survey inspectors are responsible for the theoretical and practical training of the personnel involved in same, and for the control of the work relating to the collection of the information. An integrated information collection procedure is carried out, which consists in the filtering and recording of the data as soon as the information is received. If required, the necessary clarifications are requested from the company with respect to the data provided. Questions concern innovation activity for 2007-2009 period. For this research a sample of 10796 companies from different sectors (Table I) and a minimum size of 10 employees has been extracted.

Next a description of variables included in the analysis is given.

TABLE I

ACTIVITY SECTOR

Sector	n
Agriculture, forestry and fishing	137
Mining and quarrying	57
Manufacturing	5488
Electricity, gas, steam and air conditioning supply	76
Water supply; sewerage, waste management and remediation activities	92
Construction	448
Wholesale and retail trade	860
Transportation and storage	240
Accommodation and food service activities	189
Information and communication	929
Financial and insurance activities	229
Real estate activities	60
Professional, scientific and technical activities	1059
Administrative and support service activities	471
Education	54

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Organizational innovations. Adoption of organizational innovations is measured with binary variables (0=no, 1=yes). Three types have been considered according to Oslo Manual (OECD, 2005).

- Organizational innovations in business practices involve the implementation of new methods for organizing routines and procedures for the conduct of work. These include, for example, the implementation of new practices to improve learning and knowledge sharing within the firm.
- Innovations in workplace organization involve the implementation of new methods for distributing responsibilities and decision making among employees for the division of work within and between firm activities (and organizational units), as well as new concepts for the structuring of activities, such as the integration of different business activities.
- New organizational methods in a firm's external relations involve the implementation of new ways of organizing relations with other firms or public institutions, such as the establishment of new types of collaborations with research organizations or customers, new methods of integration with suppliers, and the outsourcing or subcontracting for the first time of business activities in production, procuring, distribution, recruiting and ancillary services

During 2007-2009, 41.5% of companies have implemented a new organizational method (Table II). Most common organizational innovation is on business practices (34.3%) followed by workplace organization (32.9%). Table III shows information of the distribution of companies according to types of organizational innovations adopted. Only 29.6% adopt one organizational innovation, the most common practice is adopting a combination of them, especially on innovation in external relations whereas 94.1% of cases are in this situation and just 5.9% of firms adopting that innovation made it alone.

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TABLE II

ORGANIZATIONAL INNOVATIONS ADOPTION

Organizational Innovation	Yes
Business practices (OI1)	34.3%
Workplace organization (OI2)	32.9%
External Relations (OI3)	15.4%
Any	41.5%

TABLE III

COMBINATIONS OF ORGANIZATIONAL INNOVATIONS ADOPTION

Organizational Innovation	Yes
OI1	15.5%
OI2	11.9%
OI3	2.2%
OI1 + OI3	3.0%
OI2 + OI3	3.3%
OI1 + OI2	35.4%
OI1 + OI2 + OI3	28.7%

Organizational innovations objectives. Items based on a Likert scale from 1 to 4 following Oslo Manual [3] recommendations.

- Reduced time to respond to customer or provider needs (Response time)
- Improve skills to develop new products or processes (Innovation skills)
- Increase quality of goods and services (Quality)
- Reduce unit labor costs (Cost)
- Improve information or communication sharing inside your firm or with other organizations or institutions (Knowledge sharing).

Information related to objectives pursued by companies adopting any organizational innovation is shown in Table IV. Main objective is improving quality (3.32) followed by

reducing response time (3.27).

Correlations among variables in this research are highly correlated especially organizational innovations among them.

TABLE IV

IMPORTANCE OF THE OBJECTIVES OF ORGANIZATIONAL INNOVATIONS ADOPTED DURING 2007-2009

Objectives	Mean (1 to 4)
Response time	3.27
Innovation skills	3.09
Quality	3.32
Cost	2.96
Knowledge sharing	3.11

4. Analyses

This work pursues analyzing relationship between a set of independent variables (Organizational Innovations Objectives) and a set of dependent variables (Organizational Innovations Adoption) (Figure 1). Canonical analysis is a multivariate statistical technique for studying the interrelationships among sets of multiple dependent or criterion variables and multiple independent or predictor variables [11]. By so doing, it is likely to control for moderator effects that may exist among various dependent variables.

A between subject multivariate analysis of variance was performed on the set of variables that constitute the Objectives construct, which was the independent variable, and Adoption construct, which was the dependent or criterion variable. The maximum number of canonical correlations (functions) between these sets of variables is the number of variables in the smaller set (Green et al., 1966). In our study, there were five predictor variables and three criterion variables. Therefore, the number of canonical functions extracted from the analysis is three, the smallest set.

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In order to provide further knowledge concerning the influence of objectives on each organizational innovation a logit regression analysis is performed. In Model I includes control variables (size and age), independent variables are added in Model II. Since the dependent variable is dichotomous, a binary logit model is developed for each organizational innovation. Logit regression tests whether coefficients are non-zero; significant and positive coefficients imply adoption facilitators, while significant and negative coefficients imply inhibitors. However, note that 'the parameters of the logit model, like those of any nonlinear regression model, are not necessarily the marginal effects we are accustomed to analyzing' (Green et al., 1966). Actually, the marginal effect - incremental change of the adoption probability due to unit increase of the regressor – is informed by the Odds-ratio ($\text{Exp}(\beta)$).

Goodness-of-fit is assessed in three ways. First, a likelihood ratio (LR) test, analogous to the F-test in multiple linear regressions, was conducted to examine the joint explanation power of independent variables. Second, the Hosmer - Lemeshow test was used to compare the proposed model with a perfect model that can classify respondents into their respective groups correctly, by comparing fitted expected values to the actual values. Third, Nagelkerke's pseudo- R^2 is calculated to measure the proportion of data variation explained (Nagelkerke, 1991). The logit model was also assessed in terms of the discriminating power. Based on the observation-prediction table, the rate of correct prediction by the logit model and by random guess may be computed. If the former is greater, we conclude that the logit model has a better discriminating power.

5. Results

Following the guidelines suggested by Hair et al. (1998), we tested the significance of the canonical functions and the overall model fit. The overall multivariate test of significance showed that the canonical functions were statistically significant. Wilks' Lambda test is significant ($F=37.190$, $p=0.000$). Table V shows the overall model fit. Three canonical functions were obtained and all of them were significant. The canonical R^2 values support this conclusion. In the first canonical function, the independent variables explain over 9.4 per cent of the variance in the dependent variables. The second canonical function explains

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1.9 per cent, and the third one explains 0.5 per cent.

The relative importance of a variable in each set of variables is indicated by the canonical weight and the canonical loading extracted for the variable. The canonical weight indicates how much a variable in the predictor or criterion set contributes to the canonical function. Variables whose weights are larger contribute more to the function. The canonical loading measures the simple linear correlation between an original observed variable in the predictor or criterion set and the set's linear composite and is interpreted like a factor loading (Hair et al. 1998). Table VI shows canonical coefficients and loadings for each variable. Given the .0.3 cut-off rule (Hair et al. 1998), it is reasonable to conclude that first and second functions are more relevant. The first function reveals a high correlation among all organizational innovations (Business practices, Workplace organization and External relations) and every organizational objective especially improving innovation skills. Companies especially worried about improving skills to develop new products or processes have implemented organizational innovations. The second function underlines some particularities of innovation in workplace organization, companies adopting this innovation are more concerned in reducing costs and less on innovation skills. The third function reveals differences in objectives between business practices and external relations. Improving information or communication sharing is more relevant in the latter and increasing quality in the former.

TABLE VI

STANDARD CANONICAL COEFFICIENTS AND CANONICAL LOADINGS

Variables	Canonical loading			Canonical weight		
	F1	F2	F3	F1	F2	F3
OI Adoption						
Business practices	0.53	0.49	-0.69	0.56	0.39	-0.73
Workplace organization	0.64	-0.76	0.08	0.63	-0.79	-0.08
External Relations	0.61	0.41	0.68	0.50	0.49	0.73
OI Objectives						
Response time	0.67	-0.37	-0.32	0.26	-0.57	-0.37
Innovation skills	0.79	0.43	0.055	0.49	0.64	0.29
Quality	0.61	0.32	-0.52	0.17	0.54	-0.61
Cost	0.64	-0.50	-0.15	0.30	-0.68	0.00
Knowledge sharing	0.49	-0.08	0.68	0.28	-0.06	0.80

Logistic regressions (Table VII to IX) confirm and specify aforementioned relationships. Improving skills to innovate in product or process is a significant predictor in every organizational innovation. New methods in workplace organization is the function with a better fit, except quality the rest of innovation objectives are relevant being the only organizational innovation where response time and cost are significant predictors. Main difference between external relations and business practices is in the importance of the role of knowledge sharing to adopt new organizational methods in external relations. Concerning the control variables only size is a significant predictor. Smaller firms are more likely to adopt new organizational methods in business practices and external relations.

TABLE VII

Logistic regression: Business Practices						
	Model I			Model II		
	β	Exp(β)		β	Exp(β)	
Constant	0.632	1.882		-0.401	0.670	
Size	-0.375	0.687	***	-0.465	0.628	** *
Age	0.001	1.001		0.000	1.000	
Response time				0.067	1.069	
Innovation skills				0.333	1.395	** *
Quality				0.260	1.297	** *
Cost				0.004	1.004	
Knowledge sharing				0.005	1.005	
<i>Chi-squared</i>		16.731	***		163.903	** *
Δ <i>Chi-squared</i>					147.173	** *
<i>likelihood ratio (LR)</i>		4119.214			3972.041	
<i>Hosmer-Lemeshow</i>		7.730			6.815	
<i>R² Nagelkerke</i>		6%			6%	
<i>% correct model</i>		82.6%			82.6%	
<i>% correct random</i>		71.3%			71.3%	

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TABLE VIII

Logistic regression: Workplace organization				
	Model I		Model II	
	β	Exp(β)	β	Exp(β)
Constant	7.198	1337.09	3.779	43.764
Size	-0.054	0.948	-0.090	.914
Age	-0.003	0.997	-0.002	.998
Response time			0.281	1.324 **
Innovation skills			0.095	1.099 *
Quality			-0.071	.931
Cost			0.322	1.380 ** *
Knowledge sharing			0.185	1.203 ** *
<i>Chi-squared</i>		4.037		214.872 ** *
Δ <i>Chi-squared</i>				210.872 ** *
<i>likelihood ratio (LR)</i>		4563.726		4352.854
<i>Hosmer-Lemeshow</i>		8.863		6.345
<i>R² Nagelkerke</i>		0.1%		7.3%
<i>% correct model</i>		79.3%		79.5%
<i>% correct random</i>		67.2%		67.2%

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TABLE IX

Logistic regression: External Relations				
	Model I		Model II	
	β	Exp(β)	β	Exp(β)
Constant	-1.327	0.265	-2.768	0.063
Size	-0.177	0.838 **	-0.235	.790 ***
Age	0.000	1.000	0.000	1.000
Response time			0.003	1.003
Innovation skills			0.370	1.448 ***
Quality			0.092	1.097 **
Cost			0.037	1.037
Knowledge sharing			0.219	1.245 ***
<i>Chi-squared</i>		6.470 **		198.816 ***
Δ <i>Chi-squared</i>				192.346 ***
<i>likelihood ratio (LR)</i>		5905.716		5713.370
<i>Hosmer-Lemeshow</i>		25.832 ***		0.950
<i>R² Nagelkerke</i>		0.2%		5.9%
<i>% correct model</i>		62.8%		63.4%
<i>% correct random</i>		53.3%		53.3%

6. Discussion and conclusions

Present study proposes two questions concerning the knowledge about situation and reasons to adopt organizational innovations. Based on recommendations of Oslo Manual (2005), empirical analysis brings information related to those topics from a representative sample of 10796 Spanish companies. 41.5% of them have accomplished any organizational innovation during 2007-2009 period. Most common organizational innovation is on business practices (34.3%) followed by workplace organization (32.9%). Only 29.6% adopt one organizational innovation, the most common practice is

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adopting a combination of them, especially on innovation in external relations whereas 94.1% of cases are in this situation and just 5.9% of firms adopting that innovation made it alone.

Correlation analysis confirms the influence of organizational innovation objectives on organizational innovations adoptions. Nevertheless, this research goes further identifying more precisely relations between innovations and objectives. Although increasing quality is the more important objective to innovate results reveal other objectives to be more influential. Specifically, improving innovation skills appear as the more relevant objective, i.e. companies especially worried about improving skills to develop new products or processes have implemented organizational innovations. Two objectives are closely related to innovations in workplace organization, they are reducing response time and cost. Precisely these objectives may be labeled as tangibles. Thus, organizational innovations in workplace organization are featured by tangible objectives. Improving innovation skills and knowledge sharing are more intangible objectives. They are pursued also by workplace organization innovations, but are main predictors in external relations innovations. So, this organizational innovation is due to intangible objectives. The adoption of new business practices (the most common one) is mainly explained by innovation skills and quality.

This study sheds light on the actual innovation behavior by identifying the true contribution of organizational innovations objectives. Enterprises are stated to engage in innovation activity for a number of reasons (Guan et al., 2009; OECD, 2005). Extant literature on innovation objectives suggests that different types of firms may have different primary innovation objectives (Burgelman et al., 2001; Wang & Chien, 2006; Yang & Hsiao, 2009). Results presented here provide evidence regarding what innovation objectives pursue and what innovation objectives influence the different types of innovation adopted. Desires to improve innovation skills and knowledge sharing are capital objectives to develop new organizational methods in business practices, workplace organization and external relations. These results show a greater influence of intangible capabilities (innovation and knowledge sharing) on adopting organizational innovations than more tangible results (cost, time and quality). That finding highlights the importance of knowledge management (KM) in a firm's

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innovating profile. Organizational interest in KM is stimulated by the possibility of resultant benefits, such as increased creativity and innovation in products and services (Darroch, 2005). That is why innovation is seen as the area of greatest payoff from KM (Majchrzak et al., 2004). Indeed, the definition of organizational innovations provided in the Oslo Manual (2005) considers the introduction of new KM systems as a form of organizational innovations (Armbruster et al., 2008). Prior research has shown that KM is an important mechanism for companies to be more innovative (López-Nicolás & Meroño-Cerdán, 2011), no matter the specific type of organizational innovations. These results would help organizations to understand the role of a clear business model based on an effective organizational configuration closely related to knowledge in successful product and process innovations.

Finally, this study has some obvious limitations, which will be addressed in future research. First, although we used survey data, we did not have directly developed the questionnaire. Second, this research was conducted using a sample of Spanish firms. In this sense, findings may be extrapolated to other countries, since economic and technological development in Spain is similar to other OECD member countries. However, in future research, a sampling frame that combines firms from different countries could be used in order to provide a more international perspective on the subject. Finally, it would be interesting to see in a future study whether differences in organizational innovation objectives and adoption exist between different sectors, for instance manufacturing or service companies or low-tech versus high-tech firms by conducting a post hoc analysis and comparing different groups of organizations

REFERENCES

- Albers, J.A. & Brewer, S. (2003). Knowledge management and the innovation process: The eco-innovation model. *Journal of Knowledge Management Practice*, 4(3).1-10.
- Armbruster, H., Bikfalvi, A., Kinkel, S., & Lay, G. (2008). Organizational innovation: The challenge of measuring non-technical innovation in large-scale surveys. *Technovation*, 28(10), 644–657.
- Burgelman, R., Maidique, M.A., & Wheelwright, S.C. (2001). *Strategic Management of Technology and Innovation*. McGraw-Hill, New York.

***ORGANIZATIONAL INNOVATION AND ITS ANTECEDENTS, PERFORMANCE
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- Darroch, J. (2005). Knowledge management, innovation and firm performance. *Journal of Knowledge Management*, 9(3), 101–115.
- Green. W. (2000). *Econometric Analysis*, Prentice-Hall, Upper Saddle River, NJ
- Guan, J., Yam, R., Tang, E., & Lau, A. (2009). Innovation strategy and performance during economic transition: Evidences in Beijing, China. *Research Policy*, 38(5), 802–812.
- Hair, J., Anderson, R., Tatham, R., & Black, W. (2006). *Multivariate Data Analysis*, 6th Prentice-Hall, Upper Saddle River, NJ.
- Hwang, H.G., Chang, I., Chen, F., & Wu, S. (2008). Investigation of the application of KMS for diseases classifications: A study in a Taiwanese hospital. *Expert Systems with Applications*, 34(1), 725–733.
- Kotabe, M. & Murray, J. (1990). Linking Product and Process Innovations and Modes of International Sourcing in Global Competition: A Case of Foreign Multinational Firms. *Journal of International Business Studies*, 21(3), 383-408.
- Leidner, D., Preston, D., & Chen, D. (2010). An examination of the antecedents and consequences of organizational IT innovation in hospitals. *Journal of Strategic Information Systems*, 19(3), 154–170.
- Leiponen, S. & Helfat, C.E. (2010). Innovation objectives, knowledge sources, and he benefits of breadth. *Strategic Management Journal*. 31(2), 224–236.
- Liao, S., & Wu, C. (2010). System perspective of knowledge management, organizational learning, and organizational innovation. *Expert Systems with Applications*, 37(2), 1096–1103.
- López-Nicolás, C., & Meroño-Cerdán, A.L. (2011). Strategic knowledge management, innovation and performance. *International Journal of Information Management*, 31(6), 502–509.
- Majchrzak, A., Cooper, L.P., & Neece, O.E. (2004). Knowledge reuse for innovation. *Management Science*, 50(2), 174–188.
- Nagelkerke, N. (1991). A note on a general definition of the coefficient of determination, *Biometrika* 78(3), 691-693.
- OECD/Statistical Office of the European Communities, Luxembourg (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, 3rd Edition, The Measurement of Scientific and Technological Activities, OECD Publishing
- Rubalcaba, L., Gallego, J., & Hertog, P. (2010). The case of market and system failures in services innovation. *Service Industries Journal*, 30 (4), 549-566.
- Wang, T. & Chien, S. (2006). Forecasting innovation performance via neural networks—a case of Taiwanese manufacturing industry. *Technovation*, 26(5-6), 635–643.

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CONSEQUENCES AND TECHNOLOGICAL COMPLEMENTARITIES***

Yang, H. & Hsiao, S. (2009). Mechanisms of developing innovative IT-enabled services: A case study of Taiwanese healthcare service. *Technovation*, 29(5), 327–337.