European Journal of Innovation Management

Learning processes, their impact on innovation performance and the moderating role of radicalness

Miguel Hernandez-Espallardo Francisco-Jose Molina-Castillo Augusto Rodriguez-Orejuela

Learning processes, their impact on innovation performance and the moderating role of radicalness

Miguel Hernandez-Espallardo and Francisco-Jose Molina-Castillo
Departamento de Comercializacion e Investigacion de Mercados, Universidad de Murcia, Murcia, Spain, and
Augusto Rodriguez-Orejuela
Department of Management and Organizations, Universidad del Valle, Cali, Colombia

Abstract

Purpose – This study aims to extend the proposal of Holmqvist with regard to organisational processes of learning and their impact on firm performance.

Design/methodology/approach – Based on a survey of 187 firms, the paper shows that certain organisational processes of learning are related to innovation performance. Further, it investigates the moderating role of product radicalness on such relationships.

Findings – Based on a survey of 187 firms, the paper shows that certain organisational processes of learning are related to innovation performance. Further, it investigates the moderating role of product radicalness on such relationships and proves that the other two types of organisational learning processes are not related to innovation performance.

Originality/value – The innovation performance of collaboration between firms has not received a great deal of attention in the literature. This research paper offers some guidelines on how to obtain great advantages from this collaboration.

Keywords Learning processes, Innovation performance, Collaboration, Radicalness, Workplace training

Paper type Research paper

1. Introduction

The successful development of innovations is a critical factor in the survival and growth of companies (Schmidt *et al.*, 2009). Consequently, scholars as well as practitioners have an interest in development strategies and the way they affect the success or failure of innovations (Henard and Szymanski, 2001). The persistently high rate of innovation failures (Stevens and Burley, 2003), forces companies to continually search for the most effective ways to develop such innovations (Astebro and Michela, 2005). As a result, the study of factors that affect the success of product development (Cooper and Kleinschmidt, 1996) has been expanded in recent times with studies about the impact of each factor on performance, both direct and moderated (Carbonell and Rodriguez, 2006; Voss *et al.*, 2008).

Among the wide variety of success factors investigated, a relevant stream of recent research has focused on the sources of organisational knowledge involved in the

The authors acknowledge the funding received from the Universidad del Valle (research project 8064-2007/VRI) and the Spanish Ministry of Science and Innovation (National Plan of R&D, project AGL2010-22335-C03-02).

European Journal of Innovation Management
Vol. 15 No. 1, 2012
pp. 77-98

1460-1060
DOI 10.1108/14601061211192843

development of innovations and, in particular, the mechanisms of learning and the processes involved in managing the knowledge used in developing innovations (Miller *et al.*, 2006). Authors such as Atuahene-Gima (2005) and Yalcinkaya *et al.* (2007) posit that the successful introduction of innovations into the market requires organisational learning to transform a company's key capacities. Similarly, Verona (1999) considers innovation to be a knowledge-intensive process and defends the central role played by the knowledge applied in innovation, whether it is developed internally or acquired through inter-company relationships.

An interesting contribution in this area comes from Holmqvist (2004) who describes the processes of experiential learning that support innovation with respect to two dimensions: the origin or learning level (intra or inter-organisational) and the mode of experiential learning (exploratory or exploitative). The combination of these dimensions gives rise to four different organisational processes of learning that can be used by a company to sustain innovation: intra-organisational exploration, intra-organisational exploitation, inter-organisational exploration and inter-organisational exploitation. For Holmqvist, the prevalence of any one of those processes over the others is a consequence of a company's satisfaction with past outcomes and with the results of the negotiation and learning of the courses of action required to change from one process to another. The author uses the case of one firm in the IT sector to confirm the existence of the four processes and the dynamics of changing between them. However, no consideration is given to how each type of organisational learning process influences the performance of innovations; to the best of our knowledge, there are no studies that investigate this question. Given this gap in knowledge, our first research question is the following: is there a relationship between each organisational process of learning applied to innovation and its performance?

As is the case for other innovation-success factors, the application of each of these learning processes to developing an innovation may have a different effect on its performance depending on other contextual factors, such as the type of innovation (Soosay and Hyland, 2008). In particular, product radicalness is one of the factors frequently studied in the literature on innovation (Kleinschmidt and Cooper, 1991) that might make one type of learning process more or less effective in influencing performance. There are a number of underlying reasons that make radicalness a good candidate as a moderating factor in the potential relationships we are investigating. Developing more radical innovations, as opposed to incremental ones, is typically more complicated for a company because of longer development cycles (Rindfleisch and Moorman, 2001), the need to expand capabilities (Danneels and Kleinschmidt, 2001) and/or the greater degree of uncertainty (Calantone *et al.*, 2006). In addition, organisational learning is more critical for radical innovations, as the company's employees may not have much experience in the relevant development activities, and the new product's manufacturing process may differ substantially from previous ones (Carbonell and Rodriguez, 2006). Therefore, our second research question is the following: is the relationship between organisational learning processes and innovations' performance moderated by the radicalness of the innovation?

This study is organized as follows. The research begins by presenting the theoretical background and hypotheses. Following, the research methods and approach used to test the hypotheses is described. It closes with a discussion of the implications of the findings.

2. Theoretical background

2.1 Exploitation versus exploration and levels of organisational learning

Organisational learning is experiential, and in the development of innovations, organisational knowledge changes as a result of experience (Cyert and March, 1992). Therefore, innovation processes, are accompanied by processes of organisational learning (Holmqvist, 2004). Holmqvist discusses four such organisational learning processes, categorised according to the mode of learning (exploitation versus exploration) and the learning level (intra-organisational versus inter-organisational). In exploitation, organisational learning consists of refining organisational capabilities and exploiting their existing knowledge to create reliability in experience; "it means productivity, refinement, routinization, production, and elaboration of existing experiences" (Holmqvist, 2003, p. 99). On the other side, in exploration, the learning process consists of engaging in a variety of experiences, experimentation, and risk-taking (Levinthal and March, 1993).

The capacity of businesses for innovation (Menguc and Auh, 2006), and whether that capacity should be based on competence exploitation or competence exploration, have received substantial attention in the literature (Atuahene-Gima, 2005; Kyriakopoulos and Moorman, 2004; Yalcinkaya *et al.*, 2007). Competence exploitation involves investing resources in refining and extending existing innovation knowledge, skills and processes, whereas competence exploration involves investing resources with the aim of acquiring entirely new knowledge, skills, and processes (March, 1991).

Scholars have proposed a variety of arguments for and against conceptualising competence exploitation versus competence exploration as an opposition. One line of research claims that the two types are contradictory in nature (Kyriakopoulos and Moorman, 2004). According to this view, because competence exploitation and competence exploration compete for scarce resources and rely on different organisational routines and capabilities (Benner and Tushman, 2003) organisations must make a trade-off between them. Moreover, the activities involved in both exploration and exploitation are self-reinforcing, creating "success traps", in which success at exploitation makes an organisation reluctant to explore new opportunities, or "failure traps", in which exploratory innovations that fail are replaced by new exploratory initiatives (March, 1991). Finally, because exploitation and exploration involve different routines and cognitive schema, there may be resistance to changing between them (Im and Rai, 2008).

However, both competence exploitation and exploration are important to a company's survival (Atuahene-Gima, 2005) at different organisational levels (Voss *et al.* 2008). Companies that focus on exploitation at the expense of exploration may be unable to adapt to environmental forces in the long term, whereas companies that focus on exploration at the expense of exploitation will be severely restricted in their ability to compete and survive under current, short-term market conditions (March, 1991).

The two strategies do not have to be incompatible. Research has shown how significant cash flows from exploitation-related activities provide financial assets that strengthen exploration-related activities, whereas exploration-related activities provide technological assets and capabilities to support the renewal of exploitation capacity (Garcia and Calantone, 2003). Moreover, several researchers, have recently suggested that previous findings regarding competence exploitation versus exploration may be

explained by the organisational learning processes that occur within and between companies (Bierly *et al.*, 2009; Hernandez-Espallardo *et al.*, 2011; Holmqvist, 2004). For instance, Hernandez-Espallardo *et al.* (2011) demonstrate that inter-organisational processes of learning favour the simultaneous implementation of both exploration- and exploitation-based innovation processes.

This leads to the second dimension by which an organisation's processes of knowledge acquisition may be categorised is their origin, i.e. whether they develop within a company or in the setting of inter-organisational relationships. Learning can happen as a consequence of processes within organisations – "for example, the learning that takes place when groups, departments, and teams share experiences and jointly learn exploitative organisational rules of refinement and explorative rules of experimenting and trialling" (Holmqvist, 2004). This is referred to as intra-organisational learning. In contrast, inter-organisational learning occurs when companies learn from other companies they have relationships with by "producing sets of inter-organisational experiential rules that are partly separate from the rules of each of its members. Thus, the inter-organisational collaboration is in itself stressed as a unique learning entity" (Holmqvist, 2003).

Therefore, four organisational processes of learning can be distinguished, namely:

(1) Intra-organisational exploitation.

(2) Intra-organisational exploration.

(3) Inter-organisational exploitation.

(4) Inter-organisational exploration.

Applying this conceptual framework to innovation projects, we define intra organisational exploitation as organisational processes developed during the course of an innovation project that involve applying pre-existing or slightly elaborated knowledge. Intra-organisational exploration involves the development and application of new and substantially different knowledge than what existed within a company prior to the commencement of the innovation project. Inter-organisational exploitation involves utilising knowledge from other entities with which the company maintains business relationships that simply refines the current knowledge base of the company. Finally, inter-organisational exploration involves using exploratory knowledge that proceeds from, or is developed in the setting of, its business relationships.

2.2 Innovation classification and the concept of radicalness

Although Holmqvist's (2004) proposal may help clarify the impact that organisational processes of knowledge can have on new-product performance, results regarding the effects of implementing any one of those four types of organisational process may not be conclusive and may depend on other related variables. For instance, Dougherty and Hardy (1996) state that innovation-to-organisation connections in such areas as resource availability, collaborative structures and processes, and the company's strategy, are vital to the success of sustained innovation; the radicalness of an innovation influences each of those factors (Day, 1994).

There is a wealth of literature on classifying innovations according to their degree of radicalness (Alexander *et al.*, 2008). The most-often-used typology has traditionally

been that developed by Booz, Allen, and Hamilton (1982). Their original matrix included six types of innovations:

(1) New-to-world products.
(2) Cost reduction products.
(3) Repositioning.
(4) Additions to existing product lines.
(5) Improvements to existing products.
(6) New product lines.

Other researchers using this typology (e.g. More, 1982) have reduced the matrix to four types, leaving out cost reductions and repositioning, which arguably are not innovations *per se*. Goldenberg *et al.* (2001) reduced the classification to three types, those with a low, medium, or high degree of newness to the market.

Regardless of the particular labels given to innovations, recent studies (Danneels and Kleinschmidt, 2001; Garcia and Calantone, 2002; Gatignon *et al.*, 2002) have argued that the traditional systems for delimiting innovations based on Booz, Allen, and Hamilton's (1982) typology needs better clarification with regard to perspective. Lee and O'Connor (2003) suggest that previous literature on defining innovations falls short in that it does not explicitly and completely characterise the every dimension of innovation. The in-depth review conducted by Garcia and Calantone (2002) has shed some light on this issue, demonstrating that the analysis of innovations has often been carried out incompletely. In addition, other researchers (Krishnan and Ulrich, 2001) contend that further investigation is needed to understand the distinctiveness of each innovation project. It is therefore essential that researchers specify clearly their approach to defining and measuring innovation to identify meaningful effects on new-product performance (Calantone *et al.*, 2006).

Since Booz, Allen, and Hamilton's (1982) proposal, many new ways to classify innovations have been put forward. A variety of definitions exist for what makes an innovation "really-new", focusing on chronological, technological, or psychological newness (Alexander *et al.*, 2008). Scholars and practitioners alike have used such labels as "innovative"/"noninnovative" (Kleinschmidt and Cooper, 1991), "discontinuous"/"continuous" (Lynn *et al.*, 1996; Veryzer, 1998), "evolutionary"/"revolutionary" (Yoon and Lilien, 1985), "really new"/"breakthrough" (Schmidt and Calantone, 1998) and "incremental"/"radical" (Dewar and Dutton, 1986; Gatignon *et al.*, 2002). The most well known of these classification systems for innovations, is the radical/incremental dichotomy. Radical innovations are those that incorporate different technologies (Dewar and Dutton, 1986), involve changes in a company's trajectory (Gatignon *et al.* 2002), serve as the basis of new technological paradigms (Ahuja and Lampert, 2001) and provide more benefits to the customer than what was previously available in the industry (Chandy and Tellis, 1998).

Henard and Szymanski (2001) have suggested that examining radicalness can help in clarifying the impact of product-success determinants. In particular, radicalness is crucial to explaining product performance (Talke, 2007), a company's communication strategy (Lee and O'Connor, 2003) and the use of sales force (Kamel *et al.*, 2003). In this paper, we posit that radicalness can also explain the differential effects of each type of

organisational learning process on performance. The set of relationships is illustrated in Figure 1 and is elaborated further in the following section.

3. Hypotheses

Whether to develop radical innovations is a difficult and risky decision for any company. Von Stamm (2004) has shown that businesses tend to seek external relationships with other companies that provide new knowledge, which is especially true in the development of radical innovations. Yalcinkaya *et al.* (2007) suggests that the relationship between innovation and market performance depends not only on a company's existing capabilities but also on their continued renewal. Additionally, Petersen *et al.* (2003) have shown that knowledge gained from suppliers that is used in new-product development has a more positive impact on performance in uncertain technological environments. Bringing inter-organisational exploratory knowledge into a company not only increases its ability to develop radical innovations but also improves the likelihood they will be commercially successful as the business partners' commitment to the innovations increases (Hernandez-Espallardo *et al.*, 2011; Nemanich, 2005).

For example, Hernandez-Espallardo *et al.* (2011) find that collaboration with distributors not only enables manufacturers to access knowledge more conducive to radical innovation, but also motivates them to explore ideas emerging from that collaborative value-creation process. Additionally, as collaboration evolves and manufacturers apply the knowledge acquired through these relationships to developing innovations, distributors become more committed to supporting commercialisation of those innovations, and consequently, the risks associated with radical innovation initiatives decrease. We therefore propose the following hypothesis:

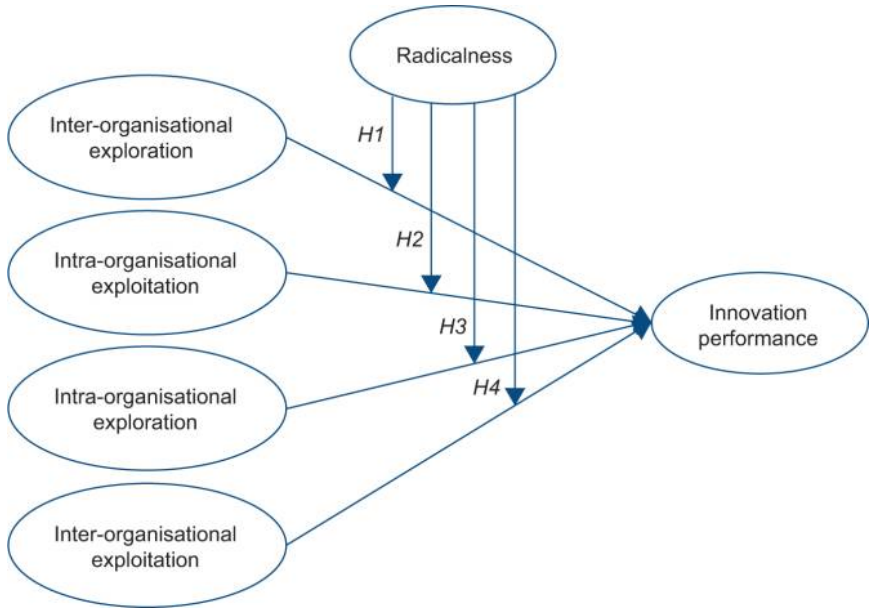

Figure 1.
Theoretical model

H1a. Inter-organisational, exploration-type learning processes are positively related to the performance of radical innovations.

Radical innovations require more resources and involve higher levels of risk than incremental innovations (Chandy and Tellis, 1998). Lavie and Rosenkopf (2006) describe the difficulties involved in implementing new capabilities to support radical innovations based on a company's existing capabilities. They argue that radical innovations are inherently more uncertain and require more learning to develop necessary new capabilities. Nemanich (2005) found that companies' capacity to absorb external knowledge is more important for radical than for incremental innovations, mainly because radical innovations involve a different knowledge base than what a company's product-development team is accustomed to using. Extending this reasoning, inter-organisational exploration processes may be more beneficial for radical innovations than incremental innovations, as higher levels of risk and experimentation characterise these innovations. Accordingly, we propose the following hypothesis:

H1b. The positive relationship between inter-organisational, exploration-type learning processes and performance is stronger for radical than for incremental innovations.

On its side, knowledge exploitation aims at increased efficiency; it promotes the extension of a company's current technologies to achieve certain short-term outcomes (March, 1991). The exploitation of intra-organisational knowledge allows a company to generate synergies (Garcia and Calantone, 2003) and to improve the efficiency and reliability of incremental-innovation processes (Soosay and Hyland, 2008). Miller *et al.* (2006) suggest that this type of knowledge is associated with incremental innovations, and March (1991) argues that it is often associated with a lack of significant new ideas in a company. Therefore, we propose that:

H2a. Intra-organisational, exploitation-type learning processes are positively related to the performance of incremental innovations.

Incremental innovations achieve greater returns from existing knowledge within a company than do radical innovations (Sivadas and Dwyer, 2000). Lavie and Rosenkopf (2006) suggest that the exploitation of knowledge is difficult to achieve in the context of certain organisational activities. They conclude that it is extremely complicated to balance the efficiency of competence exploitation with the processes necessary for developing radical innovations. As a result, the exploitation of existing knowledge has traditionally been linked with an absence of new ideas or with the development of less radical innovations within a company (Atuahene-Gima, 2005). Based on these assertions, we propose the following hypothesis:

H2b. The positive relationship between intra-organisational, exploitation-type learning processes and performance is stronger for incremental than for radical innovations.

Because of the exploratory character of intra-organisational exploration, it is more conductive to radical innovation (Nord and Tucker, 1987). However, insofar as it is not involved in a company's external relationships, this type of organisational learning

process may pose problems with regard to the integration and acceptance of a radical innovation within the company's business network or on the market (Nemanich, 2005). Rosenkopf and Nerkar (2001) argue that "the gains associated with the internal development of technology are not sustainable unless the organisation is able to integrate external developments". This is a consequence of insularity, which can also entail myopic behaviours that lead to competency traps (March, 1991) and core rigidities (Leonard-Barton, 1992). The final result is that innovations become less relevant and/or less understandable for external partners because they are based on different, or even incompatible, cognitive schemas or technologies (Sawheny and Prandelli, 2000). Based on these analyses, we propose the following:

H3. Intra-organisational, exploration-type learning processes are not related to the performance of innovations, whether those innovations are radical or incremental.

The case of inter-organisational exploitation can be similarly analysed. Because of its exploitative character, it may be appropriate for incremental innovations; however, for this type of innovations, intra-organisational exploitation is likely to produce better results. As Nord and Tucker (1987) state, incremental innovations are supported by current abilities within a company, making knowledge and abilities accessed through outside relationships less useful. Moreover, the fact that this knowledge is composed of small pieces of information that do not alter the company's understandings, assumptions, or paradigms makes it easy to internalise, so the company may have difficulty identifying whether the success of the innovation is due to knowledge gained through external relationships. In fact, according to Attribution Theory, it is more likely that when exploitation of inter-organisational knowledge is behind an incremental innovation that succeeds, the external source of that knowledge is less likely to be accurately ascribed than when it is a failure. Finally, according to the resource-dependence theory of organisations (Pfeffer and Salancik, 1978), there is also a chance that external entities that generate incremental innovations that require a small amount of effort from a company will demand a greater share of the innovations' returns, limiting the effect of the innovation on the company's performance. Therefore, we propose the:

H4. Inter-organisational, exploitation-type learning processes are not related to the performance of innovations, whether those innovations are radical or incremental.

4. Methodology

4.1 Data collection and sample

Data for the study were obtained from a sample of Colombian manufacturers. We triangulated data from several sources in order to locate firms of interest for our data collection. In particular, we used

- the Second National Survey of Development and Technological Innovation (2005) advanced by the National Department of Planning;
- information from the Administrative National Department of Science and Technology (Colciencias); and
- the Administrative National Department of Statistic (DANE).

The results of this work was the creation of a directory of 1,030 manufacturers that, first, were approached by letter and, later, were telephonically asked to participate in the study. A preliminary condition to participate was the manufacturer's confirmation that it had been involved in a significant innovation project during the last three years (Lee and O'Connor, 2003). Key informant approach was later used to contact the person in the firm with most knowledge about the most significant innovation project the firm had been involved during that period of time. A total of 300 firms qualified and agreed to participate by indicating the person and descriptive data of the innovation project. Professional interviewers trained by the researchers were in charge of meeting with these persons and collecting data through personal interview. Data were obtained by means of a questionnaire that was personally administered. This substantially reduces the problems with gatekeepers inside the organization (Cavusgil and Elvey-Kirk, 1998). Also, compared to mail surveys (Lee and O'Connor, 2003) or online surveys this procedure offers clear advantage in terms of their response rate (Olsen, 2009). A total of 187 firms completely answered the items of this study, thus becoming the sample size used in our data analysis. Respondents were male in the majority of the cases (70.4 per cent) and they occupied the position of the firm's general manager or owner in the 10.8 per cent of the cases, production manager (40.3 per cent), marketing manager (12.4 per cent) and innovation or R&D manager in the 15.1 per cent of the cases.

Firms belong to a wide array of manufacturing industries, with special reference to the chemical sector (22.5 per cent), manufacturers of rubber and plastic (16.6 per cent), and food-and-beverages manufacturers (16.0 per cent). The firms are in average 29.4 years old, with an average turnover of 15 million dollars, and 305 employees. In almost half of the cases the type of innovation analysed is on products (47.6 per cent) and 40.5 per cent on processes. Marketing (4.3 per cent) and organisational (7.6 per cent) innovations are present, although in a considerably minor degree. We asked to distribute 100 points among different options that represent the purpose of the innovation project under research. Results show that the most important is increasing sales, with an average weight of 50.1 per cent, followed by reducing costs (36.5 per cent), and to adapt to regulatory changes (13.4 per cent). Also, 100 points were distributed to evaluate whether the project was initiated by the own initiative of the firm (60.7 per cent) or because of the influence of clients (26.8 per cent), suppliers (6.5 per cent) or normative regulations (6.0 per cent).

4.2 Measurement instruments

The questionnaire items that were employed in this investigation are listed in the Appendix. The dependent variable in the study is innovation performance. We followed De Luca and Atuahene-Gima's (2007) method for measuring the extent to which a company has achieved the following innovation objectives: market share and sales (market indicators), return on assets, return on investments, and profitability (financial indicators). We used seven-point scales with the anchors 1 = "Not at all" and 7 = "Completely".

A close analysis of the items used for measuring innovation performance, lead us to categorise this scales as formative (Jarvis *et al.*, 2003). It is clear that a change in an indicator determines a change in the value of the latent variable rather than the other way round; therefore, the items cannot be interchangeable. Therefore, the quality of the scale was assessed using Diamantopoulos and Winklhofer's (2001) method, first by

evaluating whether the items used represent the content of the concepts. This can be assumed, as we used De Luca and Atuahene-Gima's indicators (2007), which have been used together in previous research and constitute the five indicators that are used most ubiquitously in research on innovation performance (Molina-Castillo and Munuera-Alemán, 2009). Second, we found that multicollinearity is not a problem, as the maximum value for the variance inflation factor (VIF) is 2.85, far below the commonly accepted cut-off threshold of 10. Third, we found that the correlations of each item with an external criterion are in the interval 0.414 to 0.636, all significant at $p < 0.01$. For the purposes of testing our hypotheses, the data for the five items of this scale were averaged to create a single measure of the construct.

The scales used to measure the four types of organisational learning processes (i.e. intra-organisational exploration, intra-organisational exploitation, inter-organisational exploration, and inter-organisational exploitation) are adapted from the work of Holmqvist (2004). We asked the respondents about the degree to which the innovations in question were supported by each organisational learning process, using a ten-point scale with 1 = "To no extent" and 10 = "Completely" as anchors.

Because they were constructed as single-item measurements, no statistical indication of the reliability of these measures can be calculated. Using single-item scales is generally viewed as defensible and is even preferred to using multiple-item scales when they describe concepts for which both the object and the attribute are concrete and singular (easily and uniformly imagined) (Rossiter, 2002). Each type of organisational learning process we asked about can be described as concrete and singular, both in the object, i.e. a company's innovation project, and the attribute, i.e. the degree to which that type of knowledge was used in the development of that project. Therefore, it is justifiable to construct a single-item measure, in line with previous research in the area that has measured the sources and types of knowledge, of the technological development, and of the innovation in the same way (Hise *et al.*, 1990).

The radicalness of the innovation in question was measured in the same way as other well-known researches (Balachandra and Friar, 1997; Booz, Allen, and Hamilton, 1982). We asked the respondents to describe their innovation projects as developing a product or process that was completely new to the world (13 cases), that was completely new for the company (85 cases), or that was an addition or improvement to an existing product or process (89 cases). After considering the distribution of responses, we assigned a value of one for either of the two first options (new to the world and to the company). A value of zero was assigned in cases in which the innovation consisted of "an addition or improvement to a pre-existing product or procedure", i.e. an incremental innovation. Other authors have used a similar approach; for example, Meyers and Tucker (1989) describe discontinuous or radical innovations as those that are based on a technology that is new to the company. Similarly, Song and Montoya-Weiss (1998) analyse the radicalness of innovations according to whether they represent a substantial change with respect to other products previously developed by the company in question. Finally, Green *et al.* (1995) evaluate radicalness based on what processes or techniques a company must implement to develop the new product. Olson *et al.* (1995) defined this as the company's level of implication with regard to the innovation. In contrast, the addition to or improvement of an existing product or process can clearly be defined as incremental innovation because it does not

incorporate new technology or require the company to develop new techniques (Chandy and Tellis, 1998).

In addition to the variables relevant to our hypotheses, we have incorporated four control variables into the analysis that may also have influence on the performance of an innovation project. They characterise aspects of the innovation projects: SALES and COSTS describe the level of importance of increasing sales or reducing costs, respectively, in the goals of the innovation project; PRODUCT and PROCESS are dummy variables describing which type of innovation project is being carried out. Table I gives the descriptive statistics for the measures.

4.3 Results

Equation 1 represents the model we used in testing our hypotheses.

$$PERF = b1\,SALES + b2\,COSTS + b3PRODUCT + b4\,PROCESS + b5\,X1 + b6\,X2 + b7\,X3 + b8\,X4 + b9\,RAD + b10\,X1 \times RAD + b11\,X2 \times RAD + b12\,X3 \times RAD + b13\,X4 \times RAD + e$$

where PERF is the manufacturer's assessment of the innovation's performance; SALES represents the importance of increasing sales as a percentage of the innovation project's goal; COSTS represents the importance of reducing costs as a percentage of the innovation project's goal; PRODUCT is a dummy variable with a value of 1 if the innovation is a product or a change to a product; PROCESS is a dummy variable with a value of 1 if the innovation is a process or a change to a process; X1 represents support from inter-organisational exploration-type learning processes; X2 represents support from intra-organisational exploitation-type learning processes; X3 represents support from intra-organisational exploration-type learning process; X4 represents support from inter-organisational exploitation-type learning processes; and RAD denotes the radicalness of the innovation project.

We estimated equation 1 using a hierarchical regression approach with ordinary-least-squares estimation procedure. To reduce the potential for multicollinearity associated with equations containing both main and interaction terms, we used the mean-centring procedure recommended by Jaccard *et al.* (1990) and Aiken and West (1991). We divided the variables in equation 1 into three clusters and tested three nested models. Model I estimates the effects of the control variables SALES, COSTS, PRODUCT, and PROCESS on performance. No significant effects were observed and R^2 is low (0.006) and non-significant (F-change probability = 0.898). Estimation of Model II, containing the control variables and the main effects of the theoretical variables yields a higher R^2 (0.052) but the change in R^2 is still insignificant (F-change probability = 0.133). Model III, which estimates the effects of the control variables and the main and interaction effects of the theoretical variables, provides the best comparative results ($R^2 = 0.354$; F-change probability = 0.000). The estimates calculated in this model, which corresponds to equation 1, are presented in Table II. Maximum VIF value is 5.9, which is well below the threshold of 10 (Hair *et al.*, 1999).

Table I.
Measures' statistics

Construct	Mean	SD	Correlations								
			1	2	3	4	5	6	7	8	9
1. COSTS	36.48	26.95									
2. SALES	50.14	28.90	−0.746								
3. PRODUCT	0.476	0.501	−0.268	0.207							
4. PROCESS	0.405	0.492	0.280	−0.169	−0.786						
5. Inter-organisational exploration	5.11	1.93	−0.117	0.068	0.077	−0.133					
6. Intra-organisational exploitation	6.86	2.50	0.124	−0.073	−0.050	0.082	0.139				
7. Intra-organisational exploration	7.79	1.91	0.163	−0.100	−0.096	0.147	0.085	0.167			
8. Inter-organisational exploitation	4.65	2.14	−0.112	0.077	0.121	−0.142	0.705	0.300	−0.061		
9. Radicalness	0.524	0.501	−0.080	0.029	0.084	−0.029	−0.030	−0.062	−0.080	−0.098	
10. Performance	5.50	0.746	0.043	−0.018	0.038	−0.004	0.057	0.100	0.167	0.072	−0.124

Independent variables	Model I Standardised coefficients	Significance	Model II Standardised coefficients	Significance	Model III Unstandardised coefficients	Standardised coefficients	Significance
Constant					5.581		0.000
COSTS	0.072	0.531	0.030	0.794	0.000	0.017	0.854
SALES	0.026	0.818	0.010	0.927	0.000	−0.017	0.865
PRODUCT	0.094	0.439	0.098	0.421	0.007	0.005	0.965
PROCESS	0.054	0.659	0.044	0.722	0.001	0.000	0.997
Inter-organisational exploration (X1)			−0.004	0.969	−0.155	−0.399	0.004
Intra-organisational exploitation (X2)			0.050	0.535	0.089	0.299	0.005
Intra-organisational exploration (X3)			0.153	0.053	0.026	0.068	0.490
Inter-organisational exploitation (X4)			0.056	0.622	−0.033	−0.095	0.523
Radicalness (RAD)			−0.108	0.151	−0.168	−0.113	0.075
X1 × RAD					0.349	0.642	0.000
X2 × RAD					−0.162	−0.418	0.000
X3 × RAD					0.015	0.029	0.768
X4 × RAD					0.085	0.183	0.208
R^2 (Adj. R^2)	0.006 (−0.016)		0.052 (0.004)		0.354 (0.305)		
F (F-probability)	0.269 (0.898)		1.076 (0.383)		7.216 (0.000)		
R^2 Change (Adjusted R^2 change)	0.006 (−0.016)		0.046 (0.020)		0.348 (0.321)		
R^2 Change Prob.	0.898		0.133		0.000		

Table II.
OLS regression estimates

We tested our hypotheses by using the methodology proposed by Aiken and West (1991). We observed that the effect of inter-organisational exploration on performance is described by the following function: $-0.155 + 0.349 \times \text{RAD}$[1]. For radical innovations, the value of RAD is 1 so that the effect has a value of 0.194, significant at $p < 0.001$[2]. This confirms our *H1a*, that inter-organisational exploration improves performance in the case of radical innovations. Moreover, this effect is significantly higher than the effect found for incremental innovations, when innovations are incremental, i.e. when RAD = 0, a difference of 0.349 in the effect on performance can be seen in comparison with a RAD of 1 ($p <$ 0.000)[3]. When RAD = 0, inter-organisational exploration actually has a significant negative effect ($-0.155; p < 0.01$) on performance. This confirms our *H1b*. It confirms that implementing learning processes involving inter-organisational exploration is more advisable when planned innovations are radical than when they are incremental; in the latter situation, inter-organisational exploration seems to be detrimental to performance.

We followed the same procedure to test *H2*, our hypothesis regarding the effects of intra-organisational exploitation on innovations' performance. The effect of intra-organisational exploitation is described by the function $.089 - 0.162 \times \text{RAD}$. In the case of incremental innovations (RAD = 0), this type of learning process has a significant positive effect ($0.089; p = 0.005$) on performance, confirming *H2a*. In contrast, when innovations are radical (RAD = 1), there is a significant negative effect ($-0.073; p = 0.015$). Taken together, these results show that intra-organisational exploitation is more advisable when developing incremental innovations than when developing radical innovations, confirming *H2b*.

With regard to *H3* and *H4*, we observe that neither intra-organisational exploration nor inter-organisational exploitation has any significant effect on the performance of innovations, whatever their degree of radicalness.

5. Conclusions and theoretical and management implications

This research is the first that applies Holmqvist's (2004) typology of four organisational learning processes to an empirical explanation of the performance of innovations. In addition, it considers the differential effects that the degree of radicalness of an innovation for the innovating company may have on knowledge requirements and on the likelihood that the company will accomplish its goals with regard to the innovation.

Our results are relevant to various strands of ongoing research including:

- product-success-determinants theory (Henard and Szymanski, 2001);
- social-network theory (Sawheny and Prandelli, 2000);
- the role of inter-organisational learning in the exploitation/exploration dynamic (Holmqvist, 2009); and
- theories regarding the dynamic strategic evolution of organisations (Rivkin and Sigglekow, 2003).

Prior studies on product-success determinants (Henard and Szymanski, 2001) point out that the antecedents of successful innovation depend on a variety of contextual factors. Our results confirm this and prove that the congruency between the source of the

knowledge applied to developing an innovation and the degree of radicalness of that innovation determines its performance. Therefore, the managers of an innovation project must to consider the level of new capabilities required, the risks, and the resources that must be committed in order to decide which organisational learning processes to seek out or favour. In carrying out this process, they should be aware of the particular circumstances involved in the development, transfer and application of different types of knowledge (Bierly *et al.*, 2009).

Moreover, our findings regarding the four types of organisational learning process confirm the "no firm is an island" assumption of Network theory (Sawheny and Prandelli, 2000). The development of radical innovations requires the establishment and management of external relationships; a company must devote attention to its relational intelligence, in which the management of inter-firm learning processes is critical (Hernandez-Espallardo *et al.*, 2010). Managers must be aware that internal (hierarchical) mechanisms of learning, such as intra-organisational learning processes, are more suited to supporting incremental innovations, whereas hybrid mechanisms such as inter-organisational relationship-building are more conducive to obtaining the exploratory knowledge necessary to developing successful radical innovations (Sawheny and Prandelli, 2000).

Our study also provides empirical proof to support previous research that uses the concept of inter-organisational learning to better understand the dynamics of exploitation and exploration (Hernandez-Espallardo *et al.*, 2011; Holmqvist, 2009). Inter-organisational exploration is the slowest and most tacit learning process and therefore the most complicated. Holmqvist's (2009) recommendation that organisations accept the complications of inter-organisational learning activities in order to avoid becoming trapped in excessive experimentation or routinisation is fine-tuned in the present study, which recommends that managers leverage inter-organisation exploration processes in developing radical innovations but avoid it as a means of supporting incremental innovation.

Our results also relate to the dynamic strategic evolution of firms. Rivkin and Sigglekow (2003) call for balancing experimentation and stability, despite the contradictions between activities involved in achieving efficiency and those targeted toward flexibility and adaptation (Abernathy, 1978). Our findings suggest that this can be done by supporting incremental innovation with intra-organisational exploitation-type learning processes, and radical innovations with inter-organisational exploration-type learning processes. In fact, we present empirical proof that supports the view that a dynamic balancing process must be involved in the successful acquisition and application of external knowledge through inter-organisational relationships (Bierly *et al.*, 2009; Lavie and Rosenkopf, 2006). We demonstrate that the most advisable process to follow would be to support radical innovations with inter-organisational exploratory learning and then, as the company internalises that knowledge, to base later incremental improvements on the exploitation of intra-organisational learning. In initiating and/or nurturing the dynamic evolution of innovations within a company, managers must realise that they will achieve greater impact by focusing primarily on exploration that builds on the developmental work of (or with) other organisations (Rosenkopf and Nerkar, 2001). This is congruent with theories of the temporal evolution of organisational structures, which suggest that companies tend to engage first in exploration, followed later by

refinements (Sigglekow and Levinthal, 2003). This allows companies to avoid competency traps; as Lavie and Rosenkopf (2006) argue, "The transition between exploration and exploitation requires firms that have traditionally followed established routines to enhance their absorptive capacity, while firms that have developed expertise in identifying external opportunities and capitalising on new knowledge must regulate some organisational procedures that improve efficiency" (p. 805). Based on our findings, we are confident in recommending that managers follow this sequential route in the acquisition and application of knowledge.

6. Limitations and directions for future research

There are a few caveats that should be acknowledged. The data used in this study were collected using subjective measures based on the perceptions of companies' managers. Although such retrospective perceptual data have been used extensively in research on business strategy, especially in research on new-product development (Henard and Szymanski, 2001), we cannot rule out the possibility that the subjectivity of the measures has biased the results of the study. Consequently, we advise readers to use caution in interpreting our findings.

In addition, although collecting data from companies in a variety of industries allows us to formulate findings that can be generalised beyond the idiosyncrasies of individual industries, studies at the level of single industries would also be useful for validating the results. Future research could also expand and refine the relationships investigated in the present study. For example, using a broader typology of innovations (Gatignon *et al.*, 2002), including the level of innovativeness (Danneels and Kleinschmidt, 2001) or analysing short- versus long-term performance (Molina-Castillo and Munuera-Alemán, 2009) might provide a clearer picture of the issue. Additionally, more research is needed to determine how much of the resources dedicated to innovation are wasted and how companies should manage the innovation process (Rosenbusch *et al.*, 2011).

Finally, the study is based on data from a single country. The fact that we conducted this research in Colombia, a developing country, with a sample of manufacturers operating in sectors far outside the high-tech sphere, contributes to counteracting a dominant bias in research on innovation, that is, the neglect of so-called low-tech and mature industries, despite the fact that they still represent a significant proportion of economic and innovative activity. However, the setting of our research may lead to some country-specific bias that should be considered in interpreting our results. In the future, cross-national studies should be conducted to assess the strength of the framework and its generalisability across varying economic systems and organisational structures. Extending the research to other local, national or European areas would allow us to obtain further results and confirm the results from this study (Massa and Testa, 2008).

Notes

1. This is the result of calculating the partial derivative of performance with respect to inter-organisational exploration (∂ PERF/∂inter-organisational exploration). Following Aiken and West (1991) unstandardised coefficients are used.

2. This is done by computing the standard error of the estimate, and then dividing the estimate by the standard error. These calculations give the *t*-value used to test the statistical significance of the estimate (see Jaccard *et al.*, 1990 for a deeper review of the process)
3. This is actually the size of the interaction coefficient.

References

Abernathy, W.J. (1978), *The Productivity Dilemma*, Johns Hopkins University Press, Baltimore, MD.

Ahuja, G. and Lampert, C.M. (2001), "Entrepreneurship in the large corporation: a longitudinal study of how established firms create breakthrough inventions", *Strategic Management Journal*, Vol. 22 No. 2, pp. 521-43.

Aiken, L.S. and West, S.G. (1991), *Multiple Regression: Testing and Interpreting Interactions*, Sage Publications, Thousand Oaks, CA.

Alexander, D.L., Lynch, J. and Wang, Q. (2008), "As time goes by: do cold feet follow warm intentions for really new versus incrementally new products?", *Journal of Marketing Research*, Vol. 45 No. 3, pp. 307-19.

Astebro, T. and Michela, J.L. (2005), "Predictors of the survival of innovations", *Journal of Product Innovation Management*, Vol. 22 No. 4, pp. 322-35.

Atuahene-Gima, K. (2005), "Resolving the capability-rigidity paradox in new product innovation", *Journal of Marketing*, Vol. 69 No. 3, pp. 61-83.

Balachandra, R. and Friar, J.H. (1997), "Factors for success in R&D projects and new product innovation: a contextual framework", *IEEE Transactions on Engineering Management*, Vol. 44 No. 3, pp. 276-87.

Benner, M. and Tushman, M.L. (2003), "Exploitation, exploration, and process management: the productivity dilemma revisited", *Academy of Management Review*, Vol. 28 No. 2, pp. 238-56.

Bierly, P., Damanpour, F. and Santorno, M. (2009), "The application of external knowledge: organisational conditions for exploration and exploitation", *Journal of Management Studies*, Vol. 46 No. 3, pp. 481-509.

Booz, Allen, and Hamilton (1982), *New Product Management for the 1980s*, Booz, Allen and Hamilton, New York, NY.

Calantone, R., Chan, K. and Cui, A.S. (2006), "Decomposing product innovativeness and its effects on new product success", *Journal of Product Innovation Management*, Vol. 23 No. 4, pp. 408-21.

Carbonell, P. and Rodriguez, A.I. (2006), "The impact of market characteristics and innovation speed on perceptions of positional advantage and new product performance", *International Journal of Research in Marketing*, Vol. 23 No. 1, pp. 1-12.

Cavusgil, S.T. and Elvey-Kirk, L.A. (1998), "Mail survey response behavior: a conceptualization of motivating factors and an empirical study", *European Journal of Marketing*, Vol. 32 Nos 11/12, pp. 1165-92.

Chandy, R. and Tellis, G. (1998), "Organizing for radical product innovation: the overlooked role of willingness to cannibalize", *Journal of Marketing Research*, Vol. 35 No. 4, pp. 474-87.

Cooper, R.G. and Kleinschmidt, E.J. (1996), "Winning businesses in product development: the critical success factors", *Research Technology Management*, Vol. 39 No. 4, pp. 18-29.

Cyert, R. and March, J.G. (1992), *Behavioral Theory of Firm*, 2nd ed., Blackwell, Cambridge, MA.

Danneels, E. and Kleinschmidt, E.J. (2001), "Product innovativeness from the firm's perspective: its dimensions and their relation with project selection and performance", *Journal of Product Innovation Management*, Vol. 18 No. 6, pp. 357-73.

Day, D. (1994), "Raising radicals: different processes for championing innovative corporate ventures", *Organization Science*, Vol. 5 No. 2, pp. 148-72.

De Luca, L.M. and Atuahene-Gima, K. (2007), "Market knowledge dimensions and cross-functional collaboration: examining the different routes to product innovation performance", *Journal of Marketing*, Vol. 71 No. 1, pp. 95-112.

Dewar, R.D. and Dutton, J.E. (1986), "The adoption of radical and incremental innovations: an empirical analysis", *Management Science*, Vol. 32 No. 11, pp. 1422-33.

Diamantopoulos, A. and Winklhofer, H.M. (2001), "Index construction with formative indicators: an alternative to scale development", *Journal of Marketing Research*, Vol. 38 No. 2, pp. 269-77.

Dougherty, D. and Hardy, C. (1996), "Sustained product innovation in large, mature organizations: overcoming innovation to organization problems", *Academy of Management Journal*, Vol. 39 No. 5, pp. 1120-53.

Garcia, R. and Calantone, R. (2002), "A critical look at technological innovation typology and innovativeness terminology: a literature review", *Journal of Product Innovation Management*, Vol. 19 No. 2, pp. 110-32.

Garcia, R. and Calantone, R. (2003), "The role of knowledge in resource allocation to exploration versus exploitation in technologically oriented organizations", *Decision Sciences*, Vol. 34 No. 2, pp. 323-50.

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*, Vol. 48 No. 9, pp. 1103-22.

Goldenberg, J., Lehmann, D.R. and Mazursky, D. (2001), "The idea itself and the circumstances of its emergence as predictors of new product success", *Management Science*, Vol. 47 No. 1, pp. 69-84.

Green, S.G., Gavin, M.B. and Aiman-Smith, L. (1995), "Assessing a multidimensional measure of radical technological innovation", *IEEE Transactions on Engineering Management*, Vol. 42 No. 3, pp. 203-14.

Hair, J.J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (1999), *Multivariate Analysis*, Prentice Hall Iberia, Madrid.

Henard, D.H. and Szymanski, D.M. (2001), "Why some new products are more successful than others", *Journal of Marketing Research*, Vol. 38 No. 3, pp. 362-75.

Hernandez-Espallardo, M., Rodriguez-Orejuela, A. and Sanchez-Perez, M. (2010), "Inter-organisational governance, learning and performance in supply chains", *Supply Chain Management: An International Journal*, Vol. 15 No. 2, pp. 101-14.

Hernandez-Espallardo, M., Sanchez-Perez, M. and Segovia-Lopez, C. (2011), "Exploitation- and exploration-based innovations: the role of knowledge in inter-firm relationships with distributors", *Technovation*, Vol. 31 No. 5, pp. 203-15.

Hise, R.T., O'Neal, L., Parasuraman, A. and McNeal, J.U. (1990), "Marketing/R&D interaction in new product development: implications for new product success rates", *Journal of Product Innovation Management*, Vol. 7 No. 2, pp. 142-55.

Holmqvist, M. (2003), "A dynamic model of intra- and interorganisational learning", *Organization Studies*, Vol. 24 No. 1, pp. 85-123.

Holmqvist, M. (2004), "Experiential learning processes of exploitation and exploration within and between organizations: an empirical study of product development", *Organization Science*, Vol. 15 No. 1, pp. 70-81.

Holmqvist, M. (2009), "Complicating the organization: a new prescription for the learning organization?", *Management Learning*, Vol. 40 No. 3, pp. 275-87.

Im, G. and Rai, A. (2008), "Knowledge sharing ambidexterity in long-term interorganisational relationships", *Management Science*, Vol. 54 No. 7, pp. 1281-96.

Jaccard, J., Turrisi, R. and Wan, C.K. (1990), *Interaction Effects in Multiple Regression*, Sage Publications, Newbury Park, CA.

Jarvis, C.B., MacKenzie, S.B. and Podsakoff, P.M. (2003), "A critical review of construct indicators and measurement model misspecification in marketing and consumer research", *Journal of Consumer Research*, Vol. 30 No. 2, pp. 199-218.

Kamel, M., Rochford, L. and Wotruba, T.R. (2003), "How new product introductions affect sales management strategy: the impact of type of newness of the new product", *Journal of Product Innovation Management*, Vol. 20 No. 4, pp. 270-83.

Kleinschmidt, E.J. and Cooper, R.G. (1991), "The impact of product innovativeness on performance", *Journal of Product Innovation Management*, Vol. 8 No. 4, pp. 240-51.

Krishnan, V. and Ulrich, K.T. (2001), "Product development decisions: a review of the literature", *Management Science*, Vol. 47 No. 1, pp. 1-21.

Kyriakopoulos, K. and Moorman, C. (2004), "Tradeoffs in marketing exploitation and exploration strategies: the overlooked role of market orientation", *International Journal of Research in Marketing*, Vol. 21 No. 3, pp. 219-40.

Lavie, D. and Rosenkopf, L. (2006), "Balancing exploration and exploitation in alliance formation", *Academy of Management Journal*, Vol. 49 No. 4, pp. 797-818.

Lee, Y. and O'Connor, G.C. (2003), "The impact of communication strategy on launching new products: the moderating role of product innovativeness", *Journal of Product Innovation Management*, Vol. 20 No. 1, pp. 4-21.

Leonard-Barton, D. (1992), "Core capabilities and core rigidities: a paradox in managing new development", *Strategic Management Journal*, Vol. 13 No. 1, pp. 111-26.

Levinthal, D.A. and March, J.G. (1993), "The myopia of learning", *Strategic Management Journal*, Vol. 14, pp. 95-112.

Lynn, G.S., Morone, J.G. and Paulson, A.S. (1996), "Marketing and discontinuous innovation: the probe and learn process", *California Management Review*, Vol. 38 No. 3, pp. 8-37.

March, J.G. (1991), "Exploration and exploitation in organisational learning", *Organization Science*, Vol. 2 No. 1, pp. 71-87.

Massa, S. and Testa, S. (2008), "Innovation and SMEs: misaligned perspectives and goals among entrepreneurs, academics, and policy makers", *Technovation*, Vol. 28 No. 7, pp. 393-407.

Menguc, B. and Auh, S. (2006), "Creating a firm-level dynamic capability through capitalizing on market orientation and innovativeness", *Journal of the Academy of Marketing Science*, Vol. 34 No. 1, pp. 63-73.

Meyers, P.W. and Tucker, F.G. (1989), "Defining roles for logistics during routine and radical technological innovation", *Journal of Academy of Marketing Science*, Vol. 17 No. 1, pp. 73-82.

Miller, K., Zhao, M. and Calantone, R. (2006), "Adding interpersonal learning and tacit knowledge to March's exploration-exploitation model", *Academy of Management Journal*, Vol. 49 No. 4, pp. 709-22.

Molina-Castillo, F.J. and Munuera-Alemán, J.L. (2009), "New product performance indicators: time horizon and importance attributed by managers", *Technovation*, Vol. 29 No. 10, pp. 714-24.

More, R.A. (1982), "Risk factors in accepted and rejected new industrial products", *Industrial Marketing Management*, Vol. 11 No. 1, pp. 9-15.

Nemanich, L.A. (2005), *The Strategic Impact of Absorptive Capacity on Technological Innovation: a Multi-dimensional, Multi-method Analysis*, University of Houston, Houston, TX, PhD dissertation.

Nord, W.R. and Tucker, S. (1987), *Implementing Routine and Radical Innovations*, Lexington Books, Lanham, MD.

Olsen, S.B. (2009), "Choosing between internet and mail survey modes for choice experiment surveys considering non-market goods", *Environmental and Resource Economics*, Vol. 44 No. 4, pp. 591-610.

Olson, E.M., Walker, O.C. and Ruekert, R.W. (1995), "Organizing for effective new product development: the moderating role of product innovativeness", *Journal of Marketing*, Vol. 59 No. 1, pp. 48-62.

Petersen, K.J., Handfield, R.B. and Ragatz, G.L. (2003), "A model of supplier integration into new product development", *Journal of Product Innovation Management*, Vol. 20 No. 4, pp. 284-99.

Pfeffer, J. and Salancik, G. (1978), *The External Control of Organizations: A Resource Dependence Perspective*, Harper & Row, New York, NY.

Rindfleisch, A. and Moorman, C. (2001), "The acquisition and utilization of information in new product alliances: a strength-of-ties perspective", *Journal of Marketing*, Vol. 65 No. 2, pp. 1-18.

Rivkin, J. and Sigglekow, N. (2003), "Balancing search and stability: interdependencies among elements of organisational design", *Management Science*, Vol. 49 No. 3, pp. 290-311.

Rosenbusch, N., Brinckmann, J. and Bausch, A. (2011), "Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs", *Journal of Business Venturing* (forthcoming).

Rosenkopf, L. and Nerkar, A. (2001), "Beyond local search: boundary-spanning, exploration, and impact in the optical disk industry", *Strategic Management Journal*, Vol. 22 No. 4, pp. 287-306.

Rossiter, J. (2002), "The C-OAR-SE procedure for scale development in marketing", *International Journal of Research in Marketing*, Vol. 19 No. 3, pp. 305-35.

Sawheny, M. and Prandelli, E. (2000), "Communities of creation: managing distributed innovation in turbulent markets", *California Management Review*, Vol. 42 No. 4, pp. 24-54.

Schmidt, J.B. and Calantone, R.J. (1998), "Are really new product development projects harder to shut down?", *Journal of Product Innovation Management*, Vol. 15 No. 2, pp. 111-23.

Schmidt, J.B., Sarangee, K.R. and Montoya, M.M. (2009), "Exploring new product development project review practices", *Journal of Product Innovation Management*, Vol. 26 No. 5, pp. 520-35.

Sigglekow, N. and Levinthal, D.A. (2003), "Temporarily divide to conquer: centralized, decentralized, and reintegrated organisational approaches to exploration and adaptation", *Academy of Management Journal*, Vol. 14 No. 6, pp. 650-69.

Sivadas, E. and Dwyer, F.R. (2000), "An examination of organisational factors influencing new product success in internal and alliance-based processes", *Journal of Marketing*, Vol. 64 No. 1, pp. 31-49.

Song, X.M. and Montoya-Weiss, M.M. (1998), "Critical development activities for really new versus incremental products", *Journal of Product Innovation Management*, Vol. 15 No. 2, pp. 124-35.

Soosay, C. and Hyland, P. (2008), "Exploration and exploitation: the interplay between knowledge and continuous innovation", *International Journal of Technology Management*, Vol. 42 No. 1, pp. 20-35.

Stevens, G. and Burley, J. (2003), "Piloting the rocket of radical innovation", *Research Technology Management*, Vol. 46 No. 2, pp. 16-25.

Talke, K. (2007), "Corporate mindset of innovating firms: influences on new product performance", *Journal of Engineering and Technology Management*, Vol. 24 No. 1, pp. 76-91.

Verona, G. (1999), "A resource-based view of product development", *Academy of Management Review*, Vol. 24 No. 1, pp. 132-42.

Veryzer, R.W. (1998), "Discontinuous innovation and the new product development", *Journal of Product Innovation Management*, Vol. 15 No. 4, pp. 304-21.

Von Stamm, B. (2004), "Collaboration with other firms and customers: innovation's secret weapon", *Strategy & Leadership*, Vol. 32 No. 3, pp. 16-20.

Voss, G.B., Sirdeshmukh, D. and Voss, Z.G. (2008), "The effects of slack resources and environmental threat on product exploration and exploitation", *Academy of Management Journal*, Vol. 51 No. 1, pp. 147-64.

Yalcinkaya, G., Calantone, R. and Griffith, D.A. (2007), "An examination of exploration and exploitation capabilities: implications for product innovation and market performance", *Journal of International Marketing*, Vol. 15 No. 4, pp. 63-93.

Yoon, E. and Lilien, G.L. (1985), "New industrial product performance: the effects of market characteristics and strategy", *Journal of Product Innovation Management*, Vol. 2 No. 3, pp. 134-44.

Appendix

Innovation performance (PERF). Based on De Luca and Atuahene-Gima (2007). Seven-point scale, on which 1 = "Not at all" and 7 = "Completely"

To what extent has the company achieved the following innovation objectives:

- Market share?
- Sales?
- Return on assets?
- Return on investments?
- Profitability?

Organisational learning processes. Inspired by Holmqvist (2004). ten-point scale, on which 1 = "To no extent" and 10 = "Completely"

To what degree is the innovation based on:

- The exploration of new and challenging knowledge obtained through, or developed via, external relationships? (INTER-ORGANISATIONAL EXPLORATION).
- The exploitation or application of knowledge already existing within the company, perhaps slightly modified? (INTRA-ORGANISATIONAL EXPLOITATION).
- The exploration of new and challenging knowledge developed within the company? (INTRA-ORGANISATIONAL EXPLORATION).

- The exploitation of knowledge obtained through external relationships that is simply refines the company's existing knowledge base? (INTER-ORGANISATIONAL EXPLOITATION).

The innovation's degree of radicalness (RAD). Inspired by Booz, Allen, and Hamilton (1982) and Balachandra and Friar (1997)

Please pick the option that best describes the firm's innovation project:

- It is something new to the world.
- It is completely new to the firm, but not to the world.
- It is an addition or improvement to a pre-existing product or procedure.

About the authors

Dr Miguel Hernández-Espallardo is Associate Professor of Marketing at the School of Economics and Business at the University of Murcia (Spain). His research interests include marketing of interorganisational relationships and co-operative marketing. He is currently Chair of the Marketing Department and has published previously, among others, in the *European Journal of Innovation Management*, *International Journal of Research in Marketing*, *Technovation* and *Supply Chain Management*.

Dr Francisco-Jose Molina-Castillo is Assistant Professor of Marketing at the School of Economics and Business at the University of Murcia (Spain). His research interests include new product launch activities as well as electronic marketing. He has been Visiting Professor at Delft University (2005) and Michigan State University (2008). Between 2008 and 2010, he was Secretary of the Spanish Marketing Association (AEMARK). He has published previously in the *Journal of Product Innovation Management*, *Industrial Marketing Management*, *Technovation* and *Information & Management*. Francisco-Jose Molina-Castillo is the corresponding author and can be contacted at: fjmolina@um.es

Dr Augusto Rodríguez-Orejuela is Dean at the Faculty of Management Science at Del Valle University (Colombia). He lectures in marketing and is consultant and researcher in the area of business competitiveness and business-to-business relationships. He has published in several journals, including *Supply Chain Management* and in the *International Entrepreneurship and Management Journal*.

This article has been cited by:

1. Silke Lennerts, Martin Eisend, Theo Lieven, Sven Molner, Tim Oliver Brexendorf, Torsten Tomczak. 2016. The Power of Innovativeness in Manufacturer–Retailer Relationships. *Journal of Business-to-Business Marketing* **23**:3, 235-251. [CrossRef]
2. Marian Garcia Martinez, Ferdaous Zouaghi, Mercedes Sanchez Garcia. 2016. Capturing value from alliance portfolio diversity: The mediating role of R&D human capital in high and low tech industries. *Technovation* . [CrossRef]
3. Beatriz Forés, César Camisón. 2016. Does incremental and radical innovation performance depend on different types of knowledge accumulation capabilities and organizational size?. *Journal of Business Research* **69**:2, 831-848. [CrossRef]
4. Pablo D'Este, Nabil Amara, Julia Olmos-Peñuela. 2015. Fostering novelty while reducing failure: Balancing the twin challenges of product innovation. *Technological Forecasting and Social Change* . [CrossRef]
5. Yan Jin Department of Business Administration, Elizabeth City State University, Elizabeth City, North Carolina, USA Paulette Edmunds Department of Business Adminstration, Elizabeth City State University, Elizabeth City, North Carolina, USA . 2015. Achieving a competitive supply chain network for a manufacturer. *Journal of Manufacturing Technology Management* **26**:5, 744-762. [Abstract] [Full Text] [PDF]
6. Biao Sun School of Management, Xi'an Jiaotong University, Xi'an, China Yi-Ju Lo College of Management, Yuan Ze University, Chung-Li, Taiwan . 2014. Achieving alliance ambidexterity through managing paradoxes of cooperation. *European Journal of Innovation Management* **17**:2, 144-165. [Abstract] [Full Text] [PDF]
7. Ossi Pesämaa, Aviv Shoham, Joakim Wincent, Ayalla A. Ruvio. 2013. How a learning orientation affects drivers of innovativeness and performance in service delivery. *Journal of Engineering and Technology Management* **30**:2, 169-187. [CrossRef]
8. Gary D. HoltThe Centre for Business, Innovation and Enterprise, Birmingham City University, Birmingham, UK. 2013. Construction business failure: conceptual synthesis of causal agents. *Construction Innovation* **13**:1, 50-76. [Abstract] [Full Text] [PDF]