TECHNOLOGICAL OPPORTUNITIES, ABSORPTIVE CAPACITY OF EXTERNAL KNOWLEDGE AND INNOVATION IN THE CERAMIC SECTOR[1]

Mª Luisa Flor, Mª José Oltra, Cristina García, Francisco Gimeno

Department of Business Administration and Marketing
Universitat Jaume I. Spain

ABSTRACT

The aim of this paper is to demonstrate that while investing in R&D&I is a significant input to strengthening a company's innovation capacity, its global innovation does not depend exclusively on such activities. Therefore, this paper proposes that technological opportunities and developing absorptive capacity of external knowledge can be equally significant variables for achieving good innovation results.

Apart from the opportunities generated within the industry, which include technological data from suppliers and customers, the term technological opportunities is also used here to refer to opportunities that arise from knowledge obtained from innovation activities at public organisations. In order to describe a firm's capacity to absorb external knowledge, the authors have used as their basis the organisational processes through which companies acquire, assimilate, transform and exploit knowledge. To measure the resulting innovation and starting from the concept that innovation can be analysed from different viewpoints, the authors

1 This paper forms part of research project 10I429.01/1 financed by the Universitat Jaume I.

concentrate on three features of innovation: the degree to which it is radical, the degree to which it increases or destroys the firm's current technological skills, and the degree to which it represents a disruption in the marketplace.

The data was taken from a sample group comprising 41 Spanish ceramic tile manufacturers and frit and glaze producers. The results indicate that there is a positive relationship between absorptive capacity and resulting innovation in companies when innovation is seen in terms of the extent of its radical nature and its skill-building effect, although the relationship is not significant in terms of disruptive innovation. On the other hand, the results obtained indicate that only technological opportunity that comes from public research institutions has a positive relationship with innovation of a disruptive nature. In global terms, the above results indicate the relevance of the absorptive capacity of external knowledge as a source of gaining competitive edge and highlight the need to consider different facets or dimensions of innovation when analysing innovation management within the company.

1. INTRODUCTION

A significant degree of consensus exists that acknowledges the importance that external sources of knowledge and internal company processes have on corporate innovation. Among the external sources, one of the variables studied traditionally is technological opportunity (Cohen, 1995; Nieto and Quevedo, 2005; Rosenberg, 1982). Internally, apart from its R&D&I activities, the ability to absorb external knowledge - defined as the company's skill at recognising the value of new information from outside the company, assimilating it and applying it to commercial ends - is considered as one of the cornerstones of any firm's innovation performance (Cohen & Levinthal, 1990). However, efforts to identify and measure technological opportunity and absorptive capacity have varied greatly, with little agreement about the dimensions that account for such concepts. Furthermore, despite the interest aroused by the study of the combined effect of both variables on innovation, very little research exists on this matter. Moreover, innovation has habitually been measured through indicators based on the number of patents and new products, without any recognition of innovation's multi-facet nature (Gatignon et al., 2002).

This paper analyses the effect that the different types of technological opportunity and the dimensions of external knowledge absorptive capacity play on resulting innovation. The contribution and novelty of this study lie in that: (1) it highlights the need to represent technological opportunity and absorptive capacity through different dimensions; (2) it examines the combined effect of both variables on resulting innovation; and (3) it considers the different facets of resulting innovation. Thus, it differentiates between technological opportunities arising within the industry and those that are delivered from outside the industry, and also between potential absorptive capacity and realised absorptive capacity. It analyses the moderating effect of absorptive capacity on the relationship between technological opportunities and resulting innovation. With regard to the dimensions of innovation, it studies the effects of independent variables on three characteristics of innovation: the degree to which it is radical, the degree to which it increases current technological skills within the company, and the degree to which it represents disruption on the market (Gatignon et al., 2002; Govindarajan and Kopalle, 2006). To do so, the following section describes the theoretical bases and assumptions behind the research. Thereafter, the method used for the empirical study and the results obtained from it are explained. Finally the conclusions to be drawn on the basis of this research are laid out.

2. REVIEW OF THE LITERATURE AND PROPOSED HYPOTHESES

2.1. Technological opportunity

Technological opportunity can be described as the sources of external knowledge available to a company that enable it to progress technologically. In a more specific interpretation, the concept of technological opportunity is often used to describe sources of technical advancement, with special reference given to developments in the science and technologies that underlie innovation (Palmberg, 2004). Therefore, technological opportunity is developed by advancement in scientific knowledge and has a positive effect on productivity and on R&D intensity (Sterlacchini, 1994).

With regard to the influence of technological opportunities on resulting innovation, improvements in production that stem from improvements in technological opportunities can lead to more efficient production processing and to greater knowledge and skills among the R&D team (Nieto & Quevedo, 2005). In other words, adopting know-how from technological opportunities widens a firm's internal skills and increases its chances of success in innovation.

Despite extensive studies on technological opportunity in the literature, little consensus appears to exist as to how to measure it empirically (Cohen & Levin, 1989; Klevorick, Levin, Nelson & Winter, 1995). A conventional manner of reflecting it, initially proposed by Scherer (1965), was to associate it directly with the industry to which the company belongs by using a classification of industries based on their field of scientific or technical knowledge. Furthermore, other papers consider the contribution made to innovation activities by alternative sources of technological knowledge outside the industry (for instance, Becker & Peters, 2000; Oltra & Flor, 2003; Palmberg, 2004; Vega-Jurado et al., 2008).

In general terms, distinction can be made between opportunities from within the industry, which include technological information from suppliers, customers and competitors, and opportunities that come from sources outside the industry, such as opportunities related to knowledge of innovation activities taking place in public institutions (Becker & Peters, 2000; Klevorick et al., 1995).

Technological information from suppliers, customers and competitors is the basis of in-industry technological opportunities. Customers and clients provide knowledge about the functional requirements of their innovations, whereas suppliers provide knowledge about the machinery, plant, components and other types of ancillary technologies that is born within the supplier sector. Collaboration with competitors is supposed to indicate contexts in which marketing innovations call for alliances or other types of collaboration agreements, for example, that reflect weak suitability conditions (Palmberg, 2004). Sources outside the industry refer to knowledge that is acquired from institutions and organisations that do not form part of the industry's core business. In general, the relevance of interac-

tion between universities and organisations that form part of the public research infrastructure has been widely corroborated in the literature about national innovation systems. As suggested by Klevorick et al. (1995) and Palmberg (2004), breakthroughs in scientific knowledge can be considered as the strongest source of technological opportunity as a consequence of the intense interaction between basic and applied research during innovation, in the sense that the design and engineering problems arising in the industry often call for basic research in several fields. To the extent that universities are the main providers of basic research, their role in this context is crucial.

Thus, taking into account the above considerations, we propose the following hypotheses:

- Hypothesis 1a. Technological opportunities arising from sources within the industry will exert a positive influence on resulting innovation.
- Hypothesis 1b. Technological opportunities arising from sources outside the industry will exert a positive influence on resulting innovation.

2.2. External knowledge absorptive capacity

The capacity to absorb external information refers to a company's skills at identifying new information from outside its immediate realm and then assimilating it and applying it to commercial ends (Cohen & Levinthal, 1990). Despite being a fairly recent subject of Business Management research, the term has spread rapidly and is now used from different theoretical viewpoints to account for a considerable number of organisational phenomena. Although several proposals have been put forward to provide a deeper and broader definition of absorptive capacity, undoubtedly the most renowned work with the widest repercussion was published by Zahra and George in 2002.

Zahra & George (2002) depict absorptive capacity as a series of organisational routines and processes through which companies acquire, assimilate, transform and exploit knowledge. In their proposal, they suggest that these four organisational capacities enhance each other to generate absorptive capacity, a dynamic capacity that bears upon the ability of a company to create and deploy the knowledge required to construct other organisational capacities. These authors distinguish between two types of absorptive capacity - potential absorptive capacity and realized absorptive capacity. Potential absorptive capacity includes the processes of acquiring and assimilating external knowledge. Potential absorptive capacity does not guarantee the exploitation of this external knowledge; for that purpose, realised absorptive capacity is required, which includes processes that transform and exploit knowledge. Zahra & George (2002) point out that, to the extent that absorptive capacity can be represented as a series of knowledge-based capacities, the company's skills at creating, handling and effectively exploiting knowledge is a critical resource that can provide an enterprise with significant competitive edge.

Potential absorptive capacity enables a company to assume changes in industry more effectively, thereby facilitating the development of capabilities it requires such as technological and production skills at the most appropriate time. In this regard, it provides enterprises with the strategic flexibility required to adapt and develop within highly dynamic environments. In this way, companies that have potential capacity to absorb external knowledge can reshape their resource base to make the best use of emerging strategic opportunities. For example, such opportunities may help companies to maintain a higher sustained performance level thanks to the advantages of being the first mover, their greater receptiveness towards customers, and other strategic advantages. Thus, in accordance with the above, we propose the following hypothesis:

- Hypothesis 2: Potential absorptive capacity of knowledge will exert a positive effect on a company's resulting innovation.

Although potential absorptive capacity of knowledge is required to identify and filter relevant external information and to understand it within the context of the company, a competitive edge in innovation will only materialise if the firm also has realised absorptive capacity (Fosfuri & Tribó, 2008). Unquestionably, knowledge, once detected by the organisation, needs to be shared amongst the members of the company and then transformed and integrated with knowledge generated internally. Realised absorptive capacity comprises transformation and exploitation processes. Transformation refers to a company's skills at developing and improving its routines to facilitate the combination of current knowledge with newly acquired and assimilated knowledge. This can be achieved by adding or eliminating knowledge or simply by interpreting the same knowledge in a different way. Exploitation as an organisational capability is based on routines that enable the company to polish, extend and lever current faculties or to create new ones by incorporating newly acquired and assimilated knowledge into its current operations. While transformation helps companies to develop new perception schemes or to change its existing processes, exploitation converts knowledge into new products (Kogut & Zander, 1996). Therefore, transformation and exploitation capacities that underlie realised absorptive capacity will influence the company's results in terms of product and process innovation (Zahra & George, 2002), which leads us to propose the following hypothesis:

- Hypothesis 3. Realised absorptive capacity will exert a positive effect on the company's resulting innovation.

2.3. The moderating role of absorptive capacity

The existence of technological opportunities in a particular sector does not have an identical effect on all companies operating in that sector but rather its effect will depend on the individual capacity each firm has to take advantage of such opportunities as a consequence of its aggregate knowledge. As Klevorick et al. (1995) indicate, only those firms that have accumulated a critical mass of

knowledge and possess a certain level of absorptive capacity will be able to take advantage of technological opportunities, whereas those companies that do not have such a minimal level of knowledge will not be able to reap the benefit from technological opportunity. On the basis of this viewpoint, absorptive capacity could be considered to represent a link between external sources of technological opportunities and the firm's internal capability to develop new products and processes. This concept therefore describes a complementary relationship that may arise between both variables.

Holmen et al. (2007) emphasise the relevance of perception and uncertainty during the choices involved in any innovation process. To the extent that potential absorptive capacity plays an important role on appreciating and understanding the potential of any external knowledge to renew the firm's knowledge and skills base required to compete in changing markets, those companies with higher potential absorptive capacity are able to take greater advantage of emerging technological opportunities.

Furthermore, both the information that comes from combining existing knowledge with newly acquired knowledge and the information that results from incorporating that resulting knowledge into in-house processes to obtain innovations are important tools for reaping the greatest benefit from technological opportunities. According to Holmen et al. (2007), a technological opportunity only exists if there also exists the possibility of identifying and using new technological and scientific knowledge, if the chance to use that knowledge to create financial gain exists and if parts of that value can be used in some way by the company looking for opportunity. In this sense, only those companies that have a critical mass of knowledge are able to use the technological opportunities around them as tools to expand their innovation capabilities. Therefore, it is fair to conclude that the higher the level of realised absorption capacity is, the greater will be the effect of technological opportunity on resulting innovation. With such arguments in mind, we therefore propose the following hypothesis:

- Hypothesis 4. A company's potential absorptive capacity will exert a moderating effect on the relationship between technological opportunity and resulting innovation.
- Hypothesis 5. A company's realised absorptive capacity will exert a moderating effect on the relationship between technological opportunity and resulting innovation.

3. STUDY SCOPE AND DATA COLLECTION

The data used to contrast our hypotheses was taken from a sample group of 41 Spanish companies with more than 50 employees, which are manufacturers of ceramic tiles and glaze and frits for the ceramic industry. According to Pavitt's model (1984) of classifying the linkages between sectors, most ceramic tile manu-

facturing enterprises are considered to fit into the category of 'supplier-dominated' and 'scale-intensive' industries. In 'supplier-dominated' companies, opportunities to innovate arise to a large extent from outside the company, although the firm has to be active and firmly committed to innovation. In companies that operate in scale-intensive industries, innovation activities are developed in internal departments and supported by collaboration with suppliers as sources of innovation and which on many occasions are innovations aimed at reducing manufacturing costs. For their part, frit and glaze producing enterprises can be considered as specialist suppliers, where internal innovation activities are enhanced by the role of the customers and the emphasis they place on product innovation.

Data collection took place between December 2009 and April 2010 by means of telephone surveys. Each company was subjected to 2 different interviews: data about questions relating to absorptive capacity was obtained from the Head of R&D&I or equivalent, whereas the data about technological opportunity and innovation characteristics was provided by the General Manager in most cases, or exceptionally by the Sales Manager, depending on the company. Heads of R&D&I were also asked about technological opportunities and innovation characteristics and the data they provided was used to assess the validity of our scales.

Table 1 gives statistics describing some of the characteristics of the firms participating in the study.

Variable	Mean	Standard deviation
Employees	188	151.6
Employees involved in R&D	8	6.1
Number of R&D projects carried out in cooperation with universities and public research centres (period 2006–2008)	2	1.5
Number of R&D projects carried out in collaboration with private companies (period 2006 – 2008)	3.8	3.2
Percentage of companies that have received financial aid from public entities to develop R&D projects	80 %	0.4
Significance in percentage terms of public financing over total funds destined to R&D	17.9 %	19.4
Percentage of sales turnover corresponding to innovations that were exclusively a novelty for the company (2008)	29.4 %	15.7
Percentage of sales turnover corresponding to innovations that were a novelty for the market (2008)	22.4 %	12.2

Table 1. Characteristics of the firms participating in this study

4. MEASUREMENT OF VARIABLES

4.1. Resulting innovation

In this paper, the representation of innovation in an enterprise is based on the scales proposed by Gatignon et al. (2002) and Govndarajan & Kopalle (2006) to evaluate the degree of novelty in an innovation, to what extent the innovation increases/destroys existing technological capabilities in the company, and the degree of disruption that such innovation represents on the market. These data were taken from the replies given by the General Managers or heads of the companies, who recorded on a scale of seven points the extent to which they agreed or disagreed with various statements related to the innovations developed by the company over the period 2006–2008.

Degree of novelty was indicated through the following items: (1) it represents a minor improvement over previous technology; (2) it constitutes a significant breakthrough (breakthrough innovation); (3) it has created a product that would be difficult to replace with others based on older technologies (given that it substitutes those older products); (4) it represents a significant technological breakthrough in a sub-system, part or component of the product. The reliability of the scale that was finally used (from which the first item was removed) was tested using the Cronbach alpha test, in which it scored 0.889.

To measure to what extent the innovation increases the firm's current technological capacities, the following items were used: (1) it has made significant use of the technological capacities the firm already possessed; (2) to a large extent it has been supported by experience and expertise already existing at the company; (3) it has been intensely supported by existing technological knowledge. The Cronbach alpha test returned a score of 0.617.

The degree to which existing technological skills are destroyed was measured using the following items (1) it has led the company's expertise to be seen as antique and obsolete; (2) it has led to the skills required to master the old technology becoming antiquated; (3) mastering the old technology has not been of help for the company to handle the innovations. The Cronbach alpha test on this scale gave a result of 0.768.

Finally, the degree of disruption produced by the innovation was measured using the following items: (1) the new products have been very attractive for a different segment of the market than was initially foreseen; (2) over time, the new products have become attractive for most customers as they have managed to satisfy their requirements; (3) the degree of disruption by the innovations (1= not at all disruptive; 7= very disruptive). The reliability of this scale was examined using the Cronbach alpha test, on which it scored 0.727.

4.2. Technological opportunities

In order to describe technological opportunities, the data used had been provided by the senior company manager with regard to the importance which, in his/her opinion, cooperation with different organisations had had as a source of information. Technological opportunities in the industry, which stem from links with other companies, were measured by means of two variables: cooperation with suppliers and customers, again measured by two items; and cooperation with competing companies. Opportunities not directly related to the industry that come from research centres were measured from the average ratings given by the company to the following activities as sources of innovation: (1) cooperation with universities; (2) cooperation with public research institutes; and (3) cooperation with technology centres. The Cronbach alpha test score of 0.750 confirmed the reliability of this scale.

4.3. Absorptive capacity

In order to account for potential and realised absorptive capacity, we adapted most of the items used by Jansen et al. (2005), who, in turn, had based their work on Zahra & George (2002) and Szulanski (1996) to include skills related to identifying, assimilating, transforming and exploiting external knowledge. These items were evaluated by the heads of R&D&I using a 7-point Likert scale, where they reflected the extent to which they agreed or disagreed with various statements.

Potential absorptive capacity, made up of knowledge acquisition and transformation processes, was measured according to the following items: (1) we rapidly understand new opportunities that arise to serve our customers; (2) we swiftly analyse and interpret changing market demands; (3) employees record and preserve new knowledge for future use; (4) we swiftly recognise the improvement that new external knowledge may give to our current knowledge; (5) there exists a clear division of roles and responsibilities when incorporating new knowledge. The Cronbach alpha test score for this scale was 0.836.

Realised absorptive capacity was measured according to the following items: (1) we incorporate external technological knowledge into our company; (2) we regularly consider the consequences of market changes in terms of new products and services; (3) we reap the maximum benefit from the opportunities that new external knowledge represents for the company; (4) we regularly meet to discuss the consequences of new trends in our sector and the development of new products; (5) we know how to perform our business activities when new knowledge is incorporated; (6) we constantly discuss how best to exploit external knowledge; (7) our employees share a common language to handle questions relating to new products and services. The reliability of this scale was tested using the Cronbach alpha test, on which it scored 0.707.

4.4. In-house R&D&I implementation

The company's internal commitment to innovation was measured as the ratio between the number of employees that form part of the R&D&I department over the total number of employees.

5. ANALYSIS AND RESULTS

	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10
1. Radical innovation	4,48	1,27	1									
2. Innovation that destroys competence	4,62	1,08	,266	1								
3. Innovation that increases competence	4,85	,94	,723	,374	1							
4. Disruptive innovation	4,56	1,05	,394	,464	,472	1						
5. In-house R&D&I	6,72	5,41	,200	-,038	,241	,224	1					
6. Technological opportunities from research institutes	5,02	1,07	,060	,095	,262	,506	,055	1				
7. Technological opportunities from the industry	5,38	,71	-,021	-,008	,084	,055	,207	,274	1			
8. Technological opportunities from competitors	4,98	1,46	,227	,211	,106	,249	-,151	,161	-,052	1		
9. Potential absorptive capacity	4,87	1,01	,454	,313	,372	-,105	,152	-,227	,160	,151	1	
10. Realised absorptive capacity	5,04	,62	,452	,454	,447	,096	-,001	-,094	,166	,367	,712	1

Table 2 shows the statistics that describe and correlate the variables used in the study.

Multiple regression analysis was used to contrast our hypotheses. A hierarchical procedure was adopted and different models estimated (table 3). In the first stage, R&D&I activities and the different types of technological opportunities were introduced as separate variables for each characteristic of the innovation, as was resulting innovation (models 1, 4, 6 and 10). In the second stage, the potential absorptive capacity and realised absorptive capacity variables were incorporated (models 2, 5, 7 and 11). Finally, different additional models were estimated in order to analyse the moderating effect of absorptive capacity between technological opportunities and resulting innovation. For this purpose, we incorporated an interaction term into each equation in the regression analysis which represented the effect of absorptive capacity and each type of technological opportunity (models 3, 8, 9, 12 and 13).

6. DISCUSSION AND CONCLUSIONS

This paper has confirmed that technological opportunities and external knowledge absorptive capacity influence innovation in companies belonging to the ceramic industry. On the whole, the results indicate the positive influence that external knowledge from universities and research centres has both in the case of innovation that supports and strengthens the firm's technological capabilities and innovations of a disruptive nature. Likewise, absorptive capacity exerts a positive

effect on resulting innovation in the case of radical, destructive and competition building innovation, which can be seen in the increased variance of the relevant variable when both dimensions of absorptive capacity are built into the regression analysis models.

Technological opportunities whose source is co-operation with suppliers and customers do not contribute to greater innovation in any of the models under study here. This circumstance may be interpreted as being due to the fact that the indistinct nature of the innovation does not lead to clear commercial advantage. In other words, although knowledge from suppliers and customers is typically used by companies in the industry to develop their businesses, it will not contribute significantly to them obtaining better results in innovation. On the other hand, co-operation with research centres and universities reveals a positive influence. In this sense, the distinctive nature of such activities should be underlined, as they indicate a stronger intention by companies to obtain a commercial edge from the technological innovation and the back-up it provides to their own internal innovation processes.

Finally, the identification of various models in which the terms of interaction account to a large extent for the variation in independent variables demonstrates to what extent external sources of knowledge complement a company's capacity to identify, assimilate, transform and exploit such knowledge.

Table 3. Results of multiple regression analysis

	Radical innovation			Destructive Innov.		Enhancing Innov.				Disruptive Innov.		
Variable	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Mod6	Mod 7	Mod 8	Mod 9	Mod10	Mod11	Mod12
In-house R&D&I	0,251	0,199	,282*	-0,01	-0,032	0,247	0,209	,299*	,304*	,247*	,271*	,359*
Rechnological opportunities Research centres (OtInv)	0,022	0,183	3,785*	0,069	0,196	0,243	,402*	1,998*	4,491*	,528*	,516*	2,064*
Technological opportunities From Industry (OTProv.Cl)	-0,062	-0,195	-,337*	-0,024	-0,146	-0,039	-0,182	-,285*	-,343*	-0,156	-0,164	-0,264
Technological opportunities From competitors (OTComp)	0,258	0,08	0,15	0,172	-0,018	0,075	-0,135	-0,109	-0,055	0,136	0,097	0,122
Potential absorptive capacity (PAC)		0,289	0,166		0,077		0,185	1,478*	0,045		-0,178	1,075
Realised absorptive capacity (RAC)		0,27	2,503*		,433*		0,414	,500*	2,948*		0,209	0,292
OT Inv*PAC								-1,851				-1,795
OT Inv*RAC			-4,005*						-4,546*			
R^2	0,112	0,328	0,434	0,039	0,233	0,125	0,378	0,43	0,515	0,352	0,37	0,419
R^2 Adjust.	0,01	0,206	0,31	-0,071	0,093	0,025	0,265	0,305	0,409	0,277	0,256	0,292
R		0,22	0,106		0,194		0,253	0,052	0,137		0,019	0,049

* Ratio is significant at 0.1.

REFERENCES

[1] Becker, W. y Peters, J. (2000) Technological opportunities, absorptive capacities y innovation. Paper presented at The Eighth International Joseph A. Schumpeter Society Conference, Manchester, July 2000.

[2] Cohen, W. y Levinthal, D. (1990) Absorptive capacity: A new perspective on learning and innovation, Administrative Science Quarterly, 35, 128-152.

[3] Escribano, A., Fosfuri, A. Tribó, J. (2009). Managing external knowledge flows: The moderating role of absorptive capacity. Research Policy, 38, 96–105.

[4] Fosfuri, A. y Tribó, J.A., 2008. Exploring the antecedents of potential absorptive capacity and its impact on innovation performance. Omega, 36(2), pp. 173-187.

[5] 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, 1103-1122.

[6] Govindarajan, V. and Kopalle, P.K. (2006). Disruptiveness of innovations. Measurement and an assessment of reliability and validity. Strategic Management Journal, 27, 189-199.

[7] Holmén, M., Magnusson, M. y Mckelvey, M., 2007. What are innovative opportunities? Industry and Innovation, 14(1), pp. 27-45.

[8] Jansen, J.J.P., Van Den Bosch, F.A.J. y Volberda, H.W., 2005. Managing potential and realized absorptive capacity: How do organizational antecedents matter? Academy of Management Journal, 48(6), pp. 999-1015.

[9] Kim, L. (1998). Crisis construction and organizational learning: Capability building in catching-up at Hyunday Motor. Organization Science, 7: 502-518.

[10] Klevorick, A. K.; Levin, R. C.; Nelson, R. R. y Winter, S. G. (1995) On the sources and significance of inter-industry differences in technological opportunities, Research Policy, 24, 185-205.

[11] Kogut, B. Y Zander, U., 1996. What Firms Do? Coordination, Identity, and Learning. Organization Science, 7(5), pp. 502-518.

[12] Lane, P.J., Koka, B.R. y Pathak, S., 2006. The reification of absorptive capacity: A critical review and rejuvenation of the construct. Academy of Management Review, 31(4), pp. 833-863.

[13] Lichtenthaler, U. (2009). Absorptive capacity, environmental turbulence, and the complementarity of organizational learning processes, Academy of Management Journal, 52 (4): 822-846.

[14] Nieto, M. y Quevedo, P., 2005. Absorptive capacity, technological opportunity, knowledge spillovers, and innovative effort. Technovation, 25(10), pp. 1141-1157.

[15] Oltra, M.J. y Flor M.L., 2003. The impact of technological opportunities and innovative capabilities on firm's output innovation. Creativity and Innovation Management, 12(3), pp. 137-144.

[16] Palmberg, Ch., 2004. The sources of innovations - looking beyond technological opportunities. Economics of Innovation & New Technology, Vol. 13, Issue 2, pag. 183-197

[17] Rosenberg, N. (1982). Inside the black box. Technology and Economics. Cambridge, Cambridge University Press

[18] Sterlacchini, A. (1994). Technological opportunities, intraindustry spillovers and firm R&D intensity, Economic Innovation and New Technology, 3, 123-137.

[19] Vega-Jurado, J., Gutiérrez-Gracia, A. y Fernández-De-Lucio, I., 2008. Analyzing the determinants of firm's absorptive capacity: Beyond R&D. R&D Management, 38(4), pp. 392-405.

[20] Zahra, S.A. y George, G., 2002. Absorptive capacity: A review, reconceptualization, and extension. Academy of Management Review, 27(2), pp. 185-203.