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Importance of knowledge sources for innovation: An analysis of service companies in Colombia

Importancia de las fuente de conocimiento para la innovación: un análisis de las empresas de servicios en Colombia

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Abstract

This paper aims to analyze the importance of external and external sources of knowledge (based on science, market, and technical assistance) according to the innovation typology of firms (innovative and potentially innovative). For this purpose, data from the Technological Development and Innovation Survey EDITS VII (2018-2019) were used, an official survey that collects information on the innovation dynamics of companies in the service sector in Colombia. The data were analyzed using joint multivariate analysis procedures, which simultaneously perform two optimization processes: dimensionality reduction and clustering. The results indicate that innovative companies give greater importance to internal sources of knowledge, compared to innovative ones. Similarly, for innovative companies, access to market-based sources and technical assistance is more relevant. Regarding scientific sources, only significant differences are evident in the importance of knowledge derived from universities among the types of companies analyzed. Finally, an inverse relationship was found between the family character and the importance given by companies to internal and external sources of knowledge to innovate. Likewise, companies that invest in R&D and training give greater importance to internal and external sources of knowledge to innovate.

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JEL Code: 031, 036
Keywords: sources of knowledge; information sources; open innovation; innovative orientation; family business

Resumen

Este estudio analiza la importancia de las fuentes de conocimiento internas y externas (basadas en la ciencia, el mercado y la asistencia técnica) de acuerdo con la tipología de innovación de las empresas (innovadoras y potencialmente innovadoras). Para este propósito, se utilizaron datos de la Encuesta de Desarrollo e Innovación Tecnológica EDITS VII (2018-2019), una encuesta oficial que recopila información sobre la dinámica de innovación de las empresas del sector servicios en Colombia. Los datos fueron analizados mediante procedimientos de análisis multivariante conjunto, el cual realiza simultáneamente dos procesos de optimización: reducción de dimensionalidad y agrupación. Los resultados indican que las empresas innovadoras otorgan mayor importancia a las fuentes internas de conocimiento, en comparación con las potencialmente innovadoras. De forma similar, para las empresas innovadoras es más relevante el acceso a fuentes basadas en el mercado y en la asistencia técnica. Respecto a las fuentes científicas, solo se evidencia diferencias significativas en la importancia del conocimiento derivado de las universidades entre las tipologías de empresas analizadas. Finalmente, se encontró una relación inversa entre el carácter familiar y la importancia otorgada por las empresas a las fuentes de conocimientos internas y externas para innovar. Asimismo, las empresas que invierten en I+D y en formación otorgan una mayor importancia a las fuentes de conocimiento internas y externas para innovar.

Código JEL: 031, 036
Palabras clave: fuentes de conocimiento; fuentes de información; innovación abierta; orientación innovadora; empresa familiar

Introduction

Innovation determines business performance and economic development (Bendig et al., 2020; Lee et al., 2019; Saparaliyev et al., 2019). Innovation began to position itself as an independent field of research during the 1960s, a date from which academic studies and the need to adequately measure the innovation initiatives of companies, industries, and countries have increased (Fagerberg, 2005). In recent years, the traditional view of innovation development, which is exclusively internal, has been transforming and moving toward a paradigm of external knowledge acquisition through open innovation processes (De Beule & Van Beveren, 2019). This concept assumes collaboration can become an important enabler of the innovative process (Chesbrough, 2003). From this perspective, innovation strongly depends on the generation, diffusion, and application of knowledge generated by different actors (Doloreux et al., 2021). Nevertheless, until recently, there has been little consensus regarding the contribution of each knowledge source in the development of new products, making it one of the most poorly explored areas in the field of open innovation (De Beule & Van Beveren, 2019). Indeed, there is an ongoing debate in the literature about the conditions under which companies can benefit from using knowledge sources (Duong et al., 2022).

Additionally, Demircioglu et al. (2019) highlight that, despite their importance, very few studies empirically analyze the links between innovative performance and the sources of knowledge used to guide the innovation process. Therefore, the literature presents mixed results regarding the impact of different external sources on innovative performance (Duong et al., 2022). These discussions suggest the need to delve deeper into how various sources of knowledge can enhance or not companies' degree of innovation orientation (Duong et al., 2022; Kumar et al., 2018). Accordingly, this study aims to analyze the importance attached to internal and external knowledge sources according to the innovation typology of service companies in Colombia.

The study addresses the context of small and medium-sized enterprises (SMEs) in an emerging economy. Globally, SMEs are important drivers of economic development (Adeyeye et al., 2018; De Moraes Silva et al., 2020; Robbins & O'Gorman, 2016) and contribute significantly to the development and diffusion of innovation (Robbins & O'Gorman, 2016). Thus, successful innovation management is an important goal for SMEs (Filser et al., 2018; Kim et al., 2018; Robbins & O'Gorman, 2016). Nevertheless, innovation can become a complex task for these types of companies due to the obstacles they face in the process (Filser et al., 2018; Strobel & Kratzer, 2017), considering that additionally, the analysis of innovation dynamics is a relevant topic for the development of public policies (Hewitt-Dundas, 2006; Tello, 2021), because barriers to innovation are present in any economy, especially in developing countries (Pereira Cabral et al., 2020), in which most of the companies are SMEs (Adeyeye et al., 2018).

This paper is structured as follows: first, the research hypotheses are presented. Second, the methodological aspects are explained, describing the database, the type of variables, and the data analysis techniques. Third, the results and discussion of the study are described. Finally, the conclusions, limitations, and future lines of research are presented.

Review of the literature and hypotheses

Internal sources of knowledge and open innovation

Innovation is among the most discussed topics in organizational, economic, and management studies. Nonetheless, research on sources of knowledge and innovation has mainly focused on external sources and the generation of technological innovations (Damanpour et al., 2018). Very few studies analyze employees as a source of innovation (Demircioglu et al., 2019). Schweisfurth (2017) highlights that employee ideas represent the starting point of the innovation process. Additionally, the study by Ramayah et al. (2020) confirms that internal sources are associated with absorptive capacity. Additionally,

absorptive capacity strongly predicts innovative performance (Ramayah et al., 2020). Based on the above, the following hypothesis is put forward:

H1: Compared to potentially innovative companies, innovative companies attach greater importance to access to internal information sources.

On the other hand, the concept of open innovation arises to address the Porterian postulate based on the fact that companies that want to achieve a long-term competitive advantage should be concerned about creating "barriers to entry" that prevent the emergence of new businesses and that most efforts should be concentrated on subtracting market share from competitors (Magendzo, 2018). From that perspective, innovation initiatives are developed only from the inside. In contrast to this view, open innovation seeks to involve the company directly with external factors such as clients, suppliers, universities, consulting centers, startups, and competitors, among others, to implement more agile and efficient innovation processes (Chesbrough, 2003).

Open innovation is commonly related to collaboration or cooperation. Nevertheless, open innovation is a much broader concept, including collaboration and cooperation as mechanisms to innovate. Open innovation is mainly based on theories such as absorptive capacity or dynamic capabilities. Specifically, absorptive capacity refers to the utilization of knowledge within the company and the ability of companies to acquire, assimilate, and exploit knowledge (Perri & Anderson, 2014), while dynamic capability is the ability of a company to create or modify its resource base by itself (Lichtenthaler & Lichtenthaler, 2009). The main contributions of these two theoretical approaches to open innovation lie in the assumption that the company can generate new knowledge within itself but can also be acquired from external sources (Lichtenthaler & Lichtenthaler, 2009). This idea suggests that to cope with technological and market turbulence, companies must constantly update their capabilities (Jiménez Jiménez & Sanz Valle, 2012) and establish alliances with external actors to benefit from their experience and knowledge (De Beule & Van Beveren, 2019).

Additionally, open innovation has been analyzed from theoretical frameworks such as transaction cost theory, cognitive theory, organizational learning theory, game theory, knowledge-based theory of the company, human capital theory, social exchange theory, contingency theory, the resource-based view of the company and from the perspective of creativity (Bertello et al., 2023).

Current organizational dynamics have increased the exploration of multiple sources for generating ideas (Kumar et al., 2018). Nevertheless, understanding open innovation's full benefits and limitations remains challenging (Bogers et al., 2019). Multiple literature reviews such as Lopes and de Carvalho (2018) have typified the main actors in an open innovation context (competitors, consultants, clients, government, suppliers, universities, and research centers), corporate performance indicators (financial indicators, market share, profitability, client satisfaction, and sales growth), indicators of

innovative behavior (new products, R&D, intellectual property, and turnover), and contingent variables (company size and age, industry sector, country, intensity of competition, number of allies, and technological and market uncertainty). On the other hand, recent literature reviews analyze the main risks associated with the open innovation process (Madanaguli et al., 2023), the limits (Saura et al., 2023), and their measurement in small and medium-sized companies (Carrasco-Carvajal et al., 2023).

On the other hand, external knowledge is vital in generating innovations (Duong et al., 2022). The literature points out that there are at least four types of knowledge sources that can impact a company's innovative performance: internal ones (e.g., employees); market-based sources, such as clients, competitors, and suppliers; science- or knowledge-based sources, such as universities and public or private research centers; and technical assistance sources, such as access to specialized consulting and entities with very specific technical capabilities (De Beule & Van Beveren, 2019; Duong et al., 2022; Rahmouni et al., 2010). The sources of knowledge used by business organizations also vary depending on the type of innovation. For example, the sources related to business innovations may differ from those required in process innovations (Demircioglu et al., 2019). It has been found, for example, that process innovations are supported by collaboration with suppliers and embedded technological knowledge, while companies conducting product innovations privilege external knowledge sources from the market and scientific institutions (Hervas-Oliver et al., 2021).

Thus, the innovation process is strongly impacted by access to knowledge sources and the combination of internal and external knowledge (Ben Arfi et al., 2018). According to Carpio Gallegos and Miralles (2018) and from a study conducted in companies of low and medium technological intensity in Peru, science-based knowledge sources positively impact product innovation. Specifically, universities are crucial sources for innovation (Demircioglu et al., 2019). For example, university-industry collaborations have been found to improve the innovative performance of companies, which is why companies should consider forming alliances with other companies and universities, as this can increase the knowledge and resource base of the organization (Tian et al., 2022). Considering the above, the following hypothesis is proposed:

H2: Compared to potentially innovative companies, innovative companies attach greater importance to access to science-based knowledge sources.

Market sources, such as clients and suppliers, have also favored product development (Del Carpio Gallegos & Miralles, 2018), and organizational and process innovations (Cesário et al., 2015). Likewise, leading users are a determining source for product development (Hamdi-Kidar et al., 2019; Schweisfurth, 2017). Thus, strong relations with suppliers and clients would be expected to positively impact organizational innovation outcomes (Medhi et al., 2019). Bertschek and Kesler (2022) conclude that feedback from clients in social networks is an important source for product innovation. On the other

hand, the study by Pihlajamaa et al. (2017) points out that innovations undertaken by suppliers could even replace the organization's internal R&D. Nevertheless, this fact establishes new requirements for the acquisition, transformation, and exploitation of knowledge, emphasizing the development of supplier management capabilities in the open innovation process (Pihlajamaa et al., 2017). Following the above, the following hypothesis is proposed:

H3: Compared to potentially innovative companies, innovative companies attach greater importance to accessing sources of market knowledge.

The literature has pointed out that companies that interact with technical assistance sources (such as consultants) achieve better innovative performance (Maghni & Oukaci, 2018) since collaborating with these actors enables access to specialized knowledge to support innovation processes. Accordingly, the results of Solomon et al. (2013) suggest that managerial and technical assistance positively affects the survival and growth of organizations. Considering the above, the following hypothesis is established:

H4: Compared to potentially innovative companies, innovative companies value access to sources of technical assistance knowledge more.

Dynamics of innovation in family-owned companies

The characteristics of a company can affect how it benefits or does not benefit from various sources of knowledge to innovate. Family-owned companies, for example, face significant challenges because it has sometimes been found that organizations of this nature have serious difficulties in managing the knowledge required in their innovation processes (Koentjoro & Gunawan, 2020). Additionally, some characteristics of family companies can negatively affect their innovative performance, among them adopting a conservative posture in management aspects due to the desire to maintain control and ownership in the hands of family members. In addition, these types of companies sometimes may resist hiring external personnel and avoid external support for innovation projects (Muñoz-Bullón et al., 2020).

The likelihood of family firms developing innovative products or services increases when they cooperate in R&D with different actors (Amato et al., 2021). In line with the above, the study by Akram et al. (2020) concludes that the depth and breadth of external knowledge search by family companies positively influences the development of new products. Additionally, the review of research trends by de las Heras-Rosas and Herrera (2021) points out that the phenomenon of open innovation in the context of small and medium-sized enterprises (SMEs) and family companies requires further development in order to understand the challenges they face in their collaborative measures.

Family firms can innovate despite investing less in R&D (Feranita, 2021). Nevertheless, empirical evidence on how these companies convert innovation inputs into innovative products is scarce (Feranita, 2021). Following the above, the following hypothesis is posed:

H5: Family companies attach less importance to internal and external knowledge sources to innovate than non-family companies.

The role of innovation capabilities in access to knowledge sources

Depending on their capabilities, such as their position in the value chain, the type of industry, and its market conditions, companies decide where to direct their innovation efforts, including investments in internal knowledge development or access to external knowledge (Hervas-Oliver et al., 2021). In this context, opportunity identification and absorptive and collaborative capabilities are dynamic capabilities necessary for incoming open innovation (Pihlajamaa, 2021).

Audretsch and Belitski's (2022) study analyzes the effect of research and development (R&D) on innovation in companies. In their approach, combining open innovation mechanisms with internal sources such as R&D departments or investment in technology positively impacts innovation. Additionally, the results of Anzola-Román et al. (2018) confirm the positive effect of the joint use of internal and external sources on companies' innovation measures. Nevertheless, compared to internal inputs, external knowledge inputs have a greater impact on firm innovation and productivity in different sectors (Audretsch & Belitski, 2022). Consequently, companies that achieve greater internal integration improve their capabilities to acquire external knowledge and, as a consequence, are more innovative (Ferraris et al., 2020). In view of the above, the following hypothesis is proposed:

H6: Companies that invest in R&D and training attach greater importance to internal and external knowledge sources for innovation.

Methodology

Below are described aspects of the database, the variables used to evaluate the hypotheses, and the data analysis techniques.

Database and variables

This study used anonymized microdata from Colombia's official innovation survey, "Encuesta de Desarrollo e Innovación Tecnológica, EDITS," corresponding to the period 2018-2019 (Departamento Administrativo Nacional de Estadística, 2021), which analyzes the innovation dynamics of 19 service subsectors in Colombia. According to the methodology used in the survey, innovative companies, in the strict sense, are those that, in the reference period, obtained at least one new or significantly improved service or good in the international market (Departamento Administrativo Nacional de Estadística, 2021). Additionally, the typology of innovative companies broadly corresponds to companies that obtained at least one innovation for the national market or the company. On the other hand, potentially innovative companies do not obtain any innovation but report having in process or having abandoned some innovation project (Departamento Administrativo Nacional de Estadística, 2021). The survey includes a total of 9 304 service companies, classified into four categories according to the level of innovation in the reference period of the survey (Table 1):

Table 1
Participation of companies in the EDITS survey (2018-2019) according to innovation typology

Typology	Number of companies	Percentage
Innovative in the strictest sense	6	0.06%
Innovative in the broadest sense	2690	28.91%
Potentially innovative	312	3.35%
Non-innovative	6296	67.67%
Total	9304	100.00%

Source: National Administrative Department of Statistics (2021).

Based on the innovation typology (Table 1), this study analyzes the importance of the sources of innovation for innovative companies in a broad and strict sense compared to potentially innovative ones. This analysis is because, according to the survey methodology, non-innovative companies do not answer the questions related to sources of knowledge and information. Accordingly, this analysis is conducted on 3 008 companies in the service sector in Colombia. For these companies (classified as innovative or potentially innovative), the survey includes the following question: "Indicate whether or not the following sources of information and knowledge were important as the origin of ideas to develop or implement new or improved services or goods, or the implementation of new or improved processes, during the period 2018 - 2019 in your company." The answer to this question is dichotomous. In this case, the variable takes a value of 1 in the case of companies that consider each source of knowledge important in the innovative process and 0 otherwise. According to previous literature (De Beule & Van Beveren, 2019; Duong et al., 2022; Rahmouni et al., 2010), the different knowledge sources were classified into

four categories: internal knowledge sources (FII), science-based knowledge sources (FCC), market-based knowledge sources (FCM), and technical assistance-based knowledge sources (FCAT) (Table 2).

Table 2
Sources of knowledge analyzed in the study

Category	Associated knowledge sources
Internal knowledge sources (FII)	Internal R&D Department
	Production Department
	Sales and marketing department
	Other company department
	Specific interdisciplinary groups to innovate
	Senior management of the company
	Other related company (if part of a conglomerate)
	Foreign parent company
Science-based knowledge sources (FCC)	Universities
	Technology Development Centers (TDC)
	Autonomous research center
	Training centers or technology parks
Market-based knowledge sources (FCM)	Competitors or other companies in the industry (except the R&D department)
	Clients
	Suppliers
	Other companies
Sources of knowledge based on technical assistance (FCAT)	Consultants, experts, or researchers
	Associations or sectorial associations
	Chambers of Commerce

Source: created by the authors.

The innovation capacity variable was measured from two survey questions related to investment in internal R&D ("Indicate the value invested by your company in the years 2018 and 2019 in scientific, technological, and innovation for the introduction of new or improved services or goods, or the implementation of new or improved processes") and investment in education and training ("Indicate the value invested by your company in the years 2018 and 2019, in scientific, technological and innovation, for the introduction of new or improved services or goods, or the implementation of new or improved processes"). In this case, the variable takes a value of 1 for companies reporting any amount of investment or in training and education and 0 otherwise.

On the other hand, the survey includes the following question related to the family nature of the companies: "Is the company managed by the founder or by a relative of the founder?" using a dichotomous scale. This variable takes a value of 1 for the companies that answer "Yes" and 0 for the companies that answer "No."

Data analysis

For all variables, marginal analyses were conducted with frequencies and percentages, contingency tables, and measures of association. In order to evaluate the effect of each factor on the dependent variable, association tests were conducted using Pearson's Chi-Square statistic. A Kendall correlation matrix was obtained for the internal (FII) and external (science-based "FCC," market-based "FCM," and technical assistance "FCAT") knowledge sources indicators. Subsequently, a multiple correspondence analysis (MCA) was conducted with a cluster analysis, explained below.

Tandem multivariate analysis and conjoint multivariate analysis

A tandem analysis is a sequence of analyses with related objectives; it usually includes a dimensionality reduction analysis followed by a clustering analysis (Greenacre & Blasius, 1994). Nevertheless, tandem analysis is not an analysis that simultaneously optimizes the two processes, and may generate some inconsistencies, so procedures have been created that conduct this optimization jointly. In this regard, Markos et al. (2019a) present a review of the theoretical and methodological elements that support this family of "ensemble" multivariate techniques, which are new procedures of joint multivariate analysis that simultaneously conduct two optimization processes: dimensionality reduction (working on the variables) and clustering (of individuals/observations) from the creation of groups.

Two options have been developed, both theoretically and numerically: (1) when the data are categorical, a cluster analysis (CA) is conducted in conjunction with a dimensionality reduction via multiple correspondence analysis (MCA); and (2) when the data are quantitative, a cluster analysis (CA) and a dimensionality reduction by the principal component analysis (PCA) method are conducted. In order to conduct these procedures, specialized libraries have been developed in free software, which produce numerical and graphical outputs that report the association between variables and the clustering of individuals (Markos et al., 2019b). Option (1) was chosen, in this case, with dichotomous variables: a joint MCA with a cluster analysis.

Results

This section presents the results derived from the statistical analysis. Table 3 shows that the proportion of innovative companies (in a broad or strict sense) corresponds to 89.63 % of the sample included in the study. The remaining 10 % corresponds to potentially innovative companies according to the typology

established in the official Colombian Innovation Survey (EDITS) 2018-2019 (Table 1). According to the descriptive analysis, the sources with the highest valuation by the analyzed companies correspond to internal sources: the management of the company (77.96 %), the sales and marketing department (47.04 %), the production department (40.46 %), and the other departments of the company (42.45 %). Subsequently, the importance of market-based sources of knowledge is highlighted: 37 % of the companies assess clients and other companies as important sources for developing innovative products. Likewise, 36% consider suppliers' knowledge as an input to innovate.

Table 3
Summary of study variables

Category	Variable	Percentage ("Yes" option)
Innovation typology (Tipología_innv)	Innovative company in the broad or narrow sense (Innova)	89.63 %
	Potentially innovative company	10.37 %
Internal knowledge sources (FII)	Internal R&D Department	13.96 %
	Production Department	40.46 %
	Sales and marketing department	47.04 %
	Other company department	42.45 %
	Specific interdisciplinary groups to innovate	19.12 %
	Senior management of the company	77.96 %
	Other related company (if part of a conglomerate)	9.47 %
	Foreign parent company	5.75 %
Science-based knowledge sources (FCC)	Universities	14.86 %
	Technology Development Centers (TDC)	5.78 %
	Autonomous research center	4.22 %
	Training centers or technology parks	4.02 %
Market-based knowledge sources (FCM)	Competitors or other companies in the industry (except the R&D department)	10.57 %
	Clients	37.87 %
	Suppliers	36.77 %
	Other companies	37.87 %
Sources of knowledge based on technical assistance (FCAT)	Consultants, experts, or researchers	19.15 %
	Associations or sectorial associations	10.74 %
	Chambers of Commerce	11.60 %
Innovation capacity	Investment in internal R&D (R&D)	24.57 %
	Investment in education and training (IF)	25.43 %
Family-owned company (Familia)	Family-owned company (Familia)	51.36 %

Source: created by the authors.

The results show that 19.15 % of the companies consider technical assistance sources concerning access to knowledge from consultants, experts, or researchers important. Regarding the sources of knowledge based on science, the highest value is given to universities (14.86 %). On the other

hand, 51 % of the sample in this study is comprised of companies that could be considered family-owned, while the proportion of companies that invest in training their personnel is very similar to the proportion of companies that invest in R&D (25 % and 24 %, respectively).

On the other hand, Figure 1 shows the positive and negative correlations in blue and red, respectively. For example, a negative correlation was found between family character and the company's level of innovation. Likewise, family character is negatively correlated with investment in training and R&D and with the importance attached to internal and external sources of knowledge. Additionally, investment in R&D positively correlates with the importance of access to internal and external knowledge sources.

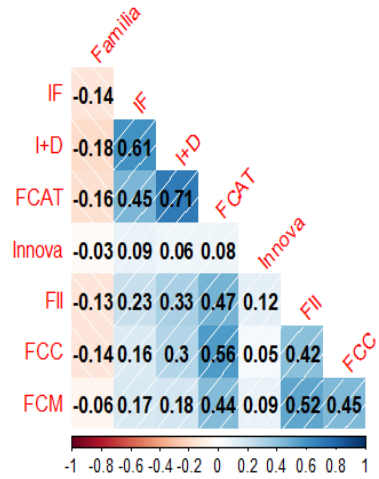

Figure 1. Visualization of the correlation between pairs of variables according to their description.
Source: created by the authors.
Notes: "Familia": Family-owned company; "IF": Investment in training; "I+D": Investment in R&D; "FCAT": Sources of technical assistance knowledge; "Innova": Innovative company; "FII": Sources of internal information; "FCC": Sources of science-based knowledge; "FCM": Sources of market knowledge.

When developing the joint analysis of MCA and CA, 3 groupings were obtained: 1814 (60.3 %), 903 (30 %), and 291 (9.7 %) in two dimensions; the percentage of variation between clusters concerning the total resulted in 77.29 %, so this segmentation is significant. Regarding the analysis of the clusters for the company's innovation typology, a high significance value was obtained to determine if the clusters segment to it ($p<0.001$).

Figure 2 shows the pattern of the characterization of each group in terms of the categories of the variables. This graphic shows that the innovative companies are most strongly associated with

technological development and investment; they are those that innovate in internal departments, those that are associated with guilds and chambers, and those that are linked to universities and other companies; these companies are precisely those grouped in cluster 3. On the other hand, the other two groups correspond to companies that are not very or regularly innovative. The difference between the two groups points to non-family companies, those with the lowest level of innovation.

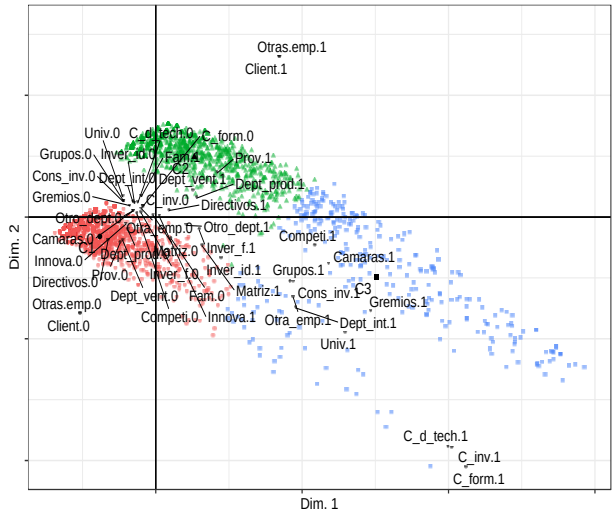

Figure 2. Clustering and correspondence map resulting from the joint MCA and CA analysis.
Source: created by the authors.

When conducting the hypothesis tests of the association of each variable concerning the type of innovation, it is found that, in general, the null hypothesis is rejected, except for technological development, training, and research centers, and whether the company is family-owned (Table 4). Given that the hypothesis test is in all cases for a 2x2 contingency table, the calculated Chi-Square value and the empirical probability value (p-value) can be read as a measure of the intensity of association of each factor with the probability that the company applies innovation.

The results confirm that innovative companies attach greater importance to internal sources (H1). The hypothesis regarding science-based sources (H2) is partially supported in this study because innovative companies only attach greater importance to universities as a source of knowledge in comparison with potentially innovative ones. For the rest of the scientific sources analyzed (technological development centers, research centers, and training centers), no significant differences are evident depending on the type of innovation of the company. On the other hand, the present study validates that innovative companies attach greater importance to the sources of knowledge related to the market (H3)

and technical assistance (H4). Finally, the hypothesis related to the negative relation of family character (H5), as well as the hypothesis on the positive relation between innovation capabilities (investment in R&D and internal training) (H6) and the importance attached to internal and external knowledge sources, were supported in the present study.

Table 4
Bivariate distributions of the variables for the innovation typology of the company

Category	Variable name	Calculated chi-square and empirical probability value
Internal knowledge sources (FII)	Internal R&D Department	15.835, <0.01 (***)
	Production Department	15.904, <0.01 (***)
	Sales and marketing department	11.471, <0.01 (***)
	Other company department	8.3995, p<0.01 (***)
	Specific interdisciplinary groups to innovate	8.4738, p<0.01 (***)
	Management	4.5164, p=0.03357 (**)
	Other related company (if part of a conglomerate)	4.2205, p= 0.03994 (**)
	Foreign parent company	7.1962, p<0.01 (***)
Science-based knowledge sources (FCC)	Universities	6.245, p= 0.01245 (**)
	Technology Development Centers (TDC)	2.0196, p = 0.1553
	Autonomous research center	1.193, p = 0.2747
	Training centers or technology parks	2.3627, p=0.1243
Market-based knowledge sources (FCM)	Competitors or other companies in the industry (except the R&D department)	9.0688, p<0.01 (***)
	Clients	10.788, p<0.01 (***)
	Suppliers	15.966, p<0.01 (***)
	Other companies	10.788, p<0.01 (***)
Sources of knowledge based on technical assistance (FCAT)	Consultants, experts, or researchers	9.4666, p<0.01 (***)
	Associations or sectorial associations	6.3078, p = 0.01202 (**)
	Chambers of commerce	4.7725, p= 0.02892 (**)
Innovation capacity	Investment in internal R&D (R&D)	12.207, p<0.01 (***)
	Investment in education and training (IF)	24.233, p<0.01 (***)
Family-owned company	Family-owned company	1.8109, p= 0.1784

Note: ** p<0.05; ***p<0.01
Source: created by the authors.

Discussion

The results of this study show that innovative companies attach greater importance to internal information sources (H1). In this regard, the study by Bernal-Torres and Frost-González (2015) highlights that Colombian companies innovate mainly through internal sources and hardly use external sources or develop open innovation processes. The above can be considered a weakness in management since constructing strategic alliances enables companies to be more innovative (García & Macías, 2022).

A large number of studies have analyzed barriers to innovation in recent years. Nevertheless, research in the area is fragmented (Hueske & Guenther, 2015). Specifically, previous literature reviews analyze barriers to radical innovation (Sandberg & Aarikka-Stenroos, 2014), the classification of barriers according to organizational levels (Hueske & Guenther, 2015), barriers to business model innovation in the agri-food industry (Ulvenblad *et al.*, 2018), and the innovation process in the public sector (Cinar *et al.*, 2019). In the Latin American context, the study by Santiago *et al.* (2017) highlights significant differences in the perception of barriers to innovation in manufacturing and service companies. Additionally, the importance of these barriers is perceived differently between sectors, so future research should further address the nature of R&D in the service sector.

Regarding scientific sources, innovative companies only attach greater importance to knowledge derived from universities than potential innovators. There are no significant differences in evaluating innovation performance in the case of technological development centers, research centers, and training centers. According to the above, hypothesis 2 (H2) is partially supported in this study. On the other hand, it is validated that innovative companies attach greater importance to market-based knowledge sources (H3) and technical assistance (H4). In the context of manufacturing companies in Colombia, for example, knowledge derived from scientific sources and managers and production departments is associated with a higher level of innovation (Corredor *et al.*, 2015). The study conducted by Ruiz-Pava and Forero-Pineda (2020) concludes that in Colombian companies, knowledge search strategies depend on the level of innovation required. Thus, in developing new products for local markets (imitation-based products), companies mainly value knowledge derived from other companies, while in the case of new products for international markets (invention-based products), companies combine internal and external sources to innovate.

Although the results are significant, the proportion of innovative companies is still very low (Table 1), as is the proportion of companies that use external sources of information and knowledge. An analysis of open innovation in emerging economies highlights that in the Colombian case, it is necessary to strengthen and deepen the links between the different actors to consolidate relations of trust and shared projects (Díaz et al., 2020).

The results of this study also confirm that family character in general is associated with less use of internal and external knowledge sources to innovate (H5). In this regard, Jocic *et al.* (2021) emphasize that family companies are often thought to be less innovative than non-family companies despite having characteristics conducive to innovation. Accordingly, the study by Maghni and Oukaci (2018) highlights that family companies do not take advantage of interactions with most sources of knowledge and information in the innovation process. Specifically, the study by Duong *et al.* (2022) concludes that the relation between the use of knowledge from market sources (clients and suppliers) and innovation

performance is weaker in family companies, while the relation between the use of knowledge obtained from universities and research institutes and innovative performance is stronger for family companies. On the other hand, the study by Tan *et al.* (2021) concludes that higher family involvement significantly reduces R&D investment intensity and the number of patent applications. Family companies play an important role in the economic development of countries. Nevertheless, this type of company's motivation and innovation intensity are relatively limited (Liu, 2021).

Additionally, in the case of service companies in Colombia, it was found that innovation capabilities, associated with investment in R&D and internal training, positively affect the importance attached by the companies to internal and external knowledge sources to innovate (H6). According to previous literature (Akram et al., 2020; AlMulhim, 2020; Dost et al., 2020; Jardon et al., 2020), internal and external knowledge sources enhance companies' innovation capabilities. Thus, innovation capabilities are key to the company's innovative system (Yam et al., 2011). The literature highlights that innovation initiatives are directly linked to innovation sources; likewise, innovation enhances firm performance (Demircioglu, 2021). Evidence also shows that external sources affect the company's innovation capabilities (Yam et al., 2011). Similarly, it has been shown that companies that combine internal and external sources of innovation capabilities achieve better performance (Awoleye et al., 2020). Specifically in Colombia, the study by Albis et al. (2021) confirms the effectiveness of public R&D support funds as a mechanism for developing absorptive capacities in companies, which favor learning processes, the development of competencies, and the competitiveness of companies.

Conclusions

Innovation is increasingly consolidated as a process involving interaction between various actors and types of knowledge (Santoro *et al.*, 2020). Nevertheless, the impact of different sources, both internal and external, on the innovative performance of companies represents a gap in the current literature (AlMulhim, 2020; De Beule & Van Beveren, 2019; Duong *et al.*, 2022). According to the above, this article supports the assumption that innovative companies attach greater importance to internal and external knowledge sources to innovate, compared to potentially innovative ones, based on the analysis of the service sector in Colombia. In addition, family companies attach less importance to internal and external knowledge sources for innovation. Likewise, the study shows that companies that invest in R&D and training attach greater importance to sources of knowledge for innovation in service companies in Colombia.

This study, due to its nature, has several limitations. The fact that it does not conduct a longitudinal analysis reduces the analysis's explanatory capacity, variability, and efficiency. Nevertheless, the type of variables used enabled the implementation of various analysis techniques to evaluate the research

hypotheses initially proposed. It is suggested that future studies analyze the best "combinations" or "configurations" of sources of information and knowledge that are most effective in achieving greater innovative performance. Similarly, it is suggested that studies be conducted among Latin American countries that periodically carry out official innovation surveys; the different innovation capacities accumulated by Latin American countries and the heterogeneity in innovative performance could lead to very relevant findings for this region.

References

Adeyeye, D., Egbetokun, A., Opele, J., Oluwatope, O., & Sanni, M. (2018). How barriers influence firms' search strategies and innovative performance. International Journal of Innovation Management, 22(2), 1–21. https://doi.org/10.1142/S1363919618500111

Akram, M. U., Ghosh, K., & Joseph, R. P. (2020). External knowledge sourcing and innovation in family firms: How and why absorptive capacity and family social capital matter. VINE Journal of Information and Knowledge Management Systems, 51(3), 438–460. https://doi.org/10.1108/VJIKMS-09-2019-0143

Albis, N., Marín, R., Sánchez, E., Bayona-Rodríguez, H., & García, J. M. (2021). The impacts of public support for innovation on firm productivity and on private investment in R&D in manufacturing and services in Colombia. Innovation and Development. https://doi.org/10.1080/2157930X.2021.1996312

AlMulhim, A. F. (2020). The role of internal and external sources of knowledge on frugal innovation: moderating role of innovation capabilities. International Journal of Innovation Science, 13(3), 341–363. https://doi.org/10.1108/IJIS-09-2020-0130

Amato, S., Ricotta, F., & Basco, R. (2021). Family-managed firms, external sources of knowledge and innovation. Industry and Innovation. https://doi.org/10.1080/13662716.2021.1976623

Anzola-Román, P., Bayona-Sáez, C., & García-Marco, T. (2018). Organizational innovation, internal R&D and externally sourced innovation practices: Effects on technological innovation outcomes. Journal of Business Research, 91, 233–247. https://doi.org/10.1016/j.jbusres.2018.06.014

Audretsch, D. B., & Belitski, M. (2022). Evaluating internal and external knowledge sources in firm innovation and productivity: an industry perspective. https://doi.org/10.1111/radm.12556

Awoleye, O. M., Ilori, O. M., & Oyebisi, T. O. (2020). Sources of innovation capability and performance of ICT agglomerated MSMEs in Nigeria. International Journal of Innovation Management, 24(4). https://doi.org/10.1142/S1363919620500322

Ben Arfi, W., Hikkerova, L., & Sahut, J.-M. (2018). External knowledge sources, green innovation and performance. Technological Forecasting and Social Change, 129, 210–220. https://doi.org/10.1016/j.techfore.2017.09.017

Bendig, D., Foege, J. N., Endriß, S., & Brettel, M. (2020). The Effect of Family Involvement on Innovation Outcomes: The Moderating Role of Board Social Capital. Journal of Product Innovation Management, 37(3), 249–272. https://doi.org/10.1111/jpim.12522

Bernal-Torres, C. A., & Frost-González, S. (2015). Open innovation in Colombian enterprises: Challenge to overcome. Revista Venezolana de Gerencia, 20(70), 252–267. https://www.scopus.com/inward/record.uri?eid=2-s2.0-84948779191&partnerID=40&md5=88dfe44cf2c8a4cbcaf927cb81fd373e

Bertello, A., De Bernardi, P., & Ricciardi, F. (2023). Open innovation: status quo and quo vadis - an analysis of a research field. Review of Managerial Science. https://doi.org/https://doi.org/10.1007/s11846-023-00655-8

Bertschek, I., & Kesler, R. (2022). Let the user speak: Is feedback on Facebook a source of firms' innovation? Information Economics and Policy, 60. https://doi.org/10.1016/j.infoecopol.2022.100991

Bogers, M., Chesbrough, H., Heaton, S., & Teece, D. J. (2019). Strategic Management of Open Innovation: A Dynamic Capabilities Perspective. California Management Review, 62(1), 77–94. https://doi.org/10.1177/0008125619885150

Carrasco-Carvajal, O., Castillo-Vergara, M., & García-Pérez-de-Lema, D. (2023). Measuring open innovation in SMEs: an overview of current research. En Review of Managerial Science (Vol. 17, Número 2). Springer Berlin Heidelberg. https://doi.org/10.1007/s11846-022-00533-9

Cesário, M., Fernandes, S., Jesus, B., & Barata, J. M. (2015). Sources of innovation: The case of portuguese consultancy sector. Journal of Technology Management and Innovation, 10(3), 44–52. https://doi.org/10.4067/S0718-27242015000300005

Chesbrough, H. W. (2003). Open Innovation. The New Imperative for Creating and Profiting from Technology. En Harvard Business School Press, Boston. https://doi.org/10.1111/j.1467-8691.2008.00502.x

Cinar, E., Trott, P., & Simms, C. (2019). A systematic review of barriers to public sector innovation process. Public Management Review, 21(2), 264–290. https://doi.org/10.1080/14719037.2018.1473477

Corredor, S., Forero, C., & Somaya, D. (2015). How external and internal sources of knowledge impact novel and imitative innovation in emerging markets: Evidence from Colombia. En Advances in

International Management (Vol. 28, pp. 161–199). Emerald Group Publishing Ltd. https://doi.org/10.1108/S1571-502720150000028010

Damanpour, F., Sanchez-Henriquez, F., & Chiu, H. H. (2018). Internal and External Sources and the Adoption of Innovations in Organizations. British Journal of Management, 29(4), 712–730. https://doi.org/10.1111/1467-8551.12296

De Beule, F., & Van Beveren, I. (2019). Sources of open innovation in foreign subsidiaries: An enriched typology. International Business Review, 28(1), 135–147. https://doi.org/10.1016/j.ibusrev.2018.08.005

de las Heras-Rosas, C., & Herrera, J. (2021). Research trends in open innovation and the role of the university. Journal of Open Innovation: Technology, Market, and Complexity, 7(1), 1–22. https://doi.org/10.3390/joitmc7010029

De Moraes Silva, D. R., Lucas, L. O., & Vonortas, N. S. (2020). Internal barriers to innovation and university-industry cooperation among technology-based SMEs in Brazil. Industry and Innovation, 27(3), 235–263. https://doi.org/10.1080/13662716.2019.1576507

Del Carpio Gallegos, J. F., & Miralles, F. (2018). Impacto de las fuentes externas de conocimiento en la innovación de productos de empresas de baja y media baja intensidad tecnológica. Estudios Gerenciales, 34(149), 435–444. https://doi.org/10.18046/j.estger.2018.149.2874

Demircioglu, M. A. (2021). Sources of Innovation, Autonomy, and Employee Job Satisfaction in Public Organizations. Public Performance and Management Review, 44(1), 155–186. https://doi.org/10.1080/15309576.2020.1820350

Demircioglu, M. A., Audretsch, D. B., & Slaper, T. F. (2019). Sources of innovation and innovation type: Firm-level evidence from the United States. Industrial and Corporate Change, 28(6), 1365–1379. https://doi.org/10.1093/icc/dtz010

Departamento Administrativo Nacional de Estadística. (2021). Encuesta de Desarrollo e Innovación Tecnológica en los sectores Servicios y Comercio EDITS VII - 2018-2019. En Dane. https://www.dane.gov.co/files/investigaciones/boletines/edit/Bol_EDIT_servicios_2016_2017.pdf

Díaz, M. L. A., Ordoñez, F. A. R., & Muñoz, R. A. T. (2020). Open innovation and public policies in developing countries. International Journal for Quality Research, 14(3), 787–804. https://doi.org/10.24874/IJQR14.03-09

Doloreux, D., Rodriguez, M., & Shearmur, R. (2021). Sources of innovation and the use of KIBS by manufacturing firms. International Journal of Technology Management, 85(1), 78–93. https://doi.org/10.1504/IJTM.2021.113694

Dost, M., Badir, Y. F., Sambasivan, M., & Umrani, W. A. (2020). Open-and-closed process innovation generation and adoption: Analyzing the effects of sources of knowledge. Technology in Society, 62. https://doi.org/10.1016/j.techsoc.2020.101309

Duong, P. A. N., Voordeckers, W., Huybrechts, J., & Lambrechts, F. (2022). On external knowledge sources and innovation performance: Family versus non-family firms. Technovation, 114. https://doi.org/10.1016/J.TECHNOVATION.2021.102448

Fagerberg, J. (2005). Innovation: A Guide to the Literature. En The Oxford Handbook of Innovation. https://doi.org/10.1093/oxfordhb/9780199286805.003.0001

Feranita, F. (2021). The transaction cost approach to collaborative innovation in family firms: a process of internal collaboration through integration of human assets. En J. International Business and Entrepreneurship Development (Vol. 13, Número 1).

Ferraris, A., Bogers, M. L. A. M., & Bresciani, S. (2020). Subsidiary innovation performance: Balancing external knowledge sources and internal embeddedness. Journal of International Management, 26(4). https://doi.org/10.1016/j.intman.2020.100794

Filser, M., De Massis, A., Gast, J., Kraus, S., & Niemand, T. (2018). Tracing the Roots of Innovativeness in Family SMEs: The Effect of Family Functionality and Socioemotional Wealth. Journal of Product Innovation Management, 35(4), 609–628. https://doi.org/10.1111/jpim.12433

García, V., & Macías, J. (2022). Analysis of the variables leading to the identification and incorporation of innovation capabilities by firms in the Colombian ICT Sector. Innovar, 32(84). https://doi.org/10.15446/innovar.v32n84.99867

Greenacre, M., & Blasius, J. (1994). Correspondence analysis in the social sciences (Academic Press (ed.)).

Hamdi-Kidar, L., Keinz, P., Le Nagard, E., & Vernette, E. (2019). Comparing Lead Users to Emergent-Nature Consumers as Sources of Innovation at Early Stages of New Product Development. Journal of Product Innovation Management, 36(5), 616–631. https://doi.org/10.1111/jpim.12500

Hervas-Oliver, J. L., Sempere-Ripoll, F., & Boronat-Moll, C. (2021). Technological innovation typologies and open innovation in SMEs: Beyond internal and external sources of knowledge. Technological Forecasting & Social Change, 162. https://doi.org/10.1016/j.techfore.2020.120338 WE - Social Science Citation Index (SSCI)

Hewitt-Dundas, N. (2006). Resource and Capability Constraints to Innovation in Small and Large Plants. Small Business Economics, 26, 257–277. https://doi.org/10.1007/s11187-005-2140-3

Hueske, A.-K., & Guenther, E. (2015). What hampers innovation? External stakeholders, the organization, groups and individuals: a systematic review of empirical barrier research. Management Review Quarterly, 65(2), 113–148. https://doi.org/10.1007/s11301-014-0109-5

Jardon, C. M., Tañski, N. C., & Martinez-Cobas, X. (2020). Sources of knowledge for innovation capability in subsistence small businesses: a case of the wood sector in Argentina. Annals of Regional Science. https://doi.org/10.1007/s00168-020-01008-z

Jiménez Jiménez, D., & Sanz Valle, R. (2012). Efectos de la estrategia de innovación en el éxito de los nuevos productos: el papel moderador del entorno. Revista Europea de Dirección y Economía de la Empresa, 21(4), 323–332. https://doi.org/10.1016/j.redee.2012.07.005

Jocic, M. R., Morris, M. H., & Kuratko, D. F. (2021). Familiness and innovation outcomes in family firms: The mediating role of entrepreneurial orientation. Journal of Small Business Management. https://doi.org/10.1080/00472778.2020.1861284

Kim, M. K., Park, J. H., & Paik, J. H. (2018). Factors influencing innovation capability of small and medium-sized enterprises in Korean manufacturing sector: Facilitators, barriers and moderators. International Journal of Technology Management, 76(3–4), 214–235. https://doi.org/10.1504/IJTM.2018.091286

Koentjoro, S., & Gunawan, S. (2020). Managing knowledge, dynamic capabilities, innovative performance, and creating sustainable competitive advantage in family companies: A case study of a family company in Indonesia. Journal of Open Innovation: Technology, Market, and Complexity, 6(3). https://doi.org/10.3390/JOITMC6030090

Kumar, V., Anand, A., & Nim, N. (2018). Assessing the relative impact of major sources of innovation on the brand equity of a firm. Review of Marketing Research, 15, 99–142. https://doi.org/10.1108/S1548-643520180000015006

Lee, C., Hallak, R., & Sardeshmukh, S. R. (2019). Creativity and innovation in the restaurant sector: Supply-side processes and barriers to implementation. Tourism Management Perspectives, 31, 54–62. https://doi.org/10.1016/j.tmp.2019.03.011

Lichtenthaler, U., & Lichtenthaler, E. (2009). A capability-based framework for open innovation: Complementing absorptive capacity. Journal of Management Studies, 46(8), 1315–1338. https://doi.org/10.1111/j.1467-6486.2009.00854.x

Liu, Y. (2021). Research on the influencing factors of family firm innovation. En K. G., L. H., & N. E.H.K. (Eds.), 2020 International Conference on New Energy Technology and Industrial Development, NETID 2020 (Vol. 235). EDP Sciences. https://doi.org/10.1051/e3sconf/202123502017

Lopes, A. P. V. B. V., & de Carvalho, M. M. (2018). Evolution of the open innovation paradigm: Towards a contingent conceptual model. Technological Forecasting and Social Change, 132(April 2016), 284–298. https://doi.org/10.1016/j.techfore.2018.02.014

Madanaguli, A., Amandeep, D., Talwar, S., Clauss, T., Kraus, S., & Kaur, P. (2023). Diving into the uncertainties of open innovation: A systematic review of risks to uncover pertinent typologies and unexplored horizons. Technovation, 119(May 2022), 102582. https://doi.org/10.1016/j.technovation.2022.102582

Magendzo, A. (2018). Empresas y emprendedores: De barreras de entrada a entradas sin barrera. BID Puntos sobre la I: Un blog del BID para conversar sobre innovación en América Latina y el Caribe. https://blogs.iadb.org/innovacion/es/conectar-startups-con-empresas/

Maghni, B., & Oukaci, K. (2018). Sources of innovation in family olive farms: The case of bejaia province in Algeria. New Medit, 17(1), 23–35. https://doi.org/10.30682/nm1801c

Markos, A., Iodice D'Enza, A., & Van de Velden, M. (2019a). Beyond tandem analysis: Joint dimension reduction and clustering in R. Journal of Statistical Software, 91(10). https://doi.org/https://doi.org/10.18637/jss.v091.i10

Markos, A., Iodice D'Enza, A., & Van de Velden, M. (2019b). clustrd: Methods for Joint Dimension Reduction and Clustering. R package version 1.3.6-2. https://cran.r-project.org/ package=clustrd.

Medhi, P. K., Jain, P., & Jain, T. (2019). Effects of information sources for new customers and suppliers on the immediate innovation output of firms. European Journal of Innovation Management, 22(4), 660–680. https://doi.org/10.1108/EJIM-09-2018-0202

Muñoz-Bullón, F., Sanchez-Bueno, M. J., & De Massis, A. (2020). Combining Internal and External R&D: The Effects on Innovation Performance in Family and Nonfamily Firms. Entrepreneurship: Theory and Practice, 44(5), 996–1031. https://doi.org/10.1177/1042258719879674

Pereira Cabral, B., Lage de Sousa, F., & Canêdo-Pinheiro, M. (2020). Assessing the impacts of innovation barriers: a qualitative analysis of Brazil's natural resources industry. Resources Policy, 68, 1–8. https://doi.org/10.1016/j.resourpol.2020.101736

Perri, A., & Andersson, U. (2014). Knowledge outflows from foreign subsidiaries and the tension between knowledge creation and knowledge protection: Evidence from the semiconductor industry. International Business Review, 23(1), 63–75. https://doi.org/10.1016/j.ibusrev.2013.08.007

Pihlajamaa, M. (2021). What does it mean to be open? A typology of inbound open innovation strategies and their dynamic capability requirements. Innovation Organization & Management. https://doi.org/10.1080/14479338.2021.1907192

Pihlajamaa, M., Kaipia, R., Säilä, J., & Tanskanen, K. (2017). Can supplier innovations substitute for internal R&D? A multiple case study from an absorptive capacity perspective. Journal of Purchasing and Supply Management, 23(4), 242–255. https://doi.org/10.1016/j.pursup.2017.08.002

Rahmouni, M., Ayadi, M., & Yildizoğlu, M. (2010). Characteristics of innovating firms in Tunisia: The essential role of external knowledge sources. Structural Change and Economic Dynamics, 21(3), 181–196. https://doi.org/10.1016/j.strueco.2010.05.001

Ramayah, T., Soto-Acosta, P., Kheng, K. K., & Mahmud, I. (2020). Developing process and product innovation through internal and external knowledge sources in manufacturing Malaysian firms: the role of absorptive capacity. Business Process Management Journal, 26(5), 1021–1039. https://doi.org/10.1108/BPMJ-11-2019-0453

Robbins, P., & O'Gorman, C. (2016). Innovation processes: do they help or hinder new product development outcomes in Irish SMEs? The Irish Journal of Management, 35(1), 88–103. https://doi.org/doi:10.1515/ijm-2016-0006

Ruiz-Pava, G., & Forero-Pineda, C. (2020). Internal and external search strategies of innovative firms: the role of the target market. Journal of Knowledge Management, 24(3), 495–518. https://doi.org/10.1108/JKM-08-2017-0349

Sandberg, B., & Aarikka-Stenroos, L. (2014). What makes it so difficult? A systematic review on barriers to radical innovation. Industrial Marketing Management, 43(8), 1293–1305. https://doi.org/10.1016/j.indmarman.2014.08.003

Santiago, F., De Fuentes, C., Dutrénit, G., & Gras, N. (2017). What hinders innovation performance of services and manufacturing firms in Mexico? Economics of Innovation and New Technology, 26(3), 247–268. https://doi.org/10.1080/10438599.2016.1181297

Santoro, G., Bresciani, S., & Papa, A. (2020). Collaborative modes with Cultural and Creative Industries and innovation performance: The moderating role of heterogeneous sources of knowledge and absorptive capacity. Technovation, 92–93. https://doi.org/10.1016/j.technovation.2018.06.003

Saparaliyev, D., Spankulova, L., Zhaxylykova, A., Aldashova, G., Saiymova, M., & Akhmetova, G. (2019). Impact of new technologies, innovations & barriers on the service delivery and financial income of the private business in transitional economies: The case of health centers. Academy of Strategic Management Journal, 18(3). https://www.scopus.com/inward/record.uri?eid=2-s2.0-85068434200&partnerID=40&md5=d2f592f3d2cbaf944942b8bd16f38913

Saura, J. R., Palacios-Marqués, D., & Ribeiro-Soriano, D. (2023). Exploring the boundaries of open innovation: Evidence from social media mining. Technovation, 119(January 2022). https://doi.org/10.1016/j.technovation.2021.102447

Schweisfurth, T. G. (2017). Comparing internal and external lead users as sources of innovation. Research Policy, 46(1), 238–248. https://doi.org/10.1016/j.respol.2016.11.002

Solomon, G. T., Bryant, A., May, K., & Perry, V. (2013). Survival of the fittest: Technical assistance, survival and growth of small businesses and implications for public policy. Technovation, 33(8), 292–301. https://doi.org/https://doi.org/10.1016/j.technovation.2013.06.002

Strobel, N., & Kratzer, J. (2017). Obstacles to innovation for SMEs: Evidence from Germany. International Journal of Innovation Management, 21(3). https://doi.org/10.1142/S136391961750030X

Tan, Q., Liu, Z., & Geng, P. (2021). Family involvement, family member composition and firm innovation. China Journal of Accounting Research, 14(1), 43–61. https://doi.org/10.1016/j.cjar.2020.12.003

Tello, M. D. (2021). Effects of obstacles to innovation: Are they complementary? lessons of the case of Peru. Journal of Innovation Economics and Management, 35(2), 187–217. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85105989283&partnerID=40&md5=7f3a736076d753f0cf4dda50337ac9e5

Tian, M., Su, Y., & Yang, Z. (2022). University-industry collaboration and firm innovation: an empirical study of the biopharmaceutical industry. The Journal of Technology Transfer, 47, 1488–1505. https://doi.org/10.1007/s10961-021-09877-y

Ulvenblad, P., Barth, H., Björklund, J. C., Hoveskog, M., Ulvenblad, P. O., & Jenny Ståhl. (2018). Barriers to business model innovation in the agri-food industry: A systematic literature review. Outlook on Agriculture, 47(4), 308–314. https://doi.org/10.1177/0030727018811785

Yam, R. C. M., Lo, W., Tang, E. P. Y., & Lau, A. K. W. (2011). Analysis of sources of innovation, technological innovation capabilities, and performance: An empirical study of Hong Kong manufacturing industries. Research Policy, 40(3), 391–402. https://doi.org/10.1016/j.respol.2010.10.013