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The role of intellectual capital on process and products innovation. Empirical study in SMEs in an emerging country

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Abstract

Purpose – The objective of this study is to analyze the influence of the intellectual capital of SMEs on innovation and organizational performance in the context of an emerging country.
Design/methodology/approach – The sample consisted of 259 industrial SMEs from the Cordoba, Argentina. The data were analyzed by partial least squares–structural equation modeling (PLS–SEM).
Findings – The study provides empirical evidence that the three components of intellectual capital generate positive and significant effects on innovation in processes and products. Structural capital is the component that has the greatest effect on innovation. It also showed a positive and significant relationship between innovation in processes and performance, contributing to the scarce empirical literature in the context of SMEs.
Research limitations/implications – The research exposes limitations that uncover a path for future. First, the work uses as the only source of information, the consultation at the highest level of the company. Second, the study covered only industrial companies. Future studies should focus on other sectors and countries.
Practical implications – The results may have important practical implications for SME owners and managers and offer a vision of the influence of intellectual capital on the innovative capacity of the organization.
Originality/value – The value of work lies in establishing the importance of intellectual capital in the environment of an emerging country such as Argentina, given the low level of knowledge that exists in this area.

Keywords Process innovation, Product innovation, Performance, Intellectual capital
Paper type Research paper

1. Introduction

Intellectual capital is key to promoting the competitiveness of companies and is seen by researchers and professionals as an important research topic (Crema and Verbano, 2016; Khalique *et al.*, 2019). The literature on intellectual capital management determines that it is a critical resource for the creation of knowledge because it is an important generator of competitive advantages (Grant, 1996). Intellectual capital is based on theories of intellectual capital and resources and capabilities, which indicate that intangible resources are capable of generating sustainable competitive advantages over time and thus create greater value for the company (Jardón and Martos, 2012). Intellectual capital is a source of creativity and innovation for companies (Abualoush *et al.*, 2018) and is increasingly important in a globalized environment, where innovation is crucial, since the demand for products and services based on knowledge is increasing (Harrington *et al.*, 2019; Rodriguez-Vaz and Selig, 2019). Intellectual capital is allowing managers to change

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their strategic focus in order to exploit their dynamic and intangible intellectual assets (Tseng and James-Goo, 2005).

The literature that analyzes the relationships between the components of intellectual capital, innovation and company performance is extensive (Agostini *et al.*, 2017; Bontis *et al.*, 2018; Santos-Rodrigues *et al.*, 2011; Subramaniam and Venkatraman, 2001; Subramaniam and Youndt, 2005). Intellectual capital is increasingly recognized as an important source of value creation (Curado *et al.*, 2011; Agostini *et al.*, 2017). Although there have been important contributions in this area, a large part of the studies has dealt with the effect of intellectual capital on the growth and value generation of companies and, to a lesser extent, in the particular context of SMEs, but there exists the need for more quantitative studies that contribute to improving the knowledge of the relationship between intellectual capital and the innovation capacities of SMEs (Ruiz-Jiménez and Fuentes-Fuentes, 2018; Agostini and Nosella, 2017).

The purpose of our study is to analyze the effect of intellectual capital (human capital, structural capital and relational capital) on the activity of innovation and the performance of SMEs. For this, an empirical study is carried out on a sample of 259 industrial SME companies in the province of Córdoba, Argentina, which have between 10 and 200 workers. The survey is carried out with the owner / manager of the company, who are usually the leader and manager of the company (Jardon, 2019). In SMEs in contexts of emerging economies, the leadership of the manager / owners plays a decisive role for the development of innovation and performance (Afriyie *et al.*, 2019). The research questions to be answered are as follows. Does intellectual capital significantly affect product and process innovation in SMEs? What factors of intellectual capital have the greatest impact on innovation? Do product and process innovation have significant effects on the performance of SMEs? The answer to these questions has important implications, both for SME management and for academia, since there is a close relationship between intellectual capital and innovative activity of companies (Crema and Verbano, 2016; Santos-Rodrigues *et al.*, 2011). Argentina is an especially interesting emerging country because industrial SMEs are a fundamental part of its business. In the province of Córdoba, Argentina, together they represent 68% of the total number of positions filled (OIR, 2017) and, together with Santa Fe and Buenos Aires, they represent 72% of the country's industrial activity (Unión Industrial, 2017). Currently, the country is undergoing a major restructuring toward a change in its production system in order to reduce the worrying failure rates of SMEs, since 97% do not reach the fifth year, a figure much higher than in other countries (Lagunes-Domínguez *et al.*, 2016).

The present investigation contributes to the literature in different aspects. First, it provides a comprehensive approach where intellectual capital is analyzed in a context of an emerging country. It is important to contextual innovation in the field of emerging markets. The literature in this field of research is very scarce and can be used by the leader and managers who work in the SMEs to be more competitive (Singh and Gaur, 2018). These markets are characterized by their relatively low levels of innovation (Heredia-Pérez *et al.*, 2019), clients are more sensitive to prices (Derbyshire, 2014) and institutions play a very important role in their strategic processes (Stock *et al.*, 2002). Although there are studies in other emerging regions (Khalique *et al.*, 2019), there are still very incipient studies in the reality of Argentina, which has characteristics that make the study of intellectual capital in this region interesting (Fernández-Jardón and Martos, 2016). Secondly, our work contributes to the literature showing how, through an intellectual capital strategy, SMEs can increase their capacities for innovation in processes and products. In particular, the results show that the component of intellectual capital that has the greatest impact on product and process innovation is structural capital. This finding provides important implications and allows SMEs to promote intellectual capital policies that favor a competitive advantage. Companies gain a competitive advantage if they know how to manage organizational knowledge (Schulz

and Jobe, 2001). And although knowledge is rooted in the experience and skills of individuals, companies provide the physical, social structure and allocation of resources so that knowledge can lead to capabilities, and depending on the latter, to the company's competitive results. (Díaz-Díaz *et al.*, 2006).

The rest of the article is organized as follows. First, in the theoretical framework, a review of the previous literature is exposed and the research hypotheses are justified. Secondly, the methodology is described, considering the characteristics of the sample and the definition of the variables. Third, the analysis and results are presented. Finally, the main conclusions and discussion are discussed.

2. Theoretical framework and hypothesis

Intellectual capital is defined as the totality of non-monetary and non-physical resources that are totally or partially controlled by the organization and that contribute to the creation of value ((Roos *et al.*, 1997). Intellectual capital contributes so that these intangible strategic resources can be measured, although there is no consensus on how to categorize the different components of strategic knowledge (Santos-Rodrigues *et al.*, 2011). Despite this, much of the literature accepts that its components are human capital, structural capital and relational capital (Crema and Verbano, 2016; Agostini *et al.*, 2017; Xu *et al.*, 2019).

The theoretical framework on which studies on intellectual capital is based on various theories. The theory of knowledge developed by Nonaka and Takeuchi (2000) and reviewed in Nonaka and Toyama (2003) maintains that the most important source of capabilities is in knowledge, this being the only source of lasting competitive advantage. In turn, the theory of resources and capacities or RBV (resource-based view), outlined by Barney (1991), provides an important framework to explain the basis of the competitive advantages that are originated by the intangible assets of companies. Along these same lines, Grant (1996) pointed out that intangible assets are the main source of innovation and value creation. As a consequence of the previous theories, the theory of intellectual capital arises (with the pioneering ideas of Edvinsson, 1997 and Sveiby, 1997). This has subsequently been enriched by contributions from an abundant theoretical and empirical literature (Bueno-Campos *et al.*, 2008). Intellectual capital theory holds that intangible assets lead to the success of companies and therefore to the generation of sustainable competitive advantages (Al-Tabbaa and Ankrah, 2016; Bontis *et al.*, 2018). In our study, we will use the aforementioned theories due to their complementarity (Calix *et al.*, 2015; Ciprés, 2006).

In general, empirical studies agree that intellectual capital significantly influences the innovation capacity and performance of companies (Díaz-Díaz *et al.*, 2006). In turn, there are some aspects, such as technological knowledge, that significantly influence intellectual capital to generate innovation (Díaz-Diaz *et al.*, 2006). This suggests that when intellectual capital management is strengthened, then there is an improvement in the capacity for innovation, which may lead to higher levels of company performance. Although the knowledge and skills required for innovation reside in individuals, the complexity of many modern innovations, however, requires a grouping and integration of multiple threads that are encompassed in intellectual capital (Santos-Rodrigues *et al.*, 2011; Agostini *et al.*, 2017; Gomes and Wojahn, 2017).

On the other hand, there is a current in the literature that has dealt with analyzing the effect that the components of intellectual capital have as drivers of the economic growth of nations. In addition to verifying if there is a different effect depending on the level of development of the countries (Edvinson, 2004; Ståhle and Bonfour, 2008). These studies are based on the pioneering work of Amidom (2003), which points out the new fundamental axes to generate development in the knowledge economy. This author argues that intellectual assets are those that must be exploited effectively through innovation since they are the most

important resources of the knowledge economy of any country. In the second place, innovation has the capacity to generate creative ideas throughout the entire value chain. In turn, it is responsible for converting knowledge flows into goods and services. And thirdly, collaboration, which replaces the competitive paradigm, prevails in many companies to this day.

At the same time, another part of the academy is working on determining the contribution to the value of the company, which may entail the presentation of reports that reflect the incidence of the different components of intellectual capital. This flow has been generated from the project Wissenssbilanz, developed in Germany, and later extended to other European countries and even Brazil, and replicated in Japan by adopting the name Wissenskapital. As these tests showed, additional knowledge and transparency in the presentation of information about intellectual capital brings with it more homogeneous evaluations of the future potential profit of organizations (Alwert *et al.*, 2009).

2.1 Human capital

Human capital represents the set of knowledge, capacities and abilities of people that are integrated into the company's resources (Nieves and Quintana, 2018) and, according to the theory of resources and capacities (Barney, 1991), are the components of human capital that have the characteristics of being rare, inimitable and not substitutable, so they are a source of competitive advantages (Kianto *et al.*, 2017).

Human capital is considered an important element for innovation (Uden *et al.*, 2017). And its importance lies in that if companies have human resources with high levels of knowledge, skills and experiences, they can find greater flexibility in acquiring new knowledge and a better capacity to innovate (Nieves and Quintana, 2018; Subramaniam and Youndt, 2005). The greater the stock of human capital, the greater the opportunities to exchange and combine knowledge. Therefore, a greater knowledge will generate a greater capacity for innovation (Wu *et al.*, 2008). In the particular case of SMEs, it becomes more important due to the shortage of physical and financial resources, so its success depends on the experience and skills of its employees (Giampaoli *et al.*, 2019).

The literature supports the existence of a positive relationship between human capital and the organization's ability to innovate (Nieves and Quintana, 2018). Smith *et al.* (2005) demonstrated a significant relationship between the level of the components of human capital with innovation in products and services. Díaz-Díaz *et al.* (2006), in their study on Spanish industrial companies, demonstrate that the hiring of personnel with a high level of knowledge and experience positively impacts innovation. Dost *et al.* (2016), in a study on companies in the chemical industry, find a positive but low significance relationship between human capital and innovation. But they observe that its effect is enhanced by the interrelation with the other components of intellectual capital.

Recent studies focused on the SME field; studies such as Quian and Huan (2017), on the medical industry in Shanghai, show that the richer the human capital in terms of professional qualifications, the better their learning capacity will be, which, in turn, will generate more innovation. The works of Agostini *et al.* (2017), and Agostini and Nosella (2017) carried out with Italian SMEs also find a positive and significant relationship between the development of human capital and innovation.

Based on the above, the following hypotheses are formulated:

H1. "A high degree of human capital development generates a positive effect on process innovation."

H2. "A high degree of human capital development generates a positive effect on product innovation."

2.2 Structural capital

Structural capital refers to the mechanisms and structures of the organization that can help employees achieve optimal intellectual performance (Bontis *et al.*, 2005). Structural capital represents the mechanisms and structure of the organization, which are made up of processes, information systems, databases and corporate culture, thereby guaranteeing efficient decision-making (Carmona-Lavado *et al.*, 2010; Walsh and Ungson, 1991). The importance of structural capital lies in that it develops the infrastructure that human capital needs to create value (Xu *et al.*, 2019).

In general, the studies agree that structural capital has a positive impact on the innovation capacity of companies (Díaz-Díaz *et al.*, 2006). In this sense, Díaz-Diaz *et al.* (2006) demonstrate that the most innovative companies require systems that allow them to monitor and analyze their environment in order to know the technological gap it has with its competitors. These results are in line with those of Frishammar and Hörte (2005), which demonstrate that the organizations that are better at handling external information are also the most innovative. Along these same lines, Mennens *et al.* (2018). referring to industrial SMEs in the Netherlands, point out that a structural capital that encourages the collaboration of employees in decision-making and interactions with various knowledge structures increases their capacity for innovation. Furthermore, if the structural capital generates strong links between the members of its staff and they share objectives, missions and visions, it allows the company to achieve a positive effect on the innovation process, both for the development of new products and in the establishment of new processes (Delgado-Verde *et al.*, 2013).

Based on the above, the following hypotheses are formulated:

H3. "The existence of solid structural capital will have a positive effect on process innovation."

H4. "The existence of solid structural capital will have a positive effect on product innovation."

2.3 Relational capital

Relational capital or client capital is made up of the network of external relations with its clients, suppliers, competitors, government bodies, universities and research centers, among others (Cabrita *et al.*, 2007; Salazar *et al.*, 2006). A developed relational capital allows obtaining and sharing knowledge through trust and mutual understanding, thereby enriching the generation of ideas and innovation (Hashim *et al.*, 2015; Kalkan *et al.*, 2014; Khalique *et al.*, 2011).

The existing research on the relationship between relational capital and innovation is mainly focused on product innovation. There is a more limited development on process innovation since it is considered a second-order innovation (Terjesen and Patel, 2015; Keupp *et al.*, 2012). In the particular context of SMEs, empirical studies show that there is a positive relationship between relational capital and innovation: Zerenler *et al.* (2008) in the auto parts sector in Turkey, Delgado-Verde *et al.* (2011) in medium- and high-technology sectors in Spain, Jardon and Martos (2012) in the wood industry in Argentina and Dost *et al.* (2016) in the chemical industry in Thailand. Meanwhile, Giampaoli *et al.* (2019), in their study on Italian SMEs, conclude that both relational capital and structural capital, but not human capital, have a positive effect on innovation, but that the latter cannot be separated from the rest of the components of intellectual capital. Similar conclusions are reached by Xu *et al.* (2019) in a study on SMEs in China. Based on the above, the following hypotheses are formulated:

H5. "Solid relational capital generates a positive effect on process innovation."

H6. "Solid relational capital generates a positive effect on product innovation."

2.4 Innovation and performance

Product innovation and process innovation play an important role in company performance (Maldonado-Guzman *et al.*, 2019). Innovation allows constant improvements in work processes in order to improve the products or services (Xu *et al.*, 2019). Process innovations improve performance by reducing costs or increasing the quality of goods and services, although they are less tangible and less obvious to the customer than product innovations (Gomes and Wojahn, 2017). If these improvements are maintained over time, they will generate an increase in their competitiveness in the market and higher performance (Ismanu and Kusmintarti, 2019). Recent empirical evidence has shown the positive relationship between different types of innovation (products and processes) and organizational performance (Gök and Peker, 2017; Gunday *et al.*, 2011; Stock and Reiferscheid, 2014; Karabulut, 2015). Innovation enables MSMEs to increase expected demand, generate higher income, retain customers and increase their market share (Ruiz-Jiménez and Fuentes-Fuentes, 2018; Gunday *et al.*, 2011). Therefore, we propose the following hypotheses:

H7. "Constant innovation in processes generates a positive effect on performance."

H8. "The constant innovation of products or services generates a positive effect on performance."

3. Methodology

3.1 Sample design and information gathering

The sample structure is based on the principles of stratified sampling for finite populations. The population is made up of SMEs (10–200 employees) from the industrial sector made up of 13 different activities, which are geographically located in the province of Córdoba in Argentina, and which were segmented according to the activity criteria. Companies with less than 10 employees were excluded due to the difficulty of obtaining information due to their high degree of informality, which is consistent with most empirical studies on intellectual capital, which also excluded them (Crema and Verbano, 2016; Leitner, 2005) (See Table 1).

The population of companies was determined based on data from the year 2017, provided by the Ministry of Industry of the government of the province of Córdoba based on the

Code	Industrial sector	Population	Number of companies in the sample
1	Textiles and clothing	94	17
2	Food and drinks	300	58
3	Dairy products	79	18
4	Animal feed	27	6
5	Metallurgical	196	36
6	Mechanical, electrical and electronic machines and equipment	288	55
7	Graphics and impressions	25	8
8	Chemical and pharmaceutical	44	6
9	Furniture and wood	46	11
10	Plastics, paper, cardboard, packaging and rubber	101	23
11	Precision and medical products	16	3
12	Software	49	12
13	Non-metallic mineral products	50	6
Total		1,315	259

Source(s): Own elaboration, based on surveyed data

Table 1. Composition of the sample

Industrial Registry of the Province (Industrial Registry of the Province of Córdoba, 2017). The one that shows a population of 1,316 companies with the characteristics described and together employs a total of 46,976 people. The sample size was determined to achieve that the maximum margin of error for the estimation of a proportion (relative frequency of response in a specific item of a question) was less than 0.03 points with a confidence level of 95%. The survey of the data was carried out by means of a questionnaire (Likert scale 1–7), aimed at the highest organizational level, since they are the ones who have a more general vision of the different activities carried out as well as the interactions between their employees and with respect to their competitors, making them the most suitable for answering comparative questions regarding the topics consulted (Cabrita *et al.*, 2007). The questionnaire was previously tested in a pilot test through personal interviews with eight managers and derived from it, with minor adjustments made to correct the weaknesses of the questionnaire and capture the specific dynamics of the sector. Subsequently, it was applied to the entire sample, following the modality of personal interviews. The data collection period took place between December 2017 and May 2018. Finally, a total of 259 interviews were obtained from the SMEs that are part of this research.

To guarantee the validity and quality of the data, non-response bias and variance bias of the common method are analyzed. The responses from the first round of interviews were not significantly different from the last round (*t*-test and chi-square test) (Vitell and Nwachukwu, 1997). Because the information was obtained from the same source (dependent and independent variables), there is the possibility of variance bias of the common method (Achidi-Ndofor and Priem, 2011). To analyze whether this bias occurs, we use the Harman single factor test (Podsakoff and Organ, 1986). From this test, we verified that all the variables are grouped into seven factors that explain 72% of the total variance. Therefore, the variance bias of the common method is not relevant in our study.

3.1.1 Variable measurement. The specification of the conceptual model was based on a review of previous studies (Gold *et al.*, 2001; Salazar *et al.*, 2006; Fernández-Jardón, 2012; Costa *et al.*, 2014). The proposed model focuses on the analysis of the interrelationships between the elements of intellectual capital with the capacity for innovation and the performance of SMEs. The selection of the observable variables in the construction of the model was made through an exhaustive review of the literature. Currently, the literature widely accepts that intellectual capital is a multidimensional higher-order level construction whose subcomponents arise from related disciplines (human resources, structure, processes, information, systems, marketing, among the main ones) (Agostini *et al.*, 2017; Bontis *et al.*, 2018). One of the key factors in performing an adequate analysis of the variables of a model understands the nature and direction of causality between the constructs in order to determine the most appropriate statistical technique (Esposito *et al.*, 2010). The determination of said analysis technique will be useful to better understand and analyze the structural model (Henseler *et al.*, 2015). In our case, we decided to use reflexive variables, which are directed from the construct to the indicator. The reason for choosing these types of variables is due to their characteristics: (1) there is no link between the direction and the influence of reflection on the constructs (Jarvis *et al.*, 2003); (2) each observable indicator is a variable; and (3) the construct indicators are highly correlated; they are interchangeable and the elimination of an indicator does not alter the content of the construct (Wetzels *et al.*, 2009).

For the data survey, the managers of the SMEs were asked to answer the questions using a 7-point Likert scale (1 "totally disagree" and 7 "totally agree").

Human capital: This construct refers to the characteristics and abilities that people possess and that allow the development of an activity (Bogdanowicz and Bailey, 2002; McGuirk *et al.*, 2015; Unger *et al.*, 2011). Human capital includes characteristics such as (1) risk taking, proactivity and creativity of employees; (2) the ability to assess the risks of investments; (3) the importance of knowledge for the success of the organization; (4) the

ability to successfully apply the knowledge acquired; (5) participation in the development of new ideas and knowledge; (6) the ability to work in teams, to interact and to debate; (7) responsible commitment to the company's strategy; (8) the ability to adapt to new situations; and (9) employees collaborate in the identification and resolution of problems.

Structural capital: This construct represents the mechanisms and structures of the organization that can help employees achieve optimal intellectual performance and therefore achieve better organizational performance (Bontis, 1998; Bontis *et al.*, 2005). It is made up of (1) the ease provided by the structures and systems to achieve the collaboration of people both inside and outside the organization; (2) the possibility to search for new knowledge; (3) coding of much of the organizational knowledge; (4) the ease provided by the structures for the transfer of new knowledge; (5) the disposition of structures to promote collective behavior before individualism; and (6) the support provided to discover and create new knowledge.

Relational capital: This construct represents all the knowledge within the relationships in an organization with its external environment including clients and strategic partners. It is considered an essential component of intellectual capital, which refers to the value of the relationships through which organizations lead their businesses, and considers their clients as the most important part of that capital (Bontis *et al.*, 2005). In our work, it is made up of (1) the relationships developed to strengthen the capacity for product and process innovation; (2) to develop new solutions; (3) measure the image that the environment and its partners have about the company; (4) the establishment of potential collaboration objectives with strategic partners; (5) the degree of knowledge about the reasons for the success of the collaboration with its strategic partners; and (6) the existence of organizational mechanisms for collaboration with third parties.

Process innovation: For the measurement of this construct, we based ourselves on the model presented by Salazar *et al.* (2006) that uses the following as observable variables: (1) the number of processes introduced in the last 2 years; (2) the pioneering character in the introduction of new processes; (3) the speed of response in the introduction of new processes; and (4) expenses for the development of new processes.

Product innovation: Continuing along the same lines as above and based on the work of Salazar *et al.* (2006), the following variables were observed: (1) the number of products introduced in the last 2 years; (2) the pioneering character in the introduction of new products; (3) the speed of response in the introduction of new products; and (4) expenses for the development of new products.

Performance: Due to the complexity in measuring this construct, we had to use a multidimensional approach that includes both financial and non-financial components (Berrone *et al.*, 2014; Neely *et al.*, 2002; Stam *et al.*, 2014; Thapa, 2015). In the particular case of SMEs, it is often difficult to obtain accurate financial data as SMEs are reluctant to provide this type of accounting information (Raffiee and Coff, 2016). For this reason, we opted for a multiple approach that encompasses an objective component, derived from accounting information and a subjective one, based on the perception of the company manager, the latter being the most recommended by the literature in the case of SMEs (Hughes, 2001), given that in SMEs accounting information has limitations. On the other hand, SMEs, in addition to financial objectives, seek to satisfy other types of objectives such as customer, employee or owner satisfaction (Bosma *et al.*, 2004). In our questionnaire, we asked managers to indicate the evolution in the last two years of the following indicators in their company: (1) sales volume; (2) profitability; (3) productivity; (4) customer satisfaction; (5) employee satisfaction; and (6) satisfaction of the owners, investors or shareholders.

3.1.1.1 Control variables. The study contemplates control variables to strengthen the proposed theoretical model and analyze its behavior. Previous studies show that the size of the organization, the age of the company and the industrial sector to which it belongs can influence human capital (Camisón and Villar-López, 2014; Damanpour, 1991; Damanpour

et al., 2009). The size of the organization is measured with the number of existing employees in the company. The age of the business is measured from the time it was founded. The descriptive statistics of the control variables are shown in Table 2.

3.2 Justification for using the PLS-SEM method

The main reasons for using SEM is that the second-generation statistical techniques, being non-parametric methods, allow us to estimate the measurement of error, the relationships between the different constructs and control the theoretical model (Esposito *et al.*, 2010; Wang *et al.*, 2015). The use of the SEM methodology implies a two-phase approach (Sarstedt *et al.*, 2014), the first is the analysis of the validity and reliability of the model, and the second is the verification of the hypotheses. In addition, internal consistency, convergent validity and discriminant validity are discussed (Hair *et al.*, 2014; Henseler *et al.*, 2015). PLS has been chosen in our research because this technique works with blocks of variables (components) and estimates the model parameters maximizing the explained variance of all the dependent variables (latent and observed) (Chin, 1998). In general, this statistical technique is used for exploratory and confirmatory research (Urbach and Ahlemann, 2010; Vinzi *et al.*, 2010).

Furthermore, we have selected this technique for three main reasons: (1) our research aims to explain how and why the dependent variable influences the independent variable, and also aims to generate new observations and / or scenarios based on predictions (Nitzl *et al.*, 2016); (2) in recent years, the use of PLS has increased in the area of social sciences and particularly in business management (Chin and Saunders, 2009); and (3) it is a flexible (soft) statistical method on the subject of normality (Chin and Dibbern, 2010) and on the type of measurement scales used (Vinzi *et al.*, 2010).

4. Results

PLS proceeds in two stages. The first stage is to evaluate the measurement model, that is, the relationships between the elements and the constructs they measure. The second stage requires the evaluation of the structural model, that is, evaluating the explanatory power of the independent variables and examining the size and importance of the route coefficients.

4.1 Measurement model

A measurement model with reflexive variables was used, proceeding to analyze (1) the individual reliability of the item (loads), (2) the reliability of the scale construction and the internal consistency (Cronbach's alpha and compound reliability), (3) validity convergent and (4) discriminant validity.

4.1.1 Individual reliability of the article. To measure the relationships and individual reliability of each element, according to specialists in the field, they consider a standardized load factor greater than 0.700 (Dibbern *et al.*, 2012). Our results were in the range between 0.703 and 0.913, and above 0.700 (see Table 3).

4.1.2 Reliability of the constructs. As the first reliability analysis, we performed the Cronbach's alpha test; this indicator is considered satisfactory when it is above 0.700

	Minimum	Maximum	Average	Standard deviation
Number of year of the company	1	117	28,57	20,615
Number of employees	10	200	33,37	43,050

Source(s): Own elaboration, based on surveyed data

Table 2.
Control variables

Table 3.
Discriminant validity of the theoretical model

	Structural capital	Human capital	Relational capital	Process innovation	Products innovation	Performance
Structural capital	0.752					
Human capital	0.589	0.801				
Relational capital	0.570	0.378	0.815			
Process innovation	0.589	0.495	0.502	0.885		
Products innovation	0.525	0.436	0.420	0.795	0.868	
Performance	0.530	0.543	0.335	0.487	0.437	0.784

Source(s): Own elaboration, based on surveyed data

(Hair *et al.*, 2006). Our results are in a range between 0.847 and 0.930, which represents a high reliability of the structures. In a second moment, we have carried out the compound reliability analysis, and recent studies have considered that the most appropriate test is Cronbach's alpha for PLS, since it does not assume that all the indicators receive the same weight (Chin, 1998; Henseler *et al.*, 2016) and is considered the only constant reliability measure (Dijkstra and Henseler, 2015). The composite reliability analysis yielded values in the range of 0.887–0.942, which meets the requirement of values greater than 0.80 for the indicators proposed by Nunnally (1978) and Vandenberg and Lance (2000); see Appendix.

4.1.3 Convergent and discriminant validity. To verify the discriminant validity of the reflexive constructs in mode A of the model, two tests have been carried out. First, the square root of average variance extracted (AVE) has been analyzed following the criteria of Fornell and Larcker (1981) Our AVE values are in the range of 0.566–0.784. These results are above the threshold of 0.500 as proposed by Hair *et al.* (2011). The vertical and horizontal AVE (diagonal) results are below the correlation between constructs. The elements of the main diagonal (in italics) are the square root of the shared variance between the construct and its measures (AVE), the elements that are shown off the diagonal are the correlations between the constructs, therefore, to achieve validity discriminant of the square root of the AVE of a construct must be greater than the correlation it has with any other construct (Nitzl *et al.*, 2016). The constructs of the research model meet the parameters to achieve discriminant and convergent validity (see Table 3).

Henseler *et al.* (2015), in their recent studies, showed that the discriminant validity test performed with the Fornell-Larcker criterion has some deficiencies. However, these limitations do not harm the authors' reputation. Furthermore, Henseler *et al.* (2015) and Franke and Sarstedt (2019) have expressed that the Fornell-Lacker test is not sensitive enough to detect discriminant validity problems and that this test is appropriate for large samples with heterogeneous loading patterns. Therefore, we have carried out a second test through the analysis of the heterotrait-monotrait ratio (HTMT), which, according to Henseler *et al.* (2015), best detects the lack of discriminant validity of the constructs in the research models. In a well-fitted model, heterotrait correlations must be smaller than monotrait correlations, which implies that the HTMT ratio must be below the value of 1 (Nitzl *et al.*, 2016). According to our results, the test does not show anomalies, since the values are below the value 0.879 as recommended by Gold *et al.* (2001) and Henseler *et al.* (2015); see Table 4.

4.2 Structural model

The statistical technique based on the variance of the structural equations was used to validate the hypotheses of our research; we use SmartPLS Professional software (version 3.2.6) (Henseler *et al.*, 2014). To evaluate the structural model, it is necessary to analyze the

	Structural capital	Human capital	Relational capital	Process innovation	Products innovation	Performance
Structural capital						
Human capital	0.660					
Relational capital	0.648	0.411				
Process innovation	0.661	0.534	0.552			
Products innovation	0.591	0.472	0.463	0.879		
Performance	0.624	0.606	0.378	0.545	0.493	

Source(s): Own elaboration, based on surveyed data

Table 4. Discriminant validity of the theoretical HTMT model

behavior of the hypothesis results (β coefficient): the algebraic sign, the magnitude and the importance of the path coefficients. To carry out these tests, the starting procedure with 5000 subsamples recommended by Chin (1998) has been used, and we have also analyzed the Student's t statistics, the size of the effect through (f^2), the value of the coefficient of determination (R^2) and also the predictive relevance and effect size of the value of (Q^2).

4.2.1 Evaluation of path coefficients, algebraic sign, magnitude and significance. Table 5 shows the results of the estimation using the PLS. The study found empirical support to demonstrate hypotheses H1, H2, H3, H4, H5, H6 and H7. However, no significance level was found for hypothesis H8. If we analyze the algebraic sign of the beta (β) values, we can see that all the hypotheses show a positive sign, with which they go in the same direction to the one proposed. Then when analyzing the t values, it is observed that the hypotheses H1, H3, H4, H5 and H7 show a significant effect since their t values (3,319; 4,926; 4,049; 3,664 and 4,433) are

Hypothesis/ Path coeficients	β value	f^2	t value	P value	Percentiles (CI) 5.0%/95%	Bias corrected (CI) 5.0%/95%
H1 Human capital -> process innovation	0.213***	0.064	3.319	0.001	0.217/0.444	0.220/0.441
H2 Human capital -> products innovation	0.185**	0.074	2.490	0.013	0.187/0.456	0.190/0.449
H3 Structural capital -> process innovation	0.330***	0.067	4.926	0.000	0.103/0.319	0.103/0.319
H4 Structural capital -> product innovation	0.322***	0.079	4.049	0.000	0.060/0.311	0.061/0.305
H5 Relational capital -> process innovation	0.236***	0.064	3.664	0.000	0.125/0.335	0.128/0.338
H6 Capital relational -> product innovation	0.170**	0.064	2.624	0.009	0.060/0.269	0.057/0.270
H7 Process innovation -> performance	0.388***	0.088	4.433	0.000	0.243/0.538	0.238/0.529
H8 Product innovation -> performance	0.146 ns	0.090	1.578	0.115	0.025/0.286	0.011/0.288

Source(s): Own elaboration, based on surveyed data. n = 5,000 subsamples: *p < 0.05; **p < 0.01; ***p < 0.001; ns: non-significant (one-tailed t Student) t (0.05; 4999) = 1,645; t (0.01; 4999) = 2,327; t (0.001; 4999) = 3,092

Table 5. Results of the hypothesis test

higher than the standard of 3,092 in So much so that hypotheses H2 and H6 with t values (2,490 and 2,624) show a moderate effect, since they are higher than the t value 2,327.

Our result indicates that none of them shows an effect on performance. In addition to the above, an analysis of the confidence intervals was performed to validate the importance of the path coefficients (hypotheses). Our results for the confidence intervals (percentile-corrected CI/bias-corrected CI) indicate that none of the hypotheses or structural relationships contain the value of (0) (Henseler *et al.*, 2009). These results provide greater empirical value and significant support for the hypotheses tested in the research model (H1 to H7). We have also analyzed the effect size through (f^2). This test measures the degree to which an exogenous construction helps to explain a specific endogenous construction in terms of R^2 (Chin, 1998). The f^2 analysis shows that the key values of the results of the relationships presented in the research model are in a range of 0.007 (small effect) and 0.139 (moderate effect), and these parameters are based on what was established by Cohen (1998); see Table 5.

4.2.2 Relevance, predictive quality and analysis of the fit of the global model. To evaluate the quality, relevance and fit of the model, the adjusted R^2 values have been analyzed: Our adjusted (R^2) values in the model are 0.393 (39.3%) for process innovation, 0.325 (32.5%) for product innovation and 0.249 (24.9%) for performance, with the process innovation variable showing the highest explanatory value of the variance. These results have a substantial impact (Chin, 1998). The Stone-Geisser test (Q^2) value > 0 (Chin, 1998). Our values of the independent variables are: 0.286 for process innovation, 0.229 for product innovation and 0.152 for performance. Standardized root mean square residual (SRMR) is recommended <0.1 (Henseler *et al.*, 2016; Hu and Bentler, 1999). Our result is 0.108, and the root mean square error correlation (RMStheta) recommended value = <0.13 (Hair *et al.*, 2019), and based on our result it is 0.132 (see Table 6). According to the tests carried out, the proposed theoretical model has an acceptable quality, predictive relevance and is adjusted to the theory.

5. Discussion

In the context of the literature on intellectual capital, our study has revealed that the components of intellectual capital (human capital, structural capital and relational capital) have a significant impact on process innovation and product innovation for SMEs. These results are aligned with other previous empirical studies (Díaz-Díaz *et al.*, 2006; Delgado-Verde *et al.*, 2011; Quian and Huan, 2017; Agostini *et al.*, 2017; Agostini and Nosella, 2017; González-Loureiro, 2012; Maboudi *et al.*, 2015; Dost *et al.*, 2016; Gomes and Wojahn, 2017). These results are also aligned with the main theoretical perspectives that analyze the relationships between the different components of intellectual capital and innovation. Thus, an efficient management of intellectual capital and organizational knowledge contributes to generate and use new knowledge that can be used to create new products and processes, improve the design of existing products or processes and improve the efficiency of the company (Kleim- Padilha and Gomes, 2016; Santos-Rodrigues *et al.*, 2011; Villegas-Gonzalez *et al.*, 2017). Therefore, it is corroborated in the study that the deployment of resources and capacities from intangible assets, particularly the components of intellectual capital, is what

Table 6.
R^2 level and predictive relevance and model fit

Dimension	R^2	Q^2	SRMR	RMStheta
Process innovation	0.393	0.286		
Products innovation	0.325	0.229		
Performance	0.249	0.152	0.108	0.132

Source(s): Own elaboration, based on surveyed data

allows the generation of sustainable competitive advantages. This is achieved through the establishment of dynamic processes and an organizational behavior oriented toward innovation and value creation for the company (Santos-Rodrigues and Figueroa-Dorrego, 2011; Wang *et al.*, 2015).

However, if we analyze the results in greater detail, it can be seen that the levels of significance are different for each component and type of innovation. In the case of process innovation, these levels of significance are high for the three components based on their values of beta and *t*, as can be seen in Table 6. While in the case of product innovation, the level of significance has been high only for structural capital, human capital and relational capital showed a moderate level of significance (see Table 6).

In the analysis of the relationships between innovation in products and processes with the performance of SMEs, we were able to verify that there is a positive and very significant relationship between innovation in processes and the performance of the company. This finding is consistent with the literature, since these innovations allow SMEs to have greater efficiency by reducing their costs, thus achieving better benefits and possibly generating more difficult competitive advantages for their competitors (Ruiz-Jiménez and Fuentes-Fuentes, 2018; Subramaniam and Youndt, 2005). However, in our study, there was no significant effect of product innovation on performance. In this sense, this result is aligned with previous studies, which suggest that product innovation does not necessarily generate improvements in efficiency and / or cost savings for the company (Leitner, 2014; Prajogo, 2006; Gomes and Wojahn, 2017). On the other hand, the empirical evidence that exists on the effects of innovation on the performance of SMEs is divergent, since there is no complete agreement on the real effect that innovation has on the performance of SMEs, which may be due to different factors such as the contexts in which the studies are carried out or not to contemplate moderating or mediating effects of the intervening variables (Giampaoli *et al.*, 2019; Agostini *et al.*, 2017).

In short, our results have shown the usefulness of intellectual capital to favor an innovative environment in the company and thus achieve higher performance. SME managers must therefore emphasize all dimensions of intellectual capital to increase their performance. In this sense, from the direction of the SME, to improve its innovative and financial performance, it must enhance (1) its human capital favoring the skills, talents and knowledge of its employees (Rezaei and Mousavi, 2015) or the processes related to their training and education to increase their performance (Radulovich *et al.*, 2018); and (2) its relationships with customers, suppliers, proximity to customer needs and the different stakeholders that relate to the SME (Kwizina and Nabaweesi, 2020). Relational capital is especially important in emerging countries (Tayles *et al.*, 2007), especially (3) its structural capital through improvements in its systems and procedures that solve problems and activate innovation (Chu *et al.*, 2006).

6. Conclusions

The objective of this work was to investigate the relationships between the components of intellectual capital (CH, CE and CR), innovation in products and processes and the performance of SMEs. Our findings were able to demonstrate that the three components of intellectual capital have positive effects on both product innovation and process innovation. Furthermore, structural capital is the component of intellectual capital that shows a more significant effect, while human capital and relational capital have a more moderate level of significance. Additionally, the results showed a positive and significant relationship between process innovation and SME performance. But this found no empirical evidence for the relationship between product innovation and performance.

6.1 Theoretical and management implications

Our results provide theoretical and managerial implications. From a theoretical point of view, the results provide more clarity on the effects that the components of intellectual capital have on innovation in products and processes in the context of SMEs. The vision of the analysis of the components carried out in this work has been little addressed by the literature (Giampaoli *et al.*, 2019; Agostini *et al.*, 2017; Jardon and Martos, 2012), particularly in the context of Argentina, given that it is a country with an emerging economy, and given the relevance that efficient management of intellectual capital has in generating innovation capacity in SMEs, even more so in the context of emerging economies such as the case analyzed, where studies on this topic are very scarce (Fernández-Jardón and Martos, 2016).

From a managerial point of view, the results achieved can be useful for owners and managers of SMEs where the vision of the components of the analyzed intellectual capital highlights the importance for management to assign attention to the management of intellectual capital since it is clear the effect it has on innovation and performance. This is due to the low level of knowledge that SME managers have about this key factor for the competitiveness of their companies (Khalique *et al.*, 2011). The results can be useful for SMEs to increase their competitive potential based on management strategies and practices by implementing ideas generated by employees, supported by their communication systems and work environment (Foss *et al.*, 2013). Managers should encourage their staff to acquire more up-to-date knowledge and information by creating knowledge groups and teams (Maboudi *et al.*, 2015). At the same time, the processes and systems must be more elaborate to contribute to the development of innovation capacities that lead SMEs to be more competitive. In addition, our results can make managers see the need to increase intellectual capital investment because this can improve company performance. Therefore, it is important for SMEs to use their intellectual capital to improve their capacity for innovation and thus generate greater value. In turn, this document opens the possibility for new research on this subject, since it is an aspect that has been dominated by large companies. For this reason, our study offers a strong signal to the SME manager to encourage them to invest in intellectual capital as one of the main drivers of innovative activity (Dumay and Garanina, 2013; Agostini *et al.*, 2017; Pedro *et al.*, 2018).

6.2 Limitations and future lines of research

The research exposes some limitations that discover a way for the development of future lines of research. Firstly, the work focuses on the use of a single source of information, the consultation at the company's management level, without considering other representative variables to measure innovation capacity, such as innovation and development costs or the number of registered patents, due to the fact that they are SMEs, which in most cases do not have reliable records on the aforementioned indicators. In the first place, the work is cross-cutting and focuses on the use of a single source of information. In future studies, in addition to gathering the opinion of the company manager, multiple sources of information (workers and middle managers) should be included and longitudinal studies should be carried out to confirm the impact of intellectual capital on innovation and SME performance. Additionally, it would be very interesting to include variables that describe the leadership of the managers. The leadership style can influence the strengthening of intellectual capital in SMEs, especially in emerging countries. Leadership is the most relevant management function in any organization and helps to increase its performance (Alrowwad *et al.*, 2020). And in the SME, the leadership ability is essential for the growth of the company (Jardon, 2019).

Second, the study covered only companies in the industrial sector without considering companies in the commercial and service sectors, or the primary sector. Third, the study was conducted in one part of a province. That is why in later studies, variables such as R&D

expenses and the number of patents registered by the company as indicators should be considered to measure the innovation capacity of companies; additionally, the sample should include the rest of the economic sectors and other regions to be able to compare the results. A fourth limitation is that other indicators can be used in the measurement of the performance variable, which could show more reliable results. Finally, it is necessary to expand the studies related to intellectual capital in emerging countries to strengthen an extension of the theoretical framework of intellectual capital that can explain its differentiating characteristics more rigorously.

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Appendix

Variables	Load Factor	Cronbach's alpha	Compound reliability	(AVE)
Human Capital		*0.930*	*0.942*	*0.642*
CEHEMP1 Take risks, are proactive, creative and brilliant	0.816			
CEHEMP2 Possess the ability to assess investment risk	0.781			
CEHEMP3 Understand the importance of knowledge for success	0.823			
CEHEMP4 Successfully apply the knowledge acquired	0.793			
COMPE1 Participate and develop new ideas and knowledge	0.783			
COMPE2 Work as a team and are encouraged to interact and debate	0.825			
COMPE3 Commitments to the strategy sense of responsibility	0.831			
COMPE4 Easily adapt to new situations	0.779			
COMPE5 Collaborate in identifying and solving problems	0.780			
Structural capital		*0.847*	*0.887*	*0.566*
CAPTEC 1 Collaborate with other people inside and outside the company	0.733			
CAPTEC 2 Search for new knowledge	0.797			
CAPTEC 3 Coding much of the business knowledge	0.724			
ESIPRO1 The structure facilitates the transfer of new knowledge	0.781			
ESIPRO2 The structure promotes collective behavior	0.703			
ESIPRO3 The structure makes it easy to discover and create new knowledge	0.773			
Relational capital		*0.899*	*0.922*	*0.664*
RELHOR1 To strengthen product and process innovation capacity	0.813			
RELHOR2 Develop solutions	0.766			
RELHOR3 Measure the image they have about the company	0.777			
RUCOLEX1 Objectives potential collaboration with its strategic partners	0.841			
RUCOLEX2 The reasons for the success of the collaboration with its partners	0.862			
RUCOLEX3 Possible organizational collaboration mechanisms	0.826			
Products innovation		*0.891*	*0.924*	*0.754*
INPR1 Number of new products or services introduced	0.862			
INPR2 Pioneering character in the introduction of new products or services	0.879			
INPR3 Speed of response in the introduction of products or services	0.899			
INPR4 R&D expenses for the development of new products or services	0.831			
Process innovation		*0.908*	*0.935*	*0.784*
NPRC1 Number of new process introduced	0.880			
NPRC2 Pioneering character in the Introduction of new process	0.913			
NPRC3 Speed of response in the introduction of process	0.883			
NPRC4 R&D expenses for the development of new process	0.863			

(*continued*)

Table A1. Item reliability and internal consistency by construct

Variables	Load Factor	Cronbach's alpha	Compound reliability	(AVE)
Performance		*0.875*	*0.905*	*0.615*
REN1 Sales volume	0.798			
REN2 Profitability	0.795			
REN3 Productivity	0.831			
REN4 Customer satisfaction	0.759			
REN5 Employee satisfaction	0.765			
REN6 Satisfaction of owners, investors or shareholders	0.756			

Table A1. **Source(s)**: Own elaboration, based on surveyed data

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