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Science, Technology, And Innovation Capabilities As Main Determinants Of Economic Performance In Aerospace Companies

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Abstract

Within the regional systems of innovation, companies play a preponderant role since they are those who appropriate and use knowledge and impact society. Scientific literature shows that this impact is conditioned by the capabilities in Science, Technology, and Innovation, among others. However, this topic has not been analyzed focused on companies innovative namely companies with specific capacities for innovation. The study analyzed a group of companies that demonstrate results of innovation in terms of products and sales growth, the behavior of the capabilities, and the focus according to the innovative intensity of the companies.

Finally, It was found that there is a real and positive effect between innovative and economic performance, and between these two and the resources management and planning capabilities.

Keywords: Knowledge; Regional innovation system RIS; resource management; research and development.

JEL classification: O32; O38

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1. Introduction

In Colombia, the business approach is oriented towards transformation and primary production, rather than the generation of industrial or knowledge value (CAF, 2017). According to the National Administrative Department of Statistics, by 2021, a total of 866,530 companies were reported nationwide, distributed in 772,975 micro-companies, 69,120 small, 18,319 medium, and 6,116 large companies (DANE, 2022) of which only 0.23% are considered innovative. Antioquia is a department of Colombia that has the second highest score according to the departmental innovation index with a total of 61.43 points for 2021, according to (Índice Departamental de Innovación Para Colombia (IDIC) 2020).
However, Antioquia's behavior in terms of size distribution is similar to the national level, the number of innovative companies is almost double the national percentage, i.e., 0.423%, corresponding to 534 companies. (DANE, 2021). The proportion of innovative companies compared to the total number of companies in the Metropolitan Area of the Valle de Aburrá (AMVA) is equivalent to 0.27%, which implies that it is one of the most innovative companies in the AMVA (CCMA, 2015; DANE, 2022; Ruta N, 2015), which implies that it is one of the regions with the greatest propensity for innovation, especially due to the efforts of Medellín as metropolitan capital in supporting business innovation, evidenced by the fact that the percentage of companies that develop innovative actions is slightly higher than the national proportion.

A Regional Innovation System (RIS) is a network of public and private institutions, called agents, whose activities and interactions contribute to the generation, transformation, use, or exploitation of knowledge (IDB et al., 2011). But from a dynamic perspective, also can be thought of as a tool for the promotion of international competitiveness and economic growth (Asheim, 2019), which can leverage public policies for the design and implementation of smart strategies according to regional and national capacities.

Companies as elements that make up a RIS are characterized as knowledge-exploiting agents as they put research results on the market thus concretizing the innovation process through the successful marketing of innovative products (OECD & EUROSTAT, 2005). On the other hand, these companies can also be knowledge explorers by helping to promote applied scientific research activities and the formation of advanced human capital by universities and research institutes, as well as knowledge-generating agents (Castellanos & Jimenez, 2008; OECD & LEED, 2015).

The willingness of a company to develop activities and investments in Science, Technology, and Innovation (STI) may vary depending on the productive segment to which it belongs, among other factors such as its size, sector, age, and origin of capital, and also in terms of the sophistication of the demand it faces, the identification of opportunities in the markets in which it competes, and the macroeconomic and business environment, among other factors according to (OECD & LEED, 2015).

According to the art state revision, the study of firm performance related to innovation processes has focused on comparing innovative and non-innovative firms (Fernandez-Jardon et al., 2014; García-Pérez de Lema et al., 2016). But, this study analyzes the relationship between performance in firms that have demonstrated results in innovation processes and STI capabilities to identify the particularities of the capability rather than its intensity.

On the other hand, the theory of Global Production Networks (GPR) proposes a perspective on how the productive enterprise is organized in a global context, highlighting the linkage of the value chain between transnational and global companies and local companies, as well as the possibility of interacting and articulating as collaborative business units. In this sense, the definition of technology and science and innovation capabilities is relevant, because it is what enhances the insertion of local organizations in the value chain of transnationals, showing the importance of these capacities for a company.

As was studied by (Tovar et al., 2015), related to innovation capacities, one of the implications could be that there is a learning context in which local companies learn from global companies by absorbing knowledge to acquire technical capabilities, from the simplest to the most complex or sophisticated ones, within the framework of a dynamic of knowledge transfer to achieve quality standards and reduce operating costs, leading to a better level of competitiveness within the value chain (Quintero Ramírez & Ramírez Giraldo, 2019; Tejera, 2013). From this theory, science, technology, and innovation are elements that define both technical and managerial competitive capabilities so that the value chain in the supply chain between small, medium, and large companies is strengthened and detonates the economy of a region such as Antioquia, according to firms' innovation capabilities.

Thus, this paper investigates the relationship between Science, Technology, and Innovation (STI) capabilities and the innovative and economic performance of a group of companies associated with the Aerospace Cluster of Colombia in the region, applying a survey only to companies with some degree of innovative success, following the structure of the Development and Technological Innovation -EDIT- survey and that of the Innovation Pact of Medellin (DANE, 2015a), and that of the Medellin Innovation Pact (Ruta N, 2015). The purpose of the survey was to collect information on STI capabilities as well as on innovative and economic performance. In this context, innovative performance is measured as the realization of the innovative process according to DANE definitions, while economic performance is measured as the growth in sales resulting from innovation processes.

The present study is developed within the framework of the research entitled Configuration of a Regional Innovation System (SRI) for the strengthening of the aerospace industry in Antioquia, financed by the Colombia Ministry of Science and Technology with project code SIGPJ1 83858/9641-898-83858.

1. Theoretical framework

Nowadays, where the knowledge economy prevails, innovations are recognized as one of the main accelerators of economic growth at the country, region, and city level, as described by (Chen et al., 2020) by analyzing the dynamics in a Chinese province through indicators and dimensions of input, output, and environment of innovation.
Another aspect studied is the effect of innovation on productivity, as it is planned to question whether investments in innovation and technologies affect the productivity of companies, sectors, and economies (Kijek & Kijek, 2019). An interesting example in Colombia is described in (Florez, 2021), where the author develops how to achieve a competitive system in the aerospace sector inside the Colombian Air Force and shows the main innovation capacities inside this case and the effects on the innovation company.

For the regions and the companies, the issue of science, technology, and innovation is highly relevant to the formation or acquisition of organizational capabilities, as expressed in their study by (Zou et al., 2016) who develop a system dynamics model that incorporates an important feedback loop between absorptive capacity, technological innovation, and the product life cycle (PLC), and also (Yuan et al., 2016) who constructed an integrative framework of technological, marketing, innovation and organizational performance capabilities based on a sample of companies from both countries.

These findings indicate that technological capabilities and marketing capabilities are complementary, and that combined they have a direct relationship with innovation, thus making it possible to obtain competitive improvement in the organization.

Coincidentally, in their work on the role of technological capabilities in product innovation, the authors propose that technological capabilities have curvilinear and differential effects as described in (Zou et al., 2016) where they describe the importance of regional innovation systems for the regional economy and national competitiveness by examining how investment in R&D by firms, universities and research institutes (a central component of Triple Helix Innovation) helps build regional innovation systems and their contingencies in China's emerging economy, and (Wang et al., 2008a).

According to these documents, is possible to say that, despite the growing importance of management practices, few studies have examined the influence of knowledge and technology management on product innovation, especially regarding technological capabilities, as shown by examining the quantitative relationship between knowledge management, innovation, and performance as a consequence of Knowledge Management processes in innovation activities since according to the study organizations are unaware of the real implications of technology management and its impact on innovation processes and how these contribute to the performance of the firm (Mardani et al., 2018).

On the other hand (Burrus et al., 2018), analyses are planned, at the regional level in the United States, to assess the relationship between innovation and firms' commitment to innovation, to frame the relationship between levels of innovation in a region and the performance of publicly traded firms in those areas, The result is that inventive activity within a country, as measured by a patent index, is positively related to revenue and earnings growth, while technical creativity, as measured by an index of employment in technical fields, is associated with process improvement and net income growth.

In other words, most of the studies propose a model that explains how technology management is related to product innovation through the role played by technological capabilities. The results classified into three levels of capabilities showed that technology management practices are closely associated with product innovation performance. It is also highlighted that at the most advanced stage, scientific activity and technology resource management have a significant correlation with innovation output.

Thus, the research results theoretically explain how technology management implies a significant impact on the improvement of product innovation and performance depending on the stage or level of technological capability at which the company is located. Although the authors state that product innovation is the process through which companies use their resources and capabilities to develop new products, they do not give a clear explanation of how to use such intangible assets as knowledge and science, which represents an opportunity for relevance in the study of the variable’s technological capability, science, and innovation.

As well as in (Rahim & Zainuddin, 2016), claims that technological innovation capabilities are important for firms to obtain core competencies and improve competitiveness. Very few previous studies refer to analysis between technological capabilities and their role in the innovation process, as well as the influence they have on business performance and their competitive advantage. In addition to the latter, it is relevant to study the dimensions of technological capabilities for innovation, namely: R&D capabilities, manufacturing capabilities, networking capabilities, and human resource capabilities, among others. The results show that R&D capability and networking capability improve competitive advantage as well as firm performance. Also, among the findings is that

competitive advantage significantly impacts firm performance, but does not mediate the effect of the dimensions of technological capabilities and innovation (R&D capability, manufacturing capability, networking capability, and human resource capability) on firm performance.
For these authors, the empirical results show that R&D capability, networking capability, and human resource capability affect a firm's competitive advantage. This means that the firm can improve its competitive advantage by training employees who have the knowledge and experience of a quality of work, encouraging the dissemination of knowledge, and promoting the retention of competent employees.

Furthermore, Mormina, (2019) argues that science and technology are key to economic and social development, however, the capacity for scientific innovation remains globally unevenly distributed. The author assumes that the use of knowledge is often reduced to the practice of promoting knowledge transfer, i.e., in some regions, only knowledge is transferred for production purposes without delving into the relevance of doing science through research to then generate technological development. The creation and development of research capabilities tend to focus on the development of technical competencies of scientists through training without parallel investments to develop and sustain the socioeconomic and political structures that facilitate the creation of knowledge.

This opens a significant gap in the scientific divide between developed and developing countries and distinguishes the need to assume scientific knowledge as a social good and the capacity to produce it assumed as a social capacity. Thus, increasing this capacity not only requires the training of research profiles, but it also becomes necessary to strengthen the social, political, and economic structures that strengthen the innovation system of a country or region, focusing this effort on access to knowledge through science and technology policies, for the construction of innovation capabilities.

Then it’s necessary, to go beyond the transfer of mechanically packaged solutions in the form of technical blueprints and rigid methodologies and tend toward innovative ways of encouraging people, organizations, and institutions to develop their capabilities, through the design and development of their technological models to generate technical and technological changes based on science, that could aid to develop de society, understanding that each zone, each region, could have differences in their strengths.

Thus, Regional capabilities are the basis for science and technology processes in their specific environment, but they require leadership in pragmatic technological research and development, i.e., oriented to the transfer of value to companies and through them to markets. However, for its success, special attention must be paid to the specific needs, regulations, and attitudes of society toward technology and its market to minimize risks, carrying out regulatory and market surveillance. Also critical in a global environment is the development of national and transnational research and management support networks to help strengthen local research systems and their capabilities, transferring and appropriating respectively capabilities and developments.

To establish a context for analysis, it is then assumed that an innovative company is one that "demonstrates the systematic implementation of activities conducive to innovation, through established processes, allocated resources and verifiable results." (DNP, 2015, p. 32).

In the same vein, for the Mexican case, a study carried out in Sonora, Mexico by (Perez-Soltero et al., 2013), shows that a widespread problem among small and medium-sized companies is their limited capacity to offer differentiated and innovative products and services, for which these companies usually have to resort to other types of innovation external to their companies as described in (van de Vrande et al., 2009). This is because, in most cases, the companies do not have the technological capabilities that would allow them to increase technological complexity, or in general the competitiveness of the product or service, since there is difficulty in accessing state-of-the-art technology, inputs, the market and financing, which is why they do not carry out scientific research, resulting in a lack of specialized knowledge.

This type of characteristic generates a disadvantage, more so nowadays where the technological advantage is a differentiating element, as described in (Martín-de Castro, 2015; Zheng et al., 2011). In this context, knowledge becomes a resource managed through management processes and technological innovation, which become key factors to generate and ensure a sustained competitive advantage and thus the survival of companies in knowledge-based and high-tech industries and in general in any industry today.

Another example of strategy is shown in Mexico the cluster strategy has given good results to address these issues (Lai et al., 2014), research on industrial clusters is developed focusing on the effects of the competitive advantage they generate, through a process of empirical research on three types of Taiwanese parks (industrial export processing, polygons, and science parks), in which economic development is especially prominent, and which have characteristics of industrial clusters, determining as an important mediator of the strategy the management of technology and knowledge for the strengthening of capabilities in terms of corporate innovation and its performance, according to (Albors-Garrigos & Hervas-Oliver, 2019; Bello Zapata, 2017; Colombian Caescol Rionegro-Antioquia Buitrago Nataly, Leiva, Juana, García Duque, 2019; Fernando Morante Granobles et al., 2018; j. & m., n.d.; Morante, Diego, Guillermo Giraldo, 2021), who explains the aerospace sector in Colombian the clustering process and more specifically the Antioquia aerospace cluster process and characteristics.

In the case of Colombia, Mexico, and Spain, the collaboration strategy has worked concerning the development of technological capabilities and the sustainability of companies. As well as, for the Colombian context, it is observed that it coincides with the fact that most companies are not innovative. For the analysis specifically in Colombia, innovative companies are classified into three groups, according to the intensity of innovative activities developed (DANE, 2015b):

- Innovators in the strict sense: those that during the last two years obtained at least one new or significantly improved good or service in the international market.
- Innovators in a broad sense: Companies that during the last two years obtained at least one new or significantly improved good or service in the domestic market or a new or improved good or service for the company, or that implemented a new or significantly improved production process for the main production line or complementary production lines or a new organizational or marketing form.
- Potentially innovative: Companies that during the last two years had not obtained any innovation; but that reported having in process or having abandoned some innovation project, either to obtain a new or significantly improved product in the international market, in the national market, or for the company; or to obtain a productive process for the main production line or the complementary lines, or a new organizational or marketing technique.

When performing a detailed analysis of the differences, these are centered on knowledge and its application to the business environment. In this sense, Know How stands out as an essential aspect for companies that intend to develop processes associated with innovation, (Escobar et al., 2016) and (Malecki, 2010) and therefore, they must search for it to synthesize, organize, and integrate it, or failing, abandon it, quickly and effectively, reducing risks and costs (Quintero Ramírez et al., 2017). In all cases, the process of knowledge exploitation in companies is the basis to improve and economize on a technology (Leonard-Barton, 1992; OECD, 2015).

In this way, the exploratory and articulation phases with the generators have a key role in the exploitation that allows the provision of new solutions (Escobar et al., 2017).

Knowledge-exploring companies have a series of capabilities supported by STI processes that provide them with the best conditions to develop in their competitive environment. (Dorrego et al., 1997) which is reflected in their innovative and economic performance. (Robledo Velásquez et al., 2009) and can be evaluated by analyzing these STI capabilities. (Fernández Jardón et al., 2012; López González et al., 2016).
For the case under analysis, the most relevant STI capabilities for the companies are:

i) R&D capacity, which can be interpreted as personnel effort, personnel profile in terms of training, and R&D output. (Garcia & Nair, 2005; He & Wong, 2004; Tushman et al., 2010a).
ii) Organizational learning capability is defined as the ability to identify, assimilate and exploit knowledge coming from the surrounding environment (Katila & Ahuja, 2002), or the ability to maintain or improve performance based on experience. (Fernandez-Jardon & Valdés, 2016)..
iii) Planning capability is represented as the firm's ability to identify strengths, weaknesses, threats, and opportunities, formulate plans according to the corporate mission and vision and adjust implementation plans, as well as the ability to adopt different types of strategies that adapt to the changing environment to excel in today's competitive environments (Carosi, 2016; Tushman et al., 2010b; Yam et al., 2004).
iv) Resource management capability refers to the firm's ability to acquire and appropriately allocate capital, expertise, and technology in innovation processes (Fang et al., 2016; Wang et al., 2008b; Yam et al., 2004).

2. Methodology

To establish a relationship between Science, Technology, and Innovation (STI) capabilities and innovative and economic performance in the region in the aerospace sector, and based on what is described in the state of the art, the research question is: What is the relationship between Science, Technology and Innovation capabilities and organizational performance?

The paper first presents a theoretical framework on the concept of the knowledge exploiting firm and its relationship with STI capabilities. To answer this question, a population framework must first be established to define the sample. In addition, a validation process is carried out, for which a bibliometric analysis of the fundamental themes of the instruments is developed.

As a next step, the technical foundations of the statistical analysis are established, and the variables are defined according to their relationship and the results of the bibliometric study in such a way that they represent factors of impact on the research. Finally, the results of the study are analyzed, and the main conclusions are drawn.

Each step of the methodology is developed and defined below.

3.1 Population and sample frame

Medellín is the core city and borders nine other municipalities. This geographic region concentrates more than 3.7 million inhabitants and is the second largest urban conglomerate in Colombia (AMVA, 2016). On the other hand, the department of Antioquia is home to 126,275 companies corresponding to 14.39% of the national total, and 78,250 are located in the AMVA, representing 8.9% nationally and 70.9% in the department (CCMA, 2015;

DANE, 2015b, 2017). However, the number of aerospace companies in these geographical areas is minimal since they do not reach a hundred. In this sense, the sample taken will be of a census type focused on the companies that are part of the aerospace sector located in the metropolitan area of Medellin. It was possible to contact and identify 18 micro and small companies in the sector of interest, 10 medium-sized companies, and finally 17 large-sized companies, which together make a sample of size 45.

3.2 Validity of the measurement instrument and its measurement scales.

For content validity, an exhaustive review of the specialized bibliography on technological innovation capabilities, and innovative and economic performance was carried out to theoretically support both the questions and the measurement scales.

Concerning face validity, this analysis establishes that the levels of measurement show what it is intended to measure; therefore, the scales of measurement initially considered were adapted, adjusted, and culturized based on the results of previous studies of this type. To this end, the research instrument was submitted to a panel of experts in MSMEs in order to refine those indicators that did not correlate with the research.

3.3 Sampling technique and statistical analysis

Once the census-type sample was defined, the reliability of the research instrument was tested using Cronbach's alpha coefficient for each of the 45 companies mentioned above. The values achieved for this study were between 0.8 and 0.9, although values of 0.7 are acceptable for this reliability indicator. To achieve the above, the measurements that ensured the aforementioned Cronbach's alpha was initially made in a round of 16 companies, and the final version was applied in three rounds: the first employing the SurveyMonkey ® electronic survey system, the second by telephone communication to companies that did not respond in the first round and finally by visiting those companies that requested it.

3.4 Variables and statistical analysis procedure

With the data obtained, a descriptive analysis of the results was performed, and the variables associated with the different capabilities were identified, seeking the reduction of the data set, and the relationship between capabilities and innovative and economic performance. Since the variables have different dimensions and scales, dimension reduction techniques were used by the extraction method of principal component analysis with Varimax normalization rotation with Kaiser ((Carlos M. Fernandez-Jardon and Martos, 2011) when applicable due to the amount and type of data. The first two resulting components, associated with the different technological capabilities, were identified by clustering, using the K-means clustering method. (Nieto et al., 2015).. The cluster results express the innovative technological capacity of the companies as an ordinal variable at two levels. Finally, a contingency table analysis was performed, using the Goodman-Kruskal gamma coefficient as a test, seeking to identify the relationship between STI capabilities and innovative and economic performance.

4. Results and discussion

For the presentation of the results, stages are established following the methodology proposed, in which each section corresponds to one of the points raised.

4.1. Characterization of the operators and innovators of the SRI of AMVA

Concerning the Characterization of the operating and innovative agents of the SRI of the AMVA, the 45 companies are grouped into three types of sizes: micro and small=18; medium=10 large companies=17, and 14 sectors.

The companies reported growth in sales due to innovation, as follows:
greater than 0% and less than 2%=14; between 2 and 5%=20 and greater than 5%=11; made investments in the innovation process as a percentage of sales, and are in one of the types of innovative companies defined in Colombia: potentially innovative= 8; innovators in a broad sense= 15; and strictly innovative= 22.

Identification of STI capabilities:

Data were processed for the four main capabilities associated with STI and are presented in Table 1 is a summary of the approaches and values found for each capability.

i. To evaluate R&D capacity, after a process of reduction of dimensions and rotation (of 9 original variables) three groups of companies were identified: those that privilege the research process (I), those that have a greater emphasis on technological development processes (D) and those that have a component called support (S). These components were classified into two groups utilizing clustering, those associated with research processes (I) and those associated with development processes (D), with R&D capacity being reclassified as a value = 2 and those associated with support processes (S), reclassified as a value = 1.

ii. To evaluate the organizational learning capacity, the budget allocated to training and the number of training were investigated, discriminating the proportion of them on innovation-related topics. With these results, the variables of the capacity were reclassified looking for ordinal variables that could be associated with performance, and two levels of intensity in the learning process were found: i) focused on innovation, which presents the companies that have a greater investment in training processes associated with innovation issues as well as the greater intensity in the number of piece of training on the subject = 2, ii) transversal, which represents companies that have a degree of allocation of resources and training actions below the average of the sample to the subject of innovation = 1.

iii. To evaluate the strategic planning capacity through the survey, five variables that express the planning capacity in terms of the alignment of the organization and the planning of innovation processes were investigated. Based on the above, a new variable was constructed to represent strategic planning capacity with two levels: one focused on innovation strategy = 2 and the other focused on generic business strategy = 1.

iv. Resource management capacity: The resource management capacity in the survey examined 10 variables that reveal how the companies articulate with the SRI. To interpret it, a process of dimension reduction and clustering was carried out to define an ordinal variable of resource management capacity with two levels, associated with the success of resource management = 2 and associated with the articulation with the regional innovation system = 1.

Capacity	**Capacity approach**	**Value**
R&D capacity	Support R&D	1
	R&D	
Organizational learning capacity	Transversal	1
	Focus on innovation	

Planning capacity	Generic business strategy	1
	Innovation strategy	
Resource management capacity	Articulation to the SRI	1
	Successful resource management	

Table 1. Structure of STI capabilities, each disaggregated into two possible approaches and values assigned as variables. Source: Own elaboration

For all figures, the contingency plots show relating the different capabilities to innovative performance and use the Goodman-Kruskal gamma coefficient and its statistical significance for Resource management capability; Planning capability; Organizational learning capability, and R&D capability.

4.2. Relationship between STI capabilities and innovative performance

The Relationship between STI capabilities and innovative performance is analyzed in figure 1, where resource management capacity, planning capacity, organizational learning capacity, and research and development capacity are graphed for companies' innovation classification since potentially innovate through strictly innovation.

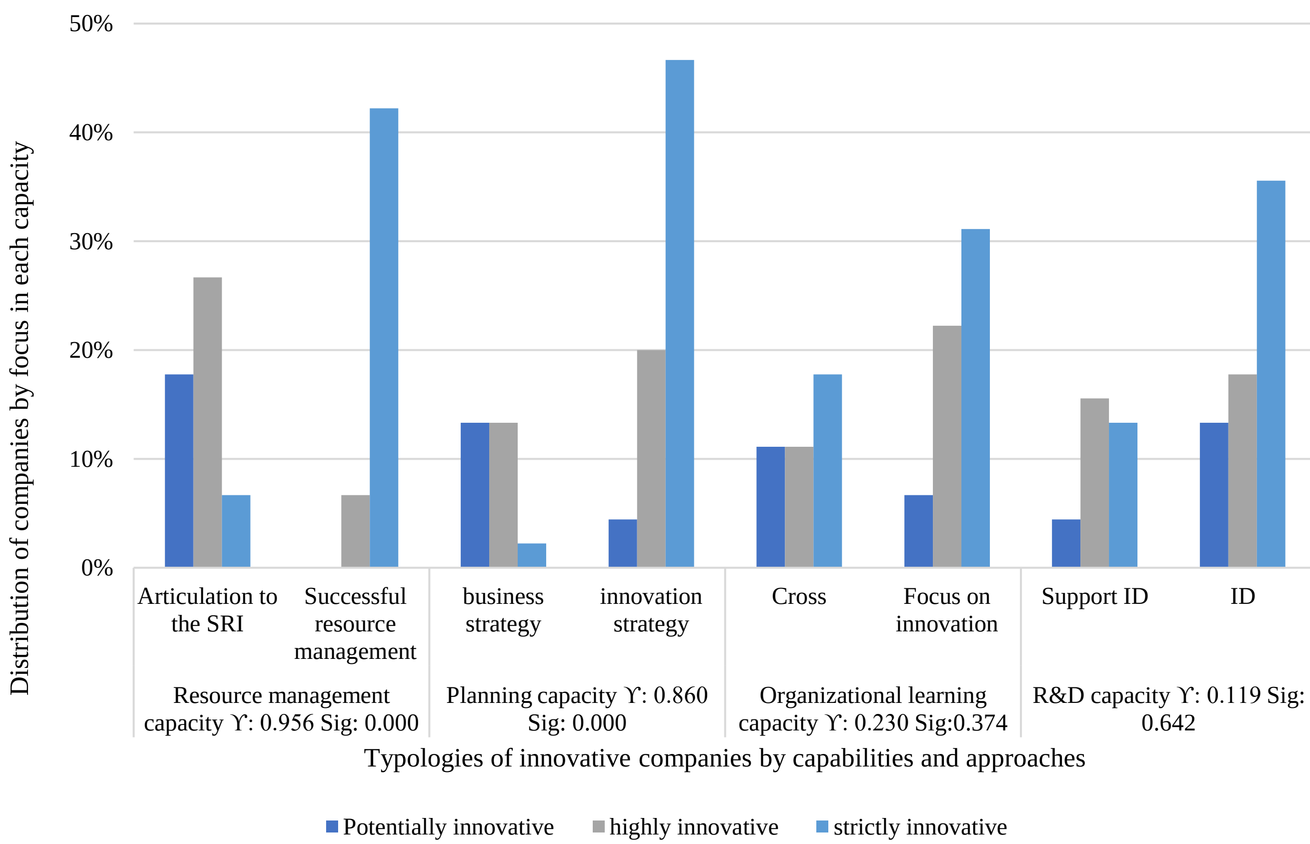


Figure 1 shows the contingency plots relating the different capabilities to innovative performance. The Goodman-Kruskal gamma coefficient and its statistical significance are presented for Resource management capability; Planning capability; Organizational learning capability and R&D capability. Then, it was found that innovative performance in firms that are already innovators is associated more with resource management and planning capabilities than with research or learning capabilities.

For potentially innovative companies, STI capabilities are associated more with the articulation of the SRI and the definition of a generic business strategy. For broadly innovative companies their alignment is towards the articulation with the SRI and the definition of an innovative business strategy. For strictly innovative companies, the focus is on successful resource management and the consolidation of the innovation strategy.

The capabilities that were not statistically significant in the evaluation were R&D and organizational learning capabilities, which can be explained by the fact that innovative companies have already developed these capabilities and therefore focus on planning and resource management capabilities. However, there is a tendency that in broadly and strictly innovative firms the focus of the learning capability is on innovation, and in potentially innovative firms the focus of the learning capability is still cross-cutting. For R&D capability, all three types of companies focus on specific R&D actions.

As mentioned above, innovative performance in innovative companies has not been studied in depth, however, authors such as (Robledo Velásquez and Zapata Toro, 2013) propose maturity levels for the innovative process, and for this purpose, the implementation of actions to improve STI capabilities (Carlos Maria Fernandez-Jardon et al., 2014), in a study developed in Argentina, they call these capabilities distinctive capabilities, since they are the result of the application of a strategy oriented to the improvement of performance. All this leads to identifying the definition of an innovative business strategy in the resource management capacity, the successful management of the system, and the planning capacity. These are the distinctive conditions of the most innovative companies and therefore, within the framework of a policy to support innovative companies, they are the focus of the capabilities to be promoted.

4.3. **Relationship between STI capabilities and economic performance**

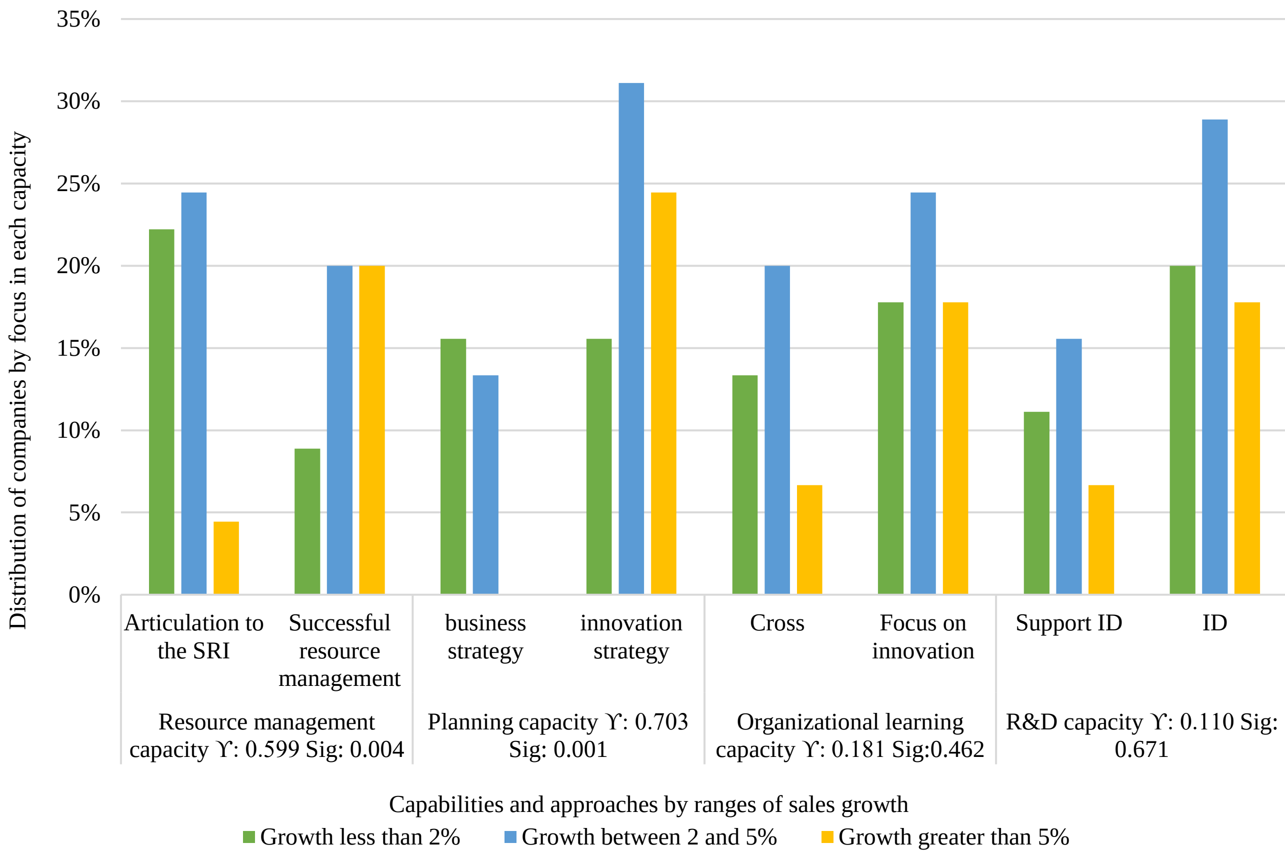


Figure 1 Relationship between STI capabilities and economic performance (sales)

In Figure 2 it is possible to observe, that the relationship between capabilities and performance is positive for all cases, maintaining the trend reported in the literature regarding the sign of the coefficient (Robledo Velásquez et al., 2013). Also, it shows, the significance of the relationship between economic performance and resource management and planning capabilities that for this case is less than 0.05; and the significance of the relationship between economic performance and learning and R&D capabilities is greater than 0.05. This implies that only two capabilities are determinants of economic performance in innovative companies.

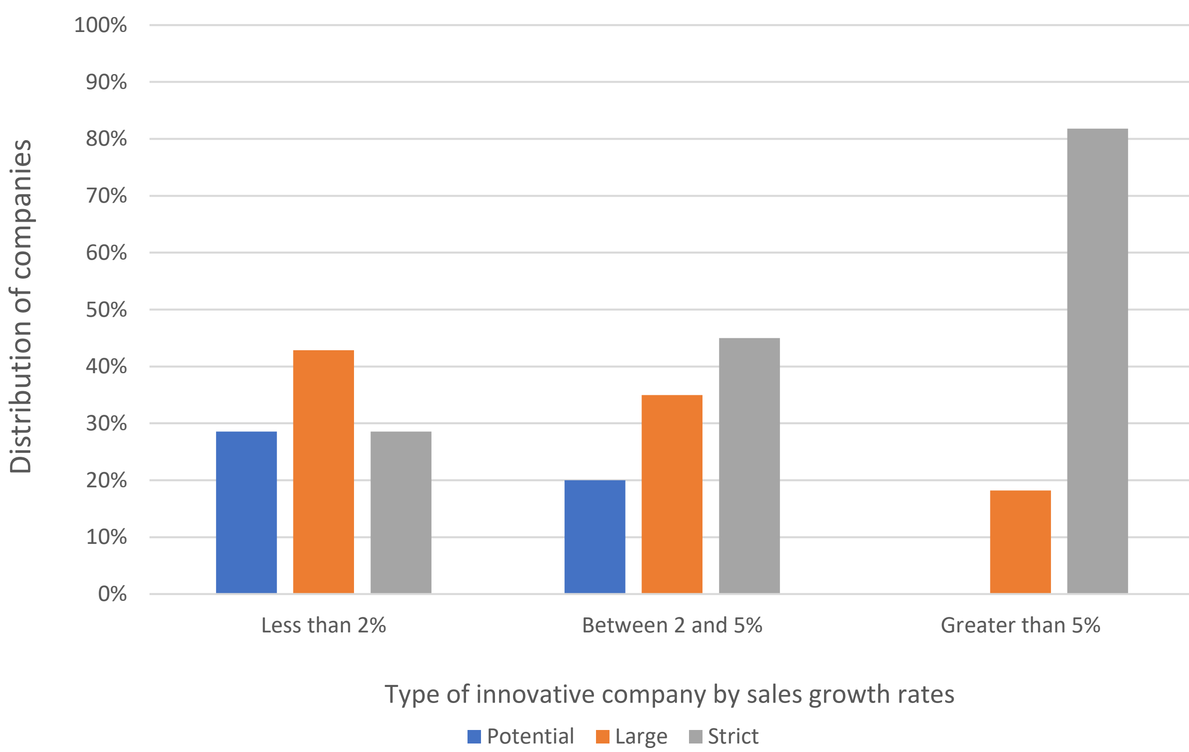
The companies that presented sales resulting from innovation processes higher than 5% were successful in obtaining resources within the resource management capacity; the planning capacity was focused on the definition of an innovation strategy; the organizational learning capacity was focused on innovation and the R&D capacity was in the R&D process. Companies with sales of less than 5% focused, in greater proportion, in terms of resource management capacity, on articulation with the SRI; planning capacity was focused on the definition of an innovation strategy; organizational learning capacity was focused on innovation, and R&D capacity was focused on the R&D process.

According to the (OECD, 2013) sales results resulting from innovation processes are a performance indicator and, in this case, all companies have sales in this sense. What is interesting is the difference between those with higher sales growth where the only capacity that differs in the approach is resource management and this happens only for companies with growth greater than 5% which may be related to the leverage with external resources. For (Katz, 2007) the relationship between economic performance and firm maturity is not necessarily proportional in traditional industries, but in technology-based processes, it does present a positive relationship; similarly, the

(CAF, 2017) finds that the regions that have better conditions for the development of technology, similar to the maturation of STI capabilities for the companies, are the ones that present better economic performance indexes.

4.4. Relationship between Innovative Performance and Economic Performance

Figure 3, shows the relationship between innovative performance and economic performance for innovative firms. Strictly innovative firms have the highest proportion of firms with sales growth above 5%; while potentially and broadly innovative firms have the highest proportion of firms with sales growth performance below 2%. All three groups have companies with sales growth between 2% and 5%. This shows how the transition process from being potentially innovative to strictly innovative boosts sales growth and with it the improvement in innovative performance. For the figure analysis, the factors were Gamma 0.549 and significance 0.002.



Error! Reference source not found.. **Relationship between Innovative Performance and Economic Performance**

Economic performance is an expression of innovative performance and therefore there is a close relationship between the two performances, however, this condition has been evidenced in the results for innovative companies, which is the case study of this research. For traditional companies, the relationship between economic performance and innovative performance is not direct, as are the relationships between capabilities and economic performance (Robledo Velásquez et al., 2009). This may be because traditional companies favor production capacity, which was not studied here, and therefore can have good economic performance without innovating.

4. Conclusions

The Colombian innovation system should promote the development of innovation capabilities within companies, reflected in the growth of their sales thanks to the strengthening of their innovation capabilities. As evidenced, the sales results of innovative processes serve as a performance indicator; however, it was observed that the focus of resource management toward innovative processes can leverage external resources and improve business indicators.

In the study area, efforts have been made that are superior to the rest of the country, which shows that at the national level only 0.23% of the companies are considered innovative, while the percentage is 0.423 %, corresponding to almost double, although they maintain a distribution by type of company like the national one. This leads to the conclusion that it is necessary to change the focus of public policies on science, technology, and innovation to have a significant impact on the behavior of agents and facilitate business development within the framework of the SRI.

Innovative firms at different levels demonstrate a connection with the SRI, which allows them to access and manage knowledge critical to innovative success. It is found that, for large and potentially innovative firms, generating networks and articulating with the SRI makes them more efficient in an innovative and economic performance as described in the theoretical context. For strictly innovative companies that have already gone through this process, STI capabilities are oriented towards the realization of the products resulting from this articulation, which materialize as access to and use of knowledge.

According to the results, the difference between the STI capabilities of the three types of innovative companies lies in their focus. This implies the need to specialize public policy efforts on the capabilities that have the most significant impact on improving innovative and economic performance. For this sector, the authors say that it would work best with a greater emphasis on improving competitive advantage by improving R&D (Science) capability, production capability, management capability, and learning capability, i.e., those capabilities that are relevant to the competitive improvement of the strategy. Traditionally, the policy has been differentiated for innovative and non-innovative firms, but the findings show the need to differentiate between the type and intensity of innovation to leverage the firm and generate results measured as innovative performance and stronger economic performance.

In summary, innovation policies for development with a regional approach are needed to enable the national system to create a link between national and regional policies and, according to regional diagnoses, to leverage distinctive capabilities to strengthen innovation processes. Likewise, this study finds that the companies that are innovative with greater intensity in their level of innovation are the most successful capabilities associated with the company.

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