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# Impact of SENA on innovation of manufacturing companies in Colombia: From the abidextrous Organizational perspective[1]

## Impacto del SENA en la innovación de las empresas manufactureras en Colombia: Una mirada desde la ambidestreza organizacional[1]

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## Abstract

The National Training Service (Servicio Nacional de Aprendizaje - SENA) is an entity of integral professional training of technologists and labor technicians in Colombia. SENA also provides technical services and participates in innovation projects with companies. In this sense, this research is about whether collaboration with SENA in innovation projects has significant effects on the capabilities and performance of manufacturing companies, by means of an empirical study from a sample of 281 companies. To do this, it is used as a frame of reference the paradigm of organizational ambidexterity, which states that organizations can carry out exploitation and exploration innovation activities simultaneously to improve their performance. In the present study, we use the knowledge-based theory of the firm, resource-based theory of the firm, and transaction costs theory to study the collaboration. The results obtained suggest that companies that collaborate to innovate in exploitation activities with SENA have higher levels of exploration, alliance capability, co-exploitation, co-exploration, and performance in terms of profitability than the ones that do not. As for those companies that collaborate to innovate in exploration activities with SENA have higher levels of exploration, alliance capability, co-exploitation, co-exploration, and performance in terms of profitability and sales than those that do not. This is relevant since companies can consider collaborative partnerships to innovate with SENA, as an alternative to improve their capabilities and performance.

**Keywords**: Innovation projects; SENA; manufacturing companies; organizational ambidexterity; exploitation; exploration; co-exploitation; co-exploration.

## Introduction

According to the Survey of Development and Technological Innovation in the Manufacturing Industry of Colombia 2009-2010 - EDIT V (DANE, 2011) and 2011-2012 -EDIT VI (DANE, 2013), 35 industrial activities according to the International Standard Industrial Classification (ISIC) revision three adapted for Colombia have between 30 % and 10% of innovative companies in a broad sense, that is to say, that in the reference period obtained at least: 1) a new or significantly improved good or service in the domestic market or 2) a new or improved good or service for the company, or 3) a new or significantly improved process for the production line or for complementary production lines, or 4) a new organizational or marketing form. For this, the companies resorted to their innovation units, hired other companies, or developed collaborative alliances through innovation projects or a mixture of the previous ones. In this sense, SENA has been the entity that provided the most supportive relationships to companies for the realization of science, technology and innovation activities - ACTI in the 2009-2010, 2011-2012 and 2013-2014 periods, according to the Surveys of Development and Technological Innovation in the manufacturing industry - EDIT V, EDIT VI and EDIT VII (DANE, 2011, 2013, 2015).

The SENA in Colombia has the function of promoting higher education for the work of technologists and labor technicians, through an offer that includes titled and complementary learning under face-to-face or virtual modality. In addition, the entity provides technological services for applied research, technical assistance, special fabrications, laboratory tests and calibrations, information services and technology dissemination, and finances innovation and technological development projects under the research, innovation and development system. technological denominated SENNOVA.

In this sense, this research is constituted in an empirical study, when dealing with the fact that the company has used SENA to complement its internal innovation efforts. The results obtained allow us to know if the SENA has an effect on the performance of the firms that use it to co-develop innovation activities. Having a greater understanding of this phenomenon will allow managers to have better criteria to manage inter-organizational collaborative relationships for innovation, so that greater benefits are obtained for their firms (eg profitability, sales, productivity) (Quinn & Rohrbaugh, 1983), and in their capacities related to innovation activities (eg absorption capacity, capacity of alliances).

### *Organizational and inter-organizational ambidestreza*

To carry out this study, the concept of organizational ambidestreza (Papachroni, Heracleous, & Paroutis, 2014) was used as a frame of reference in the context of inter-organizational relations (Rossignoli & Ricciardi, 2015; Solís-Molina, Hernández-Espallardo , & Rodríguez-Orejuela, 2015) and of the organization that learns (López Zapata, García Muiña, & García Moreno, 2012), What supposes the simultaneous development of activities of innovation of exploitation and exploration, leaning in relations of collaboration for the innovation with other organizations (Kauppila, 2010). This concept is related to the proposal of March (1991) according to which exploitation is "refinement, production, efficiency, selection, implementation, execution" (p.71) to meet the needs of current customers (Benner & Tushman, 2003, 2015), and exploration is "search, variation, risk taking, experimentation, game, flexibility, discovery, innovation" (p.71) to meet the expectations of future clients (Benner & Tushman, 2015; Levinthal & March, 1993). In this sense, companies can benefit both from exploitation to obtain resources from their existing products or services, and from exploration to develop new initiatives in which to invest the resources obtained as a product of exploitation in a virtuous cycle (Lavie, Stettner, & Tushman, 2010). In this respect, a company is characterized as an ambidextrous organization when it manages to maintain high levels of exploitation and exploration simultaneously (He & Wong, 2004).

The literature on organizational ambidestreza is nourished by the theories on organizational learning (Levitt & March, 1988), the Theory of the firm based on knowledge (Grant, 1996, Kogut & Zander, 1992, 1996), the Theory of the firm based in resources and capacities (Barney, 1991; Wernerfelt, 1984), Theory of dynamic capacities (Easterby-Smith & Prieto, 2008; Teece, Pisano, & Shuen, 1997) and Theory of transaction costs (Williamson & Ouchi , 1980), among others. The ambidestreza organizational as a paradigm in organizational theory seeks to respond to the need of organizations to maintain a performance above the industry average in the short term and sustained in the long term (Raisch, Birkinshaw, Probst, & Tushman, 2009). This concept has been addressed theoretically (eg, Gupta *et al*, 2006, O'Reilly III & Tushman, 2008, O'Reilly III & Tushman, 2013, Raisch & Birkinshaw, 2008, Raisch *et al*., 2009, Simsek, Heavey , Veiga, & Souder, 2009; Tushman

& O'Reilly III, 1996) and empirically (eg, Adler, Goldoftas, & Levine, 1999; Andriopoulos & Lewis, 2009; Atuahene-Gima, 2005; He & Wong, 2004; Jansen , Tempelaar, van den Bosch, & Volberda, 2009; Jansen, Van Den Bosch, & Volberda, 2006; Lubatkin, Simsek, Ling, & Veiga, 2006) to establish their relationship with the performance of organizations. The results found the support that the ambidestreza organizational has a positive effect on the actions of the firm, but there are still questions about when and how this effect is positive and under what contexts this is possible (Junni, Sarala, Taras & Tarba, 2013).

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## *Interorganizational collaboration for innovation*

According to Zeng, Xie and Tam (2010), the actors with which firms can establish collaborations to innovate can be mainly: firms (eg suppliers, customers and / or competitors), government agencies (eg information services, innovation and / or supervision), intermediaries (eg technology by transfer or sale, or industry associations) and organizations of research and development (eg universities, research centers and technical institutes). In their study of small and medium industries (SMEs) in China, Zeng, Xie, and Tam (2010) found positive and significant effects of inter-organizational cooperation relationships with other firms, intermediaries and research and development organizations, and the performance of innovation by small and medium-sized companies. However, these authors did not find positive and significant relationships between government agencies and the innovation performance of small and medium-sized companies, but rather between government agencies and intermediaries, and government agencies and research organizations. and development SENA, as such, could be considered as a hybrid between a government agency

and an intermediary or interface in innovation activities since, although it is an entity attached to the Ministry of Labor with higher education functions, which links it with The Ministry of Education for the implementation of qualified records for the approval of training programs, also has budgets oriented to finance research, development programs technology and innovation for companies under the name of SENNOVA. For this reason, it is expected that the SENA can have positive impacts on the capabilities and performance of companies.

As for the activities of co-exploitation, SENA provides technological laboratory services, technical assistance, and applied research projects, related to training programs to expand the existing knowledge base in companies. In this way, we propose the following hypotheses:

$H_{1a1}$: Companies that carry out co-operating innovation activities with SENA has a greater exploitation capacity.

$H_{1a2}$: Companies that carry out co-operating innovation activities with SENA has a greater capacity for exploration.

$H_{1a3}$: Companies that carry out activities of Co-exploitation innovation with SENA has a greater absorption capacity.

$H_{1a4}$: Companies that carry out co-operating innovation activities with SENA has a greater capacity for alliances.

$H_{1a5}$: The companies that carry out activities Co-exploitation innovation with SENA has a greater capacity for co-exploitation.

$H_{1a6}$: Companies that carry out co-exploitation innovation activities with SENA has a greater capacity for co-exploration.

With regard to co-exploration activities, SENA participates in research projects with companies and universities, and through the SENNOVA program, it co-finances innovation and technological development projects to incorporate new knowledge in companies. Therefore, we propose the following hypotheses:

$H_{1b1}$: The companies that carry out activities of co-exploration innovation with SENA has a greater exploitation capacity.

$H_{1b2}$: Companies that carry out co-exploration innovation activities with SENA have a greater exploration capacity.

$H_{1b3}$: The companies that carry out co-exploration innovation activities with SENA has a greater absorption capacity.

$H_{1b4}$: Companies that carry out activities of activities Co-exploration innovation with SENA has a greater capacity for alliances.

$H_{1b5}$: Companies that carry out co-exploration innovation activities with SENA has a greater capacity for co-exploitation.

$H_{1b6}$: Companies that carry out activities of co-exploration innovation with SENA has a greater capacity for co-exploration.

Based on the technological services associated with the training programs and the SENNOVA program, it is expected that the companies that collaborate to innovate with SENA will be able to perform better. In this sense, we propose the following hypotheses:

$H_{2a}$: Companies that perform innovation activities of co-exploitation with SENA have a higher performance.

$H_{2b}$: Companies that carry out co-exploration innovation activities with SENA have a higher performance.

On the other hand, Mishra & Shah (2009) found that collaborative competence has a direct impact on the performance of projects; however, its impact on market performance is indirect, mediated by the performance of the project. In this sense, the results suggest that achieving a superior performance in the market product of the inter and intra-organizational involvement is consistent with obtaining a superior performance in the project. Therefore, we propose the following hypotheses:

$H_{3}$: Companies that carry out innovation activities in collaboration with others have a greater performance in innovation projects with the participation of SENA.

$H_{3a}$: Companies that carry out co-exploitation innovation activities have a higher performance in innovation projects with SENA participation.

$H_{3b}$: Companies that carry out co-exploration

innovation activities have a higher performance in innovation projects with SENA participation.

## Methodology

The empirical literature on the dialectic between exploration and exploitation has analyzed at times the portfolios of all the relationships of companies (Kauppila, 2015), in others the relationships with specific groups of partners (Zeng *et al*., 2010) and even a type of relationship in particular (Im & Rai, 2008). In our study, we analyze a particular type of relationship, to consider inter-organizational collaborative agreements of a formal or informal nature to execute innovation projects of product, process, marketing or organization (OECD, 2005). Inter-organizational relationships should have allowed sharing or co-developing knowledge to complement internal innovation efforts (Faems, Janssens, & Neyens, 2012). In accordance with the Uniform Industrial Classification of all economic activities adapted for Colombia (ie CIIU Revision 4 AC), the codes of the companies to be surveyed corresponded to section C of manufacturing industries divisions 10 to 33 (eg elaboration of food products, manufacture of beverages, chemistry and pharmaceuticals, manufacture of rubber and plastic products, manufacture of metal products, manufacture of vehicles, among others). The contact information of the companies was obtained through the Business Information and Reporting System - SIREM (Sociedades, 2012). Of the 27,032 companies reported, 4,622 corresponded to manufacturing companies. In total, a directory with 4,287 companies was created. The other 335 companies did not present contact information or had a sales level of zero.

The process of collecting data from the sample of companies was carried out through the following stages: 1) telephone contact, 2) sending an invitation to participate in the study, 3) arranging the appointment and 4) carrying out the interview. Of the 4,287 companies, 2,996 were contacted. In 268 cases, the companies refused to participate in the study for a rejection rate of 9%. The first telephone contact information was obtained on whether the companies had carried out projects of product innovation, production processes, administrative processes and/or management or marketing in the last three years. In 426 of the 2,728 cases, it was not possible to establish the innovative status of the company. Subsequently, the innovative companies were asked if the projects had been done in collaboration with other organizations. In this way, 1,622 non-innovative companies were identified, 462 innovative companies by themselves and 218 companies with innovation projects in collaboration with other organizations. During the telephone call, the contact details of the person to contact who knew about the innovation project were obtained. In 580 of the 680 innovative companies, it was possible to contact the 462 innovative companies by themselves and 218 companies with innovation projects in collaboration with other organizations. During the telephone call, the contact details of the person to contact who knew about the innovation project were obtained. In 580 of the 680 innovative companies, it was possible to contact the indicated person. In the second phase, he was sent an email to the person referred to, with a letter inviting her to participate in the investigation. In a third phase, once there was an affirmative answer, the person was called to arrange the appointment. For the fourth phase, three methods were used for data collection: 1) face-to-face interview, 2) telephone interview and 3) virtual questionnaire. The fieldwork started in July 2014 and ended in February 2015.

In total, 330 surveys were obtained. Of these, 49. 23 face-to-face and telephone and 26 virtual ones were canceled. 16 corresponded to micro companies with 10 or fewer employees, in which the personal characteristics can be confused with the characteristics of the company. 15 concerned companies that had claimed to be innovative or collaborative innovators, but when conducting the survey they were not according to the filter questions of the questionnaire. 15 were repeated as they were answered by two or more people from the same company, 10 of them virtual, from which those that had been answered by the person with the highest hierarchical rank in the company were chosen. Additionally, three companies belonged to sectors whose main activity was not manufacturing. In summary, data were obtained from 281 companies, 134 surveys through face-to-face interviews, 116 by telephone and 31 virtual ones. When comparing the data obtained through face-to-face interviews with telephone and virtual interviews, by means of an analysis of variance of the means of the exploitation variables ($F = 2.490$, $p = 0.116$), exploration ($F = 0.365$, $p = 0.546$) and performance ($F = 0.393$, $p = 0.531$), no significant differences were found. Therefore, the observations of the three methods of data collection were used when estimating that the collection method did not introduce relevant biases.

The 38 % were small companies in a number of employees (<= 50), 41% medium companies (> 50 and <= 200) and 21% large companies (> 200). The interviews were directed to the managers and executives of the companies in the main cities of Colombia (Bogotá D.C., Medellín,

Cali, Barranquilla, Cartagena D.T., Bucaramanga, among others). The knowledge about the aspects treated in the questionnaire of the people to be interviewed was checked when asking about their time of permanence in the company, which was on average 10 years. On the other hand, the average length of stay in the sector was 14 years. In addition, the respondents rated their level of knowledge on the topics consulted with an average of 8 on a scale of zero to ten.

In the investigation, the companies were asked if they had used or had relied on the SENA to carry out exploitation and / or exploration innovations. To measure the different concepts, Likert scales were used. The scale used to measure the performance of the firm is based on the rational goal effectiveness model proposed by Quinn and Rohrbaugh (1983) and in the dimensions proposed by Kumar, Stern, and Achrol (1992). On this scale, we asked about the degree of satisfaction with the performance of the company during the last three years, with zero being completely dissatisfied and ten completely satisfied. In order to measure exploitation and exploration innovation capacities, the scales proposed by Atuahene-Gima (2005) were used, being zero in any measure and ten in maximum degree. The scale of absorption capacity is based on the operationalization carried out by Chen *et al*. (2009) and the dimensions proposed by Zahra and George (2002). The capacity scale of alliances is based on the dimensions proposed by Hernández-Espallardo *et al*. (2011) from Draulans and Volberda (2003), with zero total disagreements and ten total agreement (see Table 1).

On the other hand, the scales used to measure the concepts of interest referred to the collaborative innovation project on which it is asked are also deduced from the existing literature. Thus, the performance scale is based on the dimensions of project satisfaction proposed by Bstieler (2006). The scales of adaptation of the collaboration and satisfaction and willingness to continue after the collaboration is concluded are supported by the dimensions proposed by Heide (1994) and Rindfleisch and Heide (1997), with zero total disagreements and ten total agreement (see Table 2).

The results obtained suggest a good adjustment of the measurement models of the dimensions at the level of the firm and the innovation project, which indicates the unidimensionality of the measured concepts (Anderson & Gerbing, 1988). The reliability values represented by the Cronbach's Alpha exceed the value of 0.70 recommended by Hair, Black, Babin, and Anderson (2010). When performing a confirmatory factor analysis, the reliability and convergent and discriminant validity of the scales used were verified. The values of reliability composed of scales (Scale Composite reliability -SCR) exceed in all cases the recommended minimum of 0.70 (Bagozzi & Yi, 2012). The totality of the items that make up the concepts have highly significant factorial loads and the standardized factorial loads of the same factor are equal to or greater than 0.5 and, in some cases, equal to or greater than 0.7, which suggests convergent validity (Hair *et al*., 2010).

According to Anderson and Gerbing (1988), if the confidence interval (± 2 times the standard error) to 95% for the correlations between the constructs does not include the value of one, there will be discriminant validity. By adopting a more restrictive criterion for checking the discriminant validity, from the estimation of the upper value of the confidence interval of the highest correlation between two 99% constructs (ie three times the standard error of the maximum phi), the highest Higher level of confidence intervals did not include the one in any case, so it was concluded that discriminant validity exists (Anderson & Gerbing, 1988).

To measure co-exploitation and co-exploration, a single item was used, in which the companies to the extent that they had collaborated with other organizations to jointly develop the exploitation and/or exploration innovations, being zero in any measure and ten in maximum degree. The use of single-item measures is based on the procedure C-OAR-SE (Construct definition, Object classification, Attribute classification, Ration identification, Scale formation, and Enumeration and reporting) proposed by Rossiter (2002), which states that an only item is enough if in the mind of the evaluators or respondents the element is singular and concrete, uniform and easy to imagine. In these cases, it is suggested that a good item provides more information than several of inferior quality that is synonymous with the main one (Bergkvist & Rossiter, 2007). In our case, it is understood that once it is clear that the company makes exploitation (or exploration), co-exploitation (or co-exploration) is a sufficiently clear, concrete and singular concept to respond through a single item without giving rise to ambiguities. We believe that the information obtained would not have been more complete by adding more items to the construct. This was verified in the pre-test of the questionnaire.

**Table 1.** Reliability of signature

| Description of the it | Standardized coefficients (value of t) sub-sample | | Reliability exploitation / exploration |
|---|---|---|---|
| | exploitation | exploration | |
| **Performance of rational objectives** | | | |
| Express your satisfaction with the performance of your company during the last 3 years in: | | | |
| P13_1. Cost effectiveness | 0.81 (15.16) | 0.88 (16.41) | α = 0.86/0.86 SCR=0.86/0.86 |
| P13_2. Sales | 0.89 (17.37) | 0.89 (16.81) | |
| P13_3. Market share | 0.77 (14.16) | 0.73 (12.52) | |
| P13_4. Productivity | 0.63 (10.87) | 0.59 (9.53) | |
| **Exploitation** | | | |
| Express to what extent your company has carried out the following activities during the last 3 years | | | |
| P6_1. You have searched for new markets to take advantage of your products and / or current technologies. | 0.57 (8.85) | 0.55 (7.85) | |
| P6_2. He has updated his knowledge in products and technologies from previous experiences. | 0.68 (10.87) | 0.56 (8.03) | α = 0.74/0.70 SCR=0.74/0.70 |
| P6_3. He has invested in improving the productivity of operations based on technology already dominated by the company. | 0.63 (9.98) | 0.60 (8.62) | |
| P6_4. For the problems of its clients, it has looked for solutions that are close to those already existing. | 0.56 (8.67) | 0.55 (7.89) | |
| P6_5. He has developed new products in areas where the company has significant experience. | 0.58 (9.00) | 0.57 (8.16) | |
| **Exploration** | | | |
| P8_1. He has explored products and / or markets previously unknown to the company. | 0.70 (12.09) | 0.70 (12.09) | |
| P8_2. It has acquired completely new organizational and management skills. | 0.68 (11.70) | 0.68 (11.70) | α = 0.84/0.77 SCR=0.84/0.78 |
| P8_3. Has developed products and / or technologies until then unknown by the company. | 0.80 (14.45) | 0.80 (14.45) | |
| P8_4. He has strengthened his innovation skills in areas where he did not have previous experience. | 0.84 (15.56) | 0.84 (15.56) | |
| **Absorption capacity** | | | |
| Express your agreement or disagreement with the following statements: | | | |
| P12_1. Identify and acquire the external knowledge you need. | 0.86 (16.72) | 0.83 (15.14) | α = 0.88/0.87 SCR=0.89/0.87 |
| P12_2. Understand, analyze and interpret the new external knowledge. | 0.91 (18.25) | 0.91 (17.45) | |
| P12_3. Combine your internal knowledge with new external knowledge. | 0.82 (15.73) | 0.80 (14.47) | |
| P12_4. Make a commercial application based on new external knowledge. | 0.65 (11.30) | 0.63 (10.36) | |
| **Capacity of alliances** | | | |
| Express your agreement or disagreement with the following statements: | | | |
| P10_1. Your company has a long tradition of collaboration in innovations with other organizations. | 0.67 (11.78) | 0.67 (11.16) | |
| P10_2. It has organizations that it considers its strategic partners to innovate. | 0.74 (13.46) | 0.77 (13.40) | α = 0.87/0.87 SCR=0.87/0.87 |
| P10_3. You and / or your staff are experts in dealing with partners when developing and implementing innovations. | 0.86 (16.74) | 0.87 (16.03) | |
| P10_4. Your company continuously analyzes what it does well and badly in its partnerships with partners. | 0.76 (13.97) | 0.75 (13.02) | |
| P10_5. Your company transfers what you have learned in collaborative relationships to innovate the way you work in other relationships. | 0.77 (14.07) | 0.75 (12.96) | |

Statistics of the measurement model of 22 indicators for 5 constructs:
Sub-muestra explotación $\chi^2_{(199)}$=434.87; GFI=0.87; RMSEA=0.069; SRMR=0.056; CFI=0.95; NNFI=0.94.
Sub-muestra exploración $\chi^2_{(199)}$=407.72; GFI=0.87; RMSEA=0.066; SRMR=0.055; CFI=0.94; NNFI=0.93.

**Source:** the authors

**Table 2.** Reliability of the scales of the innovation project

| Description of the item | Standardized coefficients | Value of t | Reliability |
|---|---|---|---|
| In collaboration with the main partner of the project. state your degree of agreement or disagreement with the following statements: | | | |
| **Satisfaction of the collaboration** | | | α = 0.91 |
| P24_1. The results and benefits obtained met expectations | 0.78 | 13.24 | SCR=0.91 |
| P24_2. The goals that were established were reached. | 0.75 | 12.68 | |
| P24_3. The time and effort invested in the development and maintenance of the collaborative relationship paid off. | 0.80 | 13.92 | |
| P24_4. The collaborative relationship with the partner was productive. | 0.88 | 15.99 | |
| P24_5. The company was satisfied with this collaboration relationship. | 0.87 | 15.72 | |
| **Adaptation of collaboration** | | | α = 0.89 |
| P19_15 The activities were adapted at all times to changes in the circumstances of the project. | 0.60 | 9.93 | SCR=0.75 |
| P19_16 They worked together to solve any unexpected circumstance that might happen. | 0.75 | 15.57 | |
| P19_17 The other party was very open to understanding the particulars of their company and acting accordingly. | 0.90 | 16.24 | |
| P19_18 It could be said that the level of flexibility of the collaboration to face the changes was high. | 0.89 | 16.00 | |
| **Satisfaction and willingness to continue** | | | α = 0.81 |
| P23_1. Increased interest in continuing to work with the same partner. | 0.81 | 12.25 | SCR=0.87 |
| P23_2. Increased interest in collaborating with other partners of the same type. | 0.67 | 9.87 | |
| P23_3. Increased interest in collaborating to innovate with any type of organization. | 0.64 | 9.30 | |

Statistics of the measurement model of 12 indicators for 3 constructs: $\chi 2$ (51) = 142.65; GFI = 0.90; RM-SEA = 0.091; SRMR = 0.058; CFI = 0.97; NNFI = 0.96.

**Source:** the authors.

Then, to contrast the hypothesis, the performance of the firm and the project is analyzed from a type of relationship (co-exploration and / or co-exploitation) with a specific actor named SENA, which represents a government entity. of the interface type versus the performance obtained with other actors.

## Results

### *Co-exploitation with SENA*

261 companies reported exploitation activities for the development of innovations based on existing knowledge. Of these, 54% carried out collaborative activities with SENA to complement their internal innovation efforts in exploitation activities. The comparisons of the means of the variables are presented in Table 3.

The results indicate that those companies that co-exploit with SENA have higher levels of exploration, capacity for alliances, co-exploitation, co-exploration and performance in terms of profitability than those that do not. Regarding exploitation and absorption capacity, no significant differences were found at the level of the global concept in favor of SENA, but in aspects related to finding solutions close to those already existing for the problems of its customers and making a commercial application from the new external knowledge. These aspects denote SENA's applied research carácter.

**Table 3.** ANOVA Co-exploitation Companies and SENA

| Variable | Half SENA | Half Others | Average difference | Value (F) | Value (p) | | Hypothesis | Result |
|---|---|---|---|---|---|---|---|---|
| Exploitation | 7.78 | 7.68 | 0.10 | 0.472 | 0.493 | | $H_{1a1}$ | Not Supported |
| Exploration | 6.31 | 5.67 | 0.64 | 6.148 | 0.014 | * | $H_{1a2}$ | Supported |
| Absorption capacity | 7.63 | 7.53 | 0.10 | 0.349 | 0.555 | | $H_{1a3}$ | Not Supported |
| Capacity of alliances | 5.78 | 4.61 | 1.17 | 16.975 | 0.000 | ** | $H_{1a4}$ | Supported |
| Co- Exploitation | 5.23 | 3.82 | 1.41 | 17.755 | 0.000 | ** | $H_{1a5}$ | Supported |
| Co- Exploration | 5.11 | 4.12 | 0.99 | 8.387 | 0.004 | ** | $H_{1a6}$ | Supported |
| Performance / profitability | 7.43 | 6.98 | 0.45 | 4.474 | 0.035 | * | $H_{2a}$ | Supported |

*p < 0.05. **p < 0.01

**Source:** the authors.

## Co-exploration with SENA

In total 239 companies reported exploration activities for the development of innovations based on new knowledge for the company. Of these, 54 % carried out collaborative activities with SENA to complement their internal innovation efforts in exploration activities. The comparisons of the means of the variables are presented in Table 4.

The results suggest that those companies that co-explore with SENA have higher levels of exploration, capacity for alliances, co-exploitation, co-exploration and performance in terms of profitability and sales than those that do not. Regarding exploitation and absorption capacity, no significant differences were found in favor of SENA, only in aspects related to acquiring organizational and management skills, developing products and / or technologies unknown until then for the company, and identifying and Acquisition of the external knowledge you need. These aspects show the role of SENA in the incorporation of new knowledge in organizations.

## Innovation projects with SENA

In the sample of 281 companies, no significant differences were observed in the performance of the innovation projects in which SENA participated (27 projects of 223, 12 %) and in those that did not. Also, regarding the performance of the innovation projects of the companies that co-operated with the SENA, no differences were observed significantly (22 of 209, 10 %). However, with respect to the performance of the innovation projects of the companies that co-explored with the SENA, differences were observed significant in favor of the other companies (20 of 194, 10 %). In all cases, the assumptions regarding the performance of innovation projects are not supported (see Table 5).

**Table 4.** ANOVA Co-exploration Companies and SENA

| Variable | SENA | Others | Average difference | Value (F) | Value (p) | | Hypothesis | Result |
|---|---|---|---|---|---|---|---|---|
| Exploitation | 7,87 | 7,83 | 0,04 | 0,069 | 0,793 | | $H_{1b1}$ | Not Supported |
| Exploration | 6,58 | 6,10 | 0,48 | 4,730 | 0,031 | * | $H_{1b2}$ | Supported |
| Absorption capacity | 7,74 | 7,63 | 0,11 | 0,421 | 0,517 | | $H_{1b3}$ | Not Supported |
| Capacity of alliances | 5,90 | 4,87 | 1,03 | 12,414 | 0,001 | ** | $H_{1b4}$ | Supported |
| Co- Exploitation | 5,15 | 4,13 | 1,02 | 8,241 | 0,004 | ** | $H_{1b5}$ | Supported |
| Co- Exploration | 5,08 | 4,21 | 0,87 | 6,473 | 0,012 | * | $H_{1b6}$ | Supported |
| Performance / profitability | 7,49 | 7,13 | 0,36 | 4,417 | 0,037 | * | $H_{2b}$ | Supported |
| Performance / sales | 7,66 | 7,17 | 0,49 | 5,975 | 0,015 | * | $H_{2b}$ | Supported |

*p < 0,05, **p < 0,01

**Source:** the authors.

**Table 5.** ANOVA Innovation projects Companies and SENA

| Variable | SENA | Others | Average difference | Value (F) | Value (p) | | Hypothesis | Result |
|---|---|---|---|---|---|---|---|---|
| Performance of innovation projects | 8.24 | 8.50 | -0.26 | 1.142 | 0.286 | | $H_3$ | Not Supported |
| Project performance / co-exploitation | 8.02 | 8.44 | -0.42 | 2.331 | 0.128 | | $H_{3a}$ | Not Supported |
| Project performance / co-exploration | 8.02 | 8.47 | -0.45 | 2.745 | 0.099 | * | $H_{3b}$ | Not Supported |

*p < 0.1

**Source:** the authors.

In a post-hoc analysis of the innovation projects with respect to the companies that co-exploit with the SENA, significant differences were observed in favor of the SENA in aspects related to considering that the relationship of collaboration with the partner was productive ($\mu_{SENAT}$=8.92, $\mu_{OtrosT}$=8.56; F=4.831, p=0.029). Also, in the variables form of cooperation with the principal partner indicating a higher level of staff participation of the company ($\mu_{SENAT}$=0.85, $\mu_{OtrosT}$=0.75; F=3.355, p=0.068), and in the satisfaction and willingness to continue once concluded the collaboration ($\mu_{SENAT}$=8.04, μOtrosT=7.65; F=3.345, p = 0.069) In contrast, the adaptation of the collaboration it is lower in the projects in which SENA participates ($\mu_{SENAT}$=8.02, μOtrosT =8.32; F=3.220, p=0.074). The results companies that carry out innovation projects and who usually co-explore with SENA, cooperate more they indicate that those companies that carry out innovation projects and that usually co-exploit with SENA have a productive collaboration relationship, more significantly with the companies that collaborate, significantly with the companies that collaborate, and show less adaptation to changes in the collaboration relationship, which could help explain the lower performance in co-exploration projects that require more adjustments in the course of collaboration.

They have greater satisfaction and willingness to continue collaborating with other partners of the same type. On the contrary, they show less adaptation to changes in the collaboration relationship.

In relation to the innovation projects of The companies that co-explore with SENA was noticed significant differences in favor of SENA in the form of cooperation with the main partner with the highest participation of the employees of the company (μSENAT =0.86, μOtrosT =0.734; F=4.823, p=0.029), and being smaller for SENA in the adaptation of the collaboration (μSENAT =7.99, μOtrosT =8.38; F=5.602, p=0.019). The results companies that carry out innovation projects and who usually co-explore with SENA, cooperate more they indicate that those companies that carry out innovation projects and that usually co-exploit with SENA have a productive collaboration relationship, more significantly with the companies that collaborate, significantly with the companies that collaborate, and show less adaptation to changes in the collaboration relationship, which could help explain the lower performance in co-exploration projects that require more adjustments in the course of collaboration.

## Discussion and Conclusions

The present research seeks to determine whether government entities such as SENA can have a significant impact on the capabilities and performance of firms, in this case, in companies in the manufacturing sector that develop innovative projects in collaboration with other organizations. In the particular case of organizations that collaborate to develop exploitation and / or exploration innovations with SENA and those that do not, we find significant differences in favor of SENA in the aspects related: the ability to carry out exploration innovation activities; capacity for alliances, co-exploitation, co-exploration and performance.

Specifically, in the companies that develop activities of co-exploitation with the SENA, a greater performance was found in terms of profitability, and in the companies that develop co-exploration activities with the SENA, a greater performance was observed in terms of profitability and sales. Regarding innovation projects, although no significant differences were found in the performance of projects in general and co-exploitation, differences were observed in favor of collaboration with other companies in the performance of joint projects. exploration. In addition, there were differences in favor of SENA in terms of cooperation with the main partner with greater participation of the company's personnel. Likewise, there was a lower

ability to adapt the collaboration in the companies that co-exploit and co-explore with SENA. This could be explained by the administrative procedures that companies experience when they have to make changes in projects with government entities that have strict procedures and that require the approval of various instances. This makes it difficult to adapt the collaboration to the changes that may occur during the execution of the innovation project, especially when it comes to co-exploration projects, where uncertainty and the likelihood of changes are greater. In terms of satisfaction and willingness to continue at the end of the collaboration, significant results were obtained in favor of SENA in the companies that co-operate with this entity.

The results of this study agree with those obtained by Zeng, Xie & Tam (2010), if the SENA more than as a governmental entity with functions of information services, innovation and / or supervision, as an interface or technology intermediary by transfer, or as a research and development organization of the type of applied research center or technical institute. With respect to the organizational ambidestreza, collaborative relationships with SENA contribute mainly to the exploration capacity. At the inter-organizational level, collaborating with SENA favors co-exploitation, co-exploration and the capacity for alliances. In this way, the results previously obtained by Kauppila (2010; 2015) on the benefits of establishing inter-organizational collaborative relationships to create ambidestreza organizationally and improve performance are supported. In this sense, it contributes with the knowledge on when and how it is possible to increase the performance through exploitation and exploration activities carried out in collaboration with other organizations (Junni, Sarala, Taras & Tarba, 2013), and also, with a unit of extended analysis that incorporates part of the firm's ecosystem as suggested by O'Reilly III and Tushman (2013).

Regarding the limitations, with respect to innovation projects, it would have been desirable to have a greater number of innovation projects with the participation of SENA. This is because the sample used corresponds to a national sample of companies and includes the other entities with which it can collaborate to innovate. Regarding the differences of means found, they do not necessarily mean a causal relationship. Future research projects can focus on explaining the differences found and their causes, using models that link the variables used. Likewise, to determine what types of companies, according to their size or productive sector, the best results of collaboration with SENA in innovation activities are obtained.

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