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Open Innovation in SMEs: Potential and Realized Absorptive Capacity for Interorganizational Learning in Dyad Collaborations with Academia

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Abstract: Due to a variety of barriers to develop innovation, small and medium enterprises (SMEs) find it necessary to collaborate with external sources of knowledge. The current study analyses the collaboration between SMEs and academia over an open innovation setting in Mexico. An absorptive capacity (ACAP) approach has been applied to understanding the process of developing new knowledge for achieving innovation. A two-part questionnaire was developed with the aim of assessing the ACAP of a new joint research unit. Data was collected from a local group of SMEs that collaborated as dyads with academia supported by a government program of innovation in Mexico. The result shows that there was a moderate potential and realized ACAP in the sample; these results are mutually related with both parts of the questionnaire which supports our findings. In conclusion, exploitation of new knowledge is a complex dimension for creating value from collaboration, which makes the outcome difficult to measure using traditional means. It can be argued that exploiting new knowledge for innovation is an iterative process of learning when exploring new sources of knowledge from academia.

Keywords: open innovation; absorptive capacity; collaboration; joint research unit; exploitation; SMEs

1. Introduction

In the new global economy, innovation has become a central issue for economic growth and success for firms. Important findings have provided enough evidence to show that innovation is a key factor in the new knowledge economy. Knowledge creation has become the basis of innovations, and an innovative organization is capable of creating new knowledge [1]. A growing interest of exploration for new sources of knowledge for innovation is removing the barriers to collaboration, providing therefore, an alternative way to the traditional closed perspective of research and development (R&D). Although there are several studies related to collaboration among large companies and open innovation (OI), there is still a lack of research focused on small and medium enterprises (SMEs) [2] under an absorptive capacity (ACAP) approach [3] and from a joint research unit perspective.

Since the theoretical development of open innovation, various cases have been studied [4] in different institutional settings of actors in networks of innovation systems (i.e., the "triple helix") [5], in order to address innovation as a multi-actor complex phenomenon. The turbulence of the business markets has ensured focused attention on knowledge as a dominant source of innovation and competitive advantage. Firms find it necessary to recognize new external knowledge, assimilate it, and apply it to commercial ends, also known as absorptive capacity [6]. ACAP is viewed as both an intra- and inter-organizational learning process [7], where the principal role is achieving innovation [8], and SMEs are particularly transitioning from the traditional perspective to include more creativity and innovation-based measures [9].

From a resource-based view of the firm [10], SMEs, in general, have limitations regarding achieving innovation [11]. Therefore, there is a need for a change of perspective, which involves opening and looking for external sources of knowledge for a collaborative learning environment. In this sense, governments have been working on policies to encourage innovation among SMEs. The necessity of working in open collaborative settings is becoming a benefit, and at the same time, a challenge. Because of this, SMEs may be hesitant to risk their current state, due to the experimental nature and the needs of extensive resources for research that become obstacles to undertake innovation by themselves; support from other actors is required to reduce the risk of failure.

For these reasons, our study focuses on dyad collaborations supported by the government in Mexico, at the unit level, where the exchange of knowledge between SMEs' workers and researchers from academia is executed. According to Cohen and Levinthal [6], ACAP not only resides in firms but also in organizational units. Therefore, establishing successful external collaborations in a joint research unit is a key aspect to developing capacities to create and disseminate new knowledge across the organization, which could result in superior performance by the firm. For this purpose, we aim to understand the ACAP generated by collaborative work between SMEs and academia to assess the potential and realized capacity of developing new knowledge for innovation at the unit level. Our study responds to the research gap in the understanding of ACAP from an interorganizational collaboration setting by studying a new joint research unit created in the SMEs that collaborate as dyads with academia in a developing country such as Mexico.

The article proceeds as follows. First, the implications of open innovation and SMES are drawn to develop a contextual base for the study, allowing for the construction of our theoretical base of ACAP and its components. Second, we present analysis of the results of our data, which was collected using a two-part questionnaire given to a group of SMEs in Mexico. Finally, we discuss the findings and draw appropriate conclusions.

2. Open Innovation and SMES

Open innovation (OI) emphasizes that the abundant external knowledge can be converted into innovation. Henry Chesbrough [4] coined the term "open innovation," which combines internal and external knowledge for the creation and commercialization of new products and services. Contrary to the closed perspective, open innovation claims there are benefits to the accelerating use of new knowledge. The main argument of the dichotomy of open and closed innovation resides in the R&D being executed as an internal (closed) key competitive advantage, whereas the open R&D focuses on finding new knowledge from outside that can be used collaboratively for the development of innovation. After many years of development of the concept, Chesbrough and Bogers [12] redefined the concept of OI as a distributed innovation process based on the management of knowledge flows through organizational boundaries. Although the concept is focused primarily at the firm level, there is the notion that OI can work at various levels across the organization, where boundaries become more open as the permeation increases to other levels (i.e., units inside the organization) [13]. Open innovation practices provide an alternative strategy for SMEs to access new external resources of knowledge at a low cost, minimizing obstacles, such as financial, technological, and human resources, that obstruct a growth-oriented perspective to access new markets. The OI model states that enterprises can acquire external knowledge from different market-based partners like customers, suppliers, competitors, and science partners from universities or research centers [14,15], therefore establishing an integrative knowledge capability through practice to support the development of the overall innovative capacity.

Nevertheless, SMEs still preserve a closed perspective to innovation, relying mostly on internal sources of knowledge to develop new products and services [15], where innovation efforts mainly aim to keep up to date with the markets [16]. The non-existence of R&D activities, due to the high costs involved, are also a determinant of the innovativeness levels of SMEs. Cooperation with other firms, suppliers, and customers have a more prominent role in the innovation process of SMEs than cooperation with research centers, universities, and government institutions [17]. The ability to

collaborate with other science-based institutions allows SMEs, with less financial and human resources, to not only develop new knowledge for new products or services, but also to introduce changes into their production processes, as well as to improve the management of the organization's resources. Nevertheless, a willingness to share valuable information from the SME needs to be done for these types of collaborative open settings. In contrast, larger firms are more familiar with collaborative relationships with external partners, such as suppliers, customers, or universities, and sometimes with competitors, to gain value from the co-creation processes [18]. Specifically, collaboration with universities or research centers increases the SMEs' internal knowledge and fosters innovation [19]. Furthermore, it has been found that small companies could compete with large companies when they consider more types of innovations [20].

In terms of open innovation settings, despite the constraints and barriers of resources to execute R&D internally, SMEs can gain more benefits undertaking open innovation than large firms as they can be more flexible, which also provides a motivation to look beyond their organizational boundaries [2]. Some barriers to open innovation in SMEs are related to cultural and organizational issues that appear when they start to interact and collaborate with external partners [16]. Cultural issues are mostly found in SMEs, principally family businesses where owners/managers usually have more operational expertise; therefore, the perception of managers' task on the competitive environment plays a significant role that facilitates the organizational learning activities in SMEs [21], but SME managers often lack some resources, especially time, to undertake innovation [22].

Isolation oriented toward the interior of the organization with limited links or channels of information is one of the main reasons for companies producing less innovation [23]. However, internal actors play a fundamental role in recognizing the opportunities of the market through the development of internal technological capabilities complemented with external assistance [24]. Internal and external resources are key determinants for the innovation of SMEs, but the connections among resources are determined by the owner/manager capacities, therefore, the manager's expertise can determine the innovativeness of the firm [25]. A lack of manager training regarding new technological competencies also becomes a barrier for innovation; having the proper knowledge has been linked with the innovativeness of the firm [26].

Investing in innovation also requires a great extent of risk inclination, even in larger companies. Risk predisposition can make a difference in innovation; executing internal research can be difficult due to the resource constraints in SMEs [27]. The managers of SMEs are mostly conservative and averse to taking risks [28,29], which results in lower innovativeness. Lack of financial capacity also provides a difficulty toward capitalizing spotted opportunities in the market due the high risk and cost involved with R&D [30].

Governments are favoring collaborations with programs and policies more often to encourage and increase new knowledge creation and competitiveness of firms [31]. While investment in SMEs with financial support resolves one of the barriers, specialized knowledge is still needed as a complementary resource. On the other hand, academia has specialized expertise interested in the practical applications of their research; therefore, an inter-organizational learning setting is established. In this sense, both actors provide the synergy required for the beneficial outcomes from a joint research project. Although this is an expected consequence, the process of developing innovation is not straight forward as both sides might have different approaches toward addressing a phenomenon, which could result in discrepancies during the exchange of knowledge and thus, influencing the outcome of the project. Although the emphasis of governments is placed in terms of the amount invested and the expected results as traditional measures of innovation (i.e., patents), it neglects in some way the complex process that exists in collaborations and other indirect factors that are difficult to measure. The concern of the appropriability of innovation via patents is still debated among scholars; from one side, it is likely to enhance the private economic returns to the disadvantage of the social returns of innovation, and from the other side, it limits research on incremental innovations and therefore the creation of new spillovers. In some cases, patents are better for large firms and very difficult for small businesses [2].

Another factor for innovation in SMEs could be the geographical location since it has been found that there is a strong connection between the concentration of SMEs and public research in local places [32]. Firms with greater resources devoted to R&D (i.e., large firms) tend to rely more often on spillovers from distant institutions than firms with fewer resources in R&D (i.e., SMEs) [33]. Approaching local universities or research centers helps to provide an advantage for SMEs in this sense due to the difficulty of having an in-house R&D. The geographical proximity between firms and universities is of significance for benefits, such as direct assistance in problem solving, since it facilitates the exchange of tacit and context-specific knowledge [34]. This exchange is due to the proximity to resources (human resources and capital) and science-based institutions that underpin networks, which promotes innovation [35].

3. Absorptive Capacity

Knowledge is assumed to be useful in the sense that increasing a firm's knowledge will increase its performance; it is among the most valuable resources. The need for acquiring new knowledge from different sources is part of every organization, and ACAP theory is focused primarily on the process of absorbing new knowledge. Cohen and Levinthal [6] conceptualize ACAP as the ability of the firm to recognize the value of new external knowledge, assimilate it, and apply it to commercial ends. According to the knowledge-based view theory [36], ACAP is viewed as an enterprise's attitude toward recognizing and perceiving not simply the knowledge from outside that can be helpful to create value, but also as the capacity to assimilate and integrate the knowledge to make it usable for the creation of innovation [37].

ACAP starts from firms searching and identifying a need for new knowledge from outside the organization to cope with a growing turbulent market and builds upon previous developmental investments of individual and organizational absorptive capacities; therefore, ACAP will tend to develop cumulatively. An organization's ACAP is not resident in a single individual but depends on the links of a variety of individual capabilities [10,38]. A diversity of knowledge sources suggests a broader perspective. Thus, firms with higher levels of ACAP will manage external knowledge flows more efficiently, stimulating innovative outcomes and thus obtaining competitive advantages [39]. ACAP enablers, such as internal R&D, external R&D, and employee expertise, have a positive influence on product innovation [40]. Nevertheless, there are abundant studies of ACAP under a variety of explanations—for example, as a process of exploratory, transformative, and exploitative learning [41]—as additional dimensions of ACAP, such as the recognition of value from new external knowledge as a previous step of acquisition [42], albeit most attention has been concentrated on tangible outcomes [43].

Zahra and Georges' [44] reconceptualization has been widely accepted and tested in different industries and contexts. The main argument suggests a two-phase model of ACAP: a potential absorptive capacity (PACAP) that includes acquisition and assimilation of knowledge capabilities, and realized absorptive capacity (RACAP) that includes transformation and exploitation of knowledge capabilities. Both phases are complementary to drive performance outcomes, such as competitive advantage and innovation. The main argument of the ACAP model is that PACAP precedes and influences RACAP, and every phase of the model provides a base for a systematic understanding of ACAP. The breadth of knowledge that a firm acquires and assimilates will determine how far its exploratory learning from the current knowledge can go and how it can be exploited for the organization's benefit.

Potential Absorptive Capacity and Realized Absorptive Capacity

The first phase of the model (PACAP) considers the two capabilities of acquisition and assimilation. Acquisition refers to the firm's capability to identify and acquire valuable external knowledge. However, as Cohen and Levinthal [6] states, it is simply insufficient to expose an individual briefly to the relevant prior knowledge; therefore, it is difficult to recognize an organization's need for specific knowledge if

no prior research has been undertaken previously. Hence, acquisition does not relate purely to the external sources, but also to the research experience acquired. Studies reveal that previous experience with knowledge searches is a significant antecedent of PACAP, and as such, has implications for the ACAP accumulation process. [45]. The intensity and speed of the efforts to identify and gather knowledge also determine the quality of the acquisition capabilities of the firm [44], meaning that firms with more developed internal research capabilities could benefit more from collaborations [46]; this goes in line with the view of the identification and evaluation process of external knowledge suggested by Cohen and Levinthal [6].

Assimilation, on the other hand, are routines and processes that permit a company analyze, interpret, and understand knowledge obtained from external sources. Interpretation of external knowledge is also related to prior knowledge acquisition [44]. A firm's ability to learn from another firm through dyads depends on the firms' knowledge similarity bases, organizational structures, and compensation policies [7], where the internalizing of knowledge is better when they have similar knowledge-processing systems. Therefore, to increase the innovative performance of companies, it is recommended to target other partners with moderately related knowledge bases [47]. Comprehension represents the knowledge articulation of the collaboration, which is the degree of acquisition of new knowledge from the counterpart. The similarity in researching processes should also be connected to the project to achieve an effective understanding of the external knowledge [7]. Therefore, practical work during the execution of the project represents mutual learning, which is achieved as the project advances and unplanned issues start to appear. Learning from experience through repetition suggests the accumulation of incremental improvements and progressively results in better ways of doing things. Excessively ambitious plans could be replaced by more realistic ones, and unnoticed opportunities could be exploited in the next period [48]. Changes and eventual needs for more resources will appear during the execution of the project, where possible loops and iterative processes might exist to move to the next phase of the model. From the individual level, they represent important sources of organizational knowledge as agents of learning, with the ability to transfer tacit and explicit knowledge, and to adapt their knowledge to new contexts [49].

The second phase in the model consider the two capabilities of transformation and exploitation. Transformation is the capability to develop and improve the routines that facilitate the combination of the existing knowledge with the acquired and assimilated new knowledge [44], which is a bisociation of the old and new knowledge, leading to a modification and conversion of current routines with the experience and practice obtained in executing the project. Bisociation is the process of combining matrices of information that allows the identification of an opportunity and seizing it through action [50]. Therefore, expertise integration is a procedure by which individually held knowledge is applied to the project [51]. In collaborative settings, bisociation exists, first with the combination of existing and old knowledge, and second, with the specialized new knowledge brought by the external organization. Thus, a modification within the existing competencies and reinterpretation of knowledge is carried out, leading to the development of new useful knowledge for the project unit and then to the firm. In this sense, intrafirm knowledge dissemination is supposed to increase responsiveness to the environment if SMEs have well-developed capabilities in external knowledge acquisition [52]; consequently, transforming and exploiting knowledge requires a well-connected knowledge structure between intraorganizational members [47].

Exploitation is the last component of ACAP. As Cohen and Levinthal [6] state, ACAP refers not only to the acquisition or assimilation of knowledge by an organization, but also to the organization's capability to exploit it for commercial ends. The outcomes of systematic exploitation routines are the continual creation of new products and processes or new organizational forms [53]. Nevertheless, firms may be able to exploit knowledge serendipitously, without specific systematic routines, which reflects the ability to harvest and incorporate knowledge in their operations [44]. Although it is possible to consider exploitation as an output of ACAP, a reconsideration of the early development approach of ACAP is needed, where commercialization of knowledge was stressed as a traditional way of measuring

the results of R&D investments. Exploitation is also evident, for example, in new ventures that capture knowledge from outside of the boundaries, which is used to generate new competencies [44]. Hence, it is worth considering both sides as outputs—commercial (products, services, and patents) and knowledge use (scientific, technical, operational and organizational)—on the absorptive capacity research, where firm performance is influenced by both types of absorptive capacity outputs [41]. Successful joint research would ultimately lead to obtaining both outputs, although benefiting the organization to different extents. The complementarity of both PACAP and RACAP will yield superior performance, while the ability of exploitation will represent a competitive advantage that will lead to innovation. Nonetheless, it is necessary to balance both phases, as argued similarly by March [54] regarding exploration and exploitation, where organizations need to manage a balance between exploratory and exploitative learning.

4. Research Design

The phenomenon of open innovation has been studied in different types of firms and industries [55]; however, our study focuses on the new joint research unit that collaboratively executes the project of innovation in open settings as dyads between SMEs and academia. We emphasize the integration of knowledge of an interorganizational collaboration to assess the ACAP that is emergent from the new joint research unit. Different from a whole organizational ACAP, the results from a unit could eventually lead to the dissemination of knowledge to the whole organization. Our interest, therefore, aims to find the development process of new knowledge through a dyad collaboration and the subsequent use of the outcome for innovative purposes.

Investing in R&D means an extra effort for the SMEs; it represents a degree of risk inclination since exploring unknown sources is time-consuming and requires an investment of many resources. Although SMEs usually focus their attention on the exploitation of their current technology and products, it is significant for them to keep running their systems to keep producing and attending to their market; for these reasons, a new joint research unit is required. It has been found that a sole unit can be more innovative than a large multiunit company if they have absorptive capacities and access to the central internal network [8]. In this sense, the support obtained from the government will let the SME overcome financial barriers to undertaking research. It also gives them the possibility of using external specialized knowledge support from academia to execute a joint research project for innovation. There is evidence that adding newly qualified people to the firm will increase the absorptive capabilities [2]. Thus, the incorporation of experts from academia could lead to a better performance in terms of innovation in SMEs.

5. Methodology

For our objective, we used a set of items based on Zahra and George's [44] construct and other additional support studies with the aim of understanding the absorptive capacities generated in the collaborative research carried out by SMEs. Our main assumption rests on the incorporation of researchers from academia into SMEs that could lead to obtaining a higher degree of absorptive capacities in the joint research unit and will generate a valuable outcome from the collaboration.

Based on the theoretical construct, we developed two sets of questionnaires for an explorative research as a first approach to the process of knowledge creation and to find possible outcomes from the execution of the project. Project leaders of the new unit are the target participants in this sense as they appropriate information from the experience that will allow us to understand the ACAP in the new joint research unit.

The study is exploratory as we first gathered information in the form of multiple-choice questionnaire to further complement the data with correlational analysis in the second part. The questions were tested for general understanding and also to find possible errors. The results are specific to the context of the group of firms, and its main purpose was to give insights about the practice of collaboration in SMEs from experience under an ACAP approach. A total of nine

items were designed based principally on Zahra and George's model [44] as an inter-organizational process. The scope of every item is shown in Table 1. The first part of the survey consisted of a set of multiple-choice questions based on the theoretical variables previously addressed, with the objective of complementing the second part of the questionnaire. The second part consisted of questions answered using a five-point Likert scale (1–5) to understand the interconnectedness and to run a correlation analysis of the variables. The aim of the two parts of the questionnaire was to obtain richer information and offer a convergent explanation.

Table 1. Operationalization of the variables, items, objectives, and references.

Phase *	Variable *	Items	The Objective of the Questions	Supporting References
Potential Absorptive Capacity (PACAP)	Acquisition (X1)	Item 1	Previous experience with research	Fosfuri and Tribó [45]
		Item 2	Intensity, speed of acquisition, and exchange of knowledge	Zahra and George [44]
		Item 3	Comprehension and understanding of external knowledge	Lane and Lubatkin [7]
	Assimilation (X2)	Item 4	Learning	Maskell and Malmberg [48]
		Item 5	Application of knowledge in daily work, new ideas	Easterby-Smith et al. [49]
Realized Absorptive Capacity (RACAP)	Transformation (X3)	Item 6	Bisociation	Smith and Gregorio [50], Zahra and George [44]
		Item 7	Modification (conversion)	Tiwana and Mclean [51]
	Exploitation (X4)	Item 8	Implementation	Zahra and George [44], Lane, Koka and Pathak [41]
		Item 9	Use of knowledge for commercial purposes	Cohen and Levinthal [6]; Lane, Koka, and Pathak [41]

* Variables based from the theoretical construct of Zahra and George [44].

6. Sample

Our sample consisted of a group of SMEs in Mexico City that worked in a joint research project of innovation supported by a government program that lasted for one year. We used a public database to find a total of 16 participating SMEs that collaborated with academia. Among different projects from diverse companies, the government institution decided according to their parameters and budget which projects are the subject of interest for their objectives and which should be funded. Therefore, the number of participating SMEs was small as only a few fulfilled the requirements. The participating SMEs were heterogeneous, ranging from services to manufacturing. We focused on a local area since a geographical proximity between the firm and its university partners have been found to be of significance as it facilitates the exchange of tacit and context-specific knowledge [34]. Two main characteristics of the SMEs were important for the study: participation in the funding program with projects to develop innovation and having collaborated with a research center or university. Among the 16 SMEs that received the funding according to the database, three never replied to the answers of the questionnaire and three SMEs were not found to be able to contact. Therefore, a total of 10 valid responses were collected using telephone calls and questionnaires sent by email. The study was developed independently of the participating SMEs, academia, or the government in order to avoid biased information and to encourage participation of the group of SMEs. We informed and stressed to the participants that the collected information was anonymous and confidential information was not required about the specific research project but instead information about the experience of the process of collaborating with academia in which they agreed to participate.

The items of the scale were tested using the Cronbach's alpha for the reliability value, which must be equal to or greater than 0.7 [56]; a coefficient of ($\alpha = 0.73$) was obtained, which as an exploratory study, is enough for the purpose of the present study.

7. Data Results

The first part of the questionnaire aimed to bring new insights as a first approach to the phenomenon. Every subset of the variables was related to the items previously mentioned; therefore, nominal data was obtained in a set of closed-answer questions to further ponder the data and obtain descriptive statistics for a statistical analysis. The second part of the questionnaire consisted of Likert scale questions to obtain ordinal data for an alternative analysis. The number of participants in the target group was ten (N = 10), and although the number of SMEs with the specific characteristics was small, a correlation analysis was enough to give complementary information and a further convergent explanation.

For the first part of the questionnaire, every item was designed according to the theoretical construct. A set of closed questions with possible answers for an easy understanding was developed such that technical words were avoided. Every item was rated on a scale of 4 to 1, which was assessed according to our theoretical construct. The first degree of the response shows the high (4), optimum or desired answer, meaning that an optimum capability was found on the item. The second degree was labelled as good (3), meaning a medium or minimum degree of the capability; the third degree was labelled as enough (2); and the fourth degree, the least desired answer, suggested a low amount or absence of the capability (1). The questionnaire also had the option of not answering any of the statements if not agreeing with the question. Table 2 shows the results with descriptive statistics and the frequency of responses separated by the degrees just mentioned.

Table 2. Descriptive statistics and grouped frequency of answers separated by degree of ACAP (N = 10).

		Mean	SD		High (4)	Good (3)	Enough (2)	Low (1)	N/A *
PACAP	Acquisition	3.25	0.42	Item 1	5	5	0	0	0
				Item 2	4	4	1	1	0
	Assimilation	3.3	1.02	Item 3	8	0	1	1	0
				Item 4	7	2	1	0	0
				Item 5	4	3	2	1	0
RACAP	Transformation	3.3	0.75	Item 6	7	3	0	0	0
				Item 7	3	5	1	1	0
	Exploitation	2.55	0.49	Item 8	3	1	6	0	0
				Item 9	1	1	8	0	0

* No answer.

From the first part of the questionnaire of our group of SMEs (N = 10), we assessed the nominal answers by degrees from 4 (highest) to 1 (lowest) for a descriptive analysis. The first variable of "acquisition" averaged 3.25 (SD = 0.42), the second variable "assimilation" averaged 3.3 (SD = 1.02), the third variable "transformation" averaged 3.3 (SD = 0.75), and the fourth variable "exploitation" averaged 2.55 (SD = 0.49). The descriptive statistics showed on average a good to high capability for the first three variables, but the fourth variable showed an enough or low capability for exploitation. On the other hand, the frequency of the answers of every item in the PACAP dimension regarding item 1, showed that most respondents stated they had previous experience in research for innovation in products or processes (a majority concentrated in high = 50% and good = 50%). The intensity, velocity, and acquisition of knowledge regarding item 2 showed a high and enough ACAP, meaning that there was a good intensity of shared information for the execution of the project (a majority in high = 40% and good = 40%). Assimilation capacity regarding item 3 showed a good articulation of the knowledge,

observing a majority with high ACAP (high = 80%). Regarding item 4, a majority was situated in high ACAP, observing a high degree of learning across the progress of the project (high = 70%). Item 5 referred to the utilized knowledge for daily work, which showed a high and good ACAP, meaning an ability to find and use new solutions for the products and processes (high = 40%, good = 30%). For the RACAP dimension, item 6 showed that there was a good bisociation of knowledge (high = 70%). Item 7 showed a good modification of the previous knowledge to be implemented inside the organization (high = 30%, good = 50%). The exploitation variable on the other hand showed most respondents had an enough degree of ACAP regarding item 8, which showed that the knowledge developed was not applied completely to the existent competences for most respondents. The knowledge output was principally stored in the internal database (a majority in enough = 60%). Item 9 showed that most respondents had an enough degree, stating a need for more research, time, and investment to achieve commercialization (a majority in enough = 80%).

The second part of the questionnaire consisted of a set of ordinal Likert type scale from 1–5. Data were grouped from X1–X4 for every variable with the purpose to run a correlation analysis from the theoretical construct of ACAP. A Spearman's ρ (rho) bivariate correlation was executed for the data analysis using statistical software. The results are shown in Table 3, where X represent each variable of absorptive capacity.

Table 3. Bivariate correlation analysis.

Method	Variables		X1	X2	X3	X4
Spearman's ρ	**X1**	Correlation Coefficient	1.000	0.641 *	0.867 **	0.317
		Sig. (two-tailed)		0.046	0.001	0.372
		N	10	10	10	10
	X2	Correlation Coefficient	0.641 *	1.000	0.834 **	−0.111
		Sig. (two-tailed)	0.046		0.003	0.761
		N	10	10	10	10
	X3	Correlation Coefficient	0.867 **	0.834 **	1.000	0.237
		Sig. (two-tailed)	0.001	0.003		0.509
		N	10	10	10	10
	X4	Correlation Coefficient	0.317	−0.111	0.237	1.000
		Sig. (two-tailed)	0.372	0.761	0.509	
		N	10	10	10	10

* Correlation was significant at the 0.05 level (two-tailed). ** Correlation was significant at the 0.01 level (two-tailed).

Table 3 shows first that acquisition (X1) was positively and significantly correlated with assimilation (X2) (0.641, $p = 0.046$), therefore having congruence to engage the potential absorptive capacity of the model. Assimilation (X2) was also correlated significantly with transformation (X3) (0.834, $p = 0.003$). In the same line, X1 was correlated with X3 (0.867, $p = 0.001$), giving congruence with the first part of realized absorptive capacity. Interestingly enough, no significant correlation between transformation (X3) and exploitation (X4) was found (0.237, $p = 0.509$), and with none of the rest of the variables. Since the purpose of this paper was not testing the model in successful collaborations but exploring the emergent absorptive capacities of the new joint research unit, we found that there is a partial ACAP in our sample, showing that a good correlation of the three first variables could not lead to achieving exploitation in this particular group of SMEs. To provide a possible description, we will use both parts of the questionnaire as a convergent way to explain the results without the objective of generalization of the phenomena.

8. Discussion

Both parts of the questionnaire complement our findings. As we aimed from the beginning, this assessment of ACAP in the group of SMES did not intend to test the model for validation,

but instead to understand the ACAP generated by the joint research unit inside the SME. The new unit was, to some extent, experimental as normal operations must continue working as the project was executed. There was no obligation to show tangible outcomes or commercialization success. Therefore, no innovation aggregate was possible for measurement through traditional means when the general assumption of innovation stresses the commercial success on the market to call it an "innovation" [57]. A simplistic view of innovation in SMEs is still frequent among policymakers who see them as nascent large firms that have to exploit innovation to achieve their growth potential [22]. Nonetheless, ACAP literature shows the importance of exploitation, not only by commercialization, but also by the creation of new competencies as knowledge outputs. This can be more adequate for understanding the process of developing innovation and thus it might suggest new indicators for innovation measurements, especially for SMEs.

SMEs might need to adapt and acquire enough capabilities to successfully exploit new knowledge; therefore, a continual iterative process of learning might occur when they collaborate with academia. The difficulty of measuring subjective achievements is their imprecision as there are no tangible results during the first phases of the development of innovation. An issue that could explain a difficulty for achieving exploitation is the risk of projects not being continuously funded or with irrelevant objectives when carrying out research. For example, a problematic continuation of support from research centers was found to be discontinued as the funding ended in collaboration settings [58].

From our results, we can show that the studied group of SMEs units collaborating with academia in the specific local context studied showed a moderate ACAP. The process of obtaining tangible outcomes from commercializing the results of the research as exploitation is still a concern for the group of SMEs. Interestingly, most respondents have shown a degree of transformation of their routines or processes as a result of the project, but not as an exploitation of the knowledge created. This shows an indirect improvement for the organization as a consequence of the collaboration, where an extent of knowledge permeation was observed that went from the unit to the rest of the organization as part of the dissemination process. Our findings also brought insights about the new emerging unit in terms of ACAP, which might gradually improve over time to bring results as strategic resources to the organization (i.e., new ventures, spillovers, patents, products, and services).

Open innovation is intended to accelerate the process of innovation. Nevertheless, accelerating the process seems to be a challenge for SMEs as they respond to a small portion of the market with different barriers and limitations, but undertaking OI represents an iterative way of learning for continual growth. Their increasing know-how will constitute valuable and indispensable knowledge to run their processes, which can be exploited over the long-term. For that reason, intellectual property is a concern among SMEs, especially in developing countries where the traditional family business is often closed to outside intervention. An interesting motivation for research could grow from new generations of SME owners that encourage an open approach to address innovation as new business models.

9. Conclusions

We analyzed the results of an open innovation collaboration between SMEs and academia under an absorptive capacity approach. The principal objective was to understand knowledge creation in collaborative projects. Theory and growing interest in research of open innovation show the possibility of achieving innovation in different ways other than the traditional view of closed R&D. Hence, internal R&D is not merely a proxy for ACAP, but rather a base to create complementary assets and capabilities with external partners that will enable opportunities for future knowledge acquisitions [59]. ACAP, in this sense, was appropriate to address the creation of new knowledge collaboratively.

The government institution decided which SMEs would participate in the program for their projects of innovation, and for that reason, our sample was heterogeneous and limited the studied context. Certain attributes were not reflected in the results as the information was not available. This included types of innovations, age of the entrepreneur, sector of the firms, and other attributes. Nonetheless, the predisposition to work collaboratively is evident for SMEs, despite its characteristics.

Greater efforts and attention are needed since knowledge exploitation depends on repeated and intense interactions with diverse actors.

From the data collected, our findings showed some patterns among the SMEs joint research units in terms of ACAP. This was supported by the results of both parts of the questionnaire that provided a convergent explanation of the observed phenomena. ACAP refers to the organization's ability to exploit knowledge to provide commercial outputs. As shown from our results, the knowledge created by the group of SMEs was not totally unproductive. It is possible to observe an indirect way of learning, where the main output observed from the collaboration was found in internal improvements. This might turn into continual learning, where the benefit from participation on this type of programs have provided experience to the SMEs that could effectively exploit this knowledge in the future. Nevertheless, it will require significant efforts from the whole organization to accomplish this situation (i.e., absorptive capacity is not a by-product). Although it is observed that ACAP enablers are the internal and external R&D undertaken for the generation of product innovation [40], our study showed in our sample of SMEs that as a consequence of collaborative R&D, exploitation was an iterative process of continual learning when exploring new sources of knowledge from academia. However, as long as internal and external R&D continue developing in conjunction, a benefit from commercialization could be achieved in the future. This goes in line with the assumption that the external knowledge processed through PACAP must go through various repeated cycles before the organization can apply it commercially through RACAP and generate business value [16].

We argue that time taken for a joint research is related to the experience obtained when working in open settings. Future specialization and familiarity with joint research processes are a primary concern during the first stages when working with academia. This, in turn, might translate into reducing the time of exploitation of the created knowledge for internal and commercial benefits in the future, but time is a difficult variable to address. Open innovation stresses that time for developments are shorter under this approach, suggesting that organizations must focus on exploiting new knowledge instead of searching for the intellectual property of the knowledge. SMEs might also need a change of their traditional business view, where the emphasis should be placed mainly on exploiting their principal products over long periods to provide a greater diversification and a continual improvement of their products. This, in turn, will lead to the development of new dynamic capabilities that are necessary to cope with the turbulent markets. A change of perspective could also be turned into the growth of small and medium enterprises that are gradually opening to innovation.

Besides funding, more support is also needed from governments, which could work as moderating variables in the process of developing innovation. It is expected that in future collaborative innovation projects, SMEs could obtain better outcomes with academia if new measurements and guidelines are developed. The participation of other relevant actors in adapted systems of innovation could also suggest the creation of a useful network of dyads defined according to the strategic needs of the organization. Therefore, SMEs should not only rely on one source but on a network of sources. However, the complexity will increase for managing multiple connections. A need for mutual trust with other participants in open systems of innovation is essential; therefore, prior preparation and experience in collaborative research is necessary to achieve beneficial outcomes from such networks. The dyad collaborations between SMEs and academia in this study denoted a first step of learning for them as a continual process of exploring for new sources of knowledge.

It can be recommended that researchers and business managers should initiate and participate in the co-production of knowledge as a collective effort in SMEs. The investment of more time and attention needs to be encouraged to consolidate a successful collaboration. These findings also bring new observations for future research in the field of exploitation of knowledge for innovation in alternative ways, which could possibly bring insights regarding new measurements and guidelines for innovation tailored to the characteristics of SMEs.

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