

# Triggering Open Innovation Processes Through Organizational Emotional Capability and Rival's Absorptive Capacity Orientation

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**Abstract**—In this article, we analyze the direct effects of the open innovation (OI) processes of acquisition and exploitation on innovation performance (IP), as well as the effects of two antecedents of OI: organizational emotional capability (EC) and rival's absorptive capacity orientation (RACO). RACO implies processing external information in an analytical manner, whereas an intuitive approach is implicit in EC. The research model is tested in a sample of medium-low-technology Colombian small and medium-sized enterprises (SMEs) using structural equations by the consistent partial least squares method. Our results provide evidence on a significant effect of the OI acquisition process on IP, as well as the determining role of RACO for firm-level innovation, in that it functions not only as an informal mechanism for intellectual property rights protection, but also as a knowledge process nourishing the OI exploitation process. This article contributes to the incipient research field of OI in low- and medium-technology SMEs, offering new evidence on the results on the OI-IP relationship in contrast with previous studies conducted in other technological contexts. Furthermore, EC, which has traditionally proven its incidence on internal innovation activities, can have a more powerful and determining role in innovation processes that imply collaborative work with third parties.

**Index Terms**—Emotional capability (EC), innovation performance (IP), knowledge appropriability, open innovation (OI), rival's absorptive capacity.

## I. INTRODUCTION

IN THE last two decades, open innovation (OI) has become one of the areas with the greatest relevance in the field of innovation management [1], [2]. OI is widely understood as the innovation process based on the purposive management of knowledge flows beyond organizational limits [3], and is subdivided into two major organizational processes: acquisition or inbound and exploitation or outbound [4], [5]. However, research of conceptual nature and case studies still prevail in OI literature and there is little empirical evidence on these processes, especially in the context of SMEs [6]. Furthermore,

most results have been obtained from panel data where OI indicators are adapted and are not always aligned with its conceptual basis, which usually raises questions regarding content validity. Some conclusions are therefore in the midst of the controversy between defenders and detractors of this type of study [7] and questions regarding OI remain unsolved due to the lack of concluding evidence.

One such question is the impact of OI activities—acquisition and exploitation—on innovation performance (IP) in SMEs [4], i.e., on their innovation results, despite a series of recent works indicating a possible positive relationship [7], [8]. Previous studies in this specific literature show some additional shortcomings: most of them analyze the relationship between the OI process of acquisition and IP exclusively, leaving aside the effects of exploitation [9], [10]. Consequently, there is a lack of evidence on the existence of a positive impact of exploitation on IP [11], [12], and some results are indeed contradictory: while some studies indicate that exploitation is the OI process with more impact on IP [13], [8], others argue that this process does not positively influence new product development [14]. In parallel, there is a recent interest in the literature to establish the organizational antecedents of OI, mainly R&D internal capabilities [15], informal links with external actors [16], the evaluation and selection of knowledge from external sources [17] and, more recently, innovation climate [6] and knowledge information systems [18]. Some authors have posited that the direct effect of knowledge appropriation on OI, understood as the ability to protect innovations to succeed in obtaining benefits, is probably the most important theoretical gap yet to be resolved in the course of this decade [19].

In this article, we contribute to the literature by offering a broader analysis of the effects of both OI processes, acquisition and exploitation, on IP in SMEs from a Colombian primary dataset. In a low- and medium-technology SMEs context, we believe that appropriation is more conditioned by the competitors' ability to assimilate and use knowledge—competitors' absorptive capacity (CAP)—than by the use of intellectual property protection measures [20]. Companies find themselves in need to prioritize permanent assessment of CAP [21]. This is done with the purpose of establishing the knowledge expropriation risk level in any OI activity, in particular those involving collaborative work with such actors [22], and recognizing what kind of knowledge could be obtained from the competition as a well-known source of external knowledge for SMEs [7].

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We further aim to contribute to the understanding of the antecedents of both OI processes. Current discussion around the organizational antecedents of OI has to do with the prevalence of works dealing with the analysis of the effects of hard organizational variables, which has drawn greater attention to the impact of soft variables on OI [9], such as the not-invented-here syndrome [23] and the organizational climate for innovation [6]. This scenario obeys, to some extent, to the incipient articulation of OI with other management or economy study fields, particularly the general theories on the nature of the firm, although there is some advance in its articulation with resource-based theory [19]. Hence, when analyzing the antecedents of OI, the incorporation of soft variables into the equation is limited, especially if they are not part of the research tradition in the field of OI.

To this end, we contribute to the discussion elaborating on the role of rival's absorptive capacity orientation (RACO) and emotional capability (EC) as antecedents in our work. RACO is the organizational process of capture and analysis of rivals' activities and specific information on their sources of knowledge, their investments in external technology acquisition and their time-to-market, among other aspects [21]. Despite the importance of this process, the debate that might probably present a higher impact on the future of the OI field has to do with the advance in the last decade of social neurosciences, neuroeconomics, and the so-called organizational cognitive neuroscience [24], [25], related to the existence of a dynamic and complementary interaction between emotions and cognition. EC refers to the organization's ability to perceive, understand, monitor, attend to, regulate and use the emotions of its members to achieve organizational objectives [26]–[28]. The ongoing interplay of such disciplines in social sciences has triggered the appearance of diverse studies that explore the role of EC as a soft antecedent of closed innovation [29]–[32]. The studies dealing with the effects of EC on the OI processes of acquisition and exploitation are incipient, even though both imply a greater organizational effort in terms of information processing and high emotional effort as compared to closed innovation. Likewise, studies connecting RACO with innovation have focused on analyzing its effects on IP as a result of internal innovation activities [20], [33].

However, the effects of RACO on the OI processes of acquisition and exploitation deserve further attention by scholars, since rivals are a key source of knowledge and OI activities imply a greater flow of knowledge outside the organizational boundaries as compared to internal innovation activities [34]. Besides, RACO implies processing external information in a rational and analytical manner, which complements the intuitive approach implicit in EC. In the next section, we elaborate on the theoretical background to explain the effects of OI on IP in SMEs, as well as the role of the described antecedents for SMEs in nonhigh-tech industries.

#### A. Theoretical Framework and Hypotheses Development

1) *OI and IP*: OI is understood as the innovation process based on the purposive management of knowledge flows beyond organizational limits [3]. In general terms, OI is subdivided into two major organizational processes: acquisition or inbound and exploitation or outbound [4], [5]. The first refers to the

business activities that enable access to external knowledge and technology; in turn, the latter is aimed at the transfer of internal knowledge and technologies with the purpose of obtaining either financial or other types of benefits [35]. IP refers to the concrete results of the innovation process mainly related to the expansion of product range through technologically new, improved products—friendly to the environment—and the development of new product lines [36], [37].

Regarding the incidence of acquisition in IP, SMEs that have a close link with key knowledge sources and a greater understanding of the opportunities offered by its innovation ecosystem are more effective in the assimilation and combination of knowledge, and so, in developing new products [7], [14], [38]–[40]. Additionally, previous studies have shown that the monitoring of technological trends and the purchase of technology from external sources are other activities pertaining to this first OI process, which stimulate the creation of new products for the market [41]. SMEs can improve their innovation results by opening and carrying out activities aimed at incorporating external ideas, knowledge and technologies that facilitate the development of new, improved products and reduce the possibility of failure in the market. This mainly involves a process of searching and building alliances with key external sources such as customers and competitors. In the case of SMEs in emerging countries, these external activities have a greater weight compared to others such as the purchase of technology from third parties, due to lack of resources [42] and the lack of internal technological skills to assimilate it and apply it in innovation processes [43]. Therefore, the following hypothesis is posed:

*H1. The OI process of acquisition positively influences IP.*

In addition to the above, the second OI process of exploitation is also relevant in the field of SMEs because it involves collaborative work with external partners either to be recipients of internal technologies and knowledge or to participate in marketing activities [35]. In general, an SME is more oriented to get involved in these exploitation activities than in others such as licensing because of resources limitations [42] and the high risk of knowledge expropriation in a low technological intensity setting [44], [45]. The literature suggests that it is precisely at the time of transferring internal knowledge to the outside world when OI becomes more relevant for SMEs given their constraints in the commercialization of their innovations [8].

Collaboration with external allies, mainly with competitors, particularly facilitates SMEs' greater understanding of the market and identifying opportunities for the introduction of their innovations [46], this being the case, for instance, of brand partnerships or cobranding for the commercialization of innovations [47]. Therefore, the OI stage of exploitation requires a process for internal and external knowledge integration which enables to overcome the main barrier for SMEs in this situation, relating to the difficulty in identifying the connection between internal technologies and knowledge with the market [34]. Moreover, SMEs' relations with actors such as government agencies facilitate the acquisition of resources that allow both the fine tuning of innovations and their launch to the market [44]. In short, collaborative work with external allies—either as recipients of

internal technologies and knowledge or participants in commercialization activities—enables SMEs to boost the creation of new or improved products thanks to the identification of new applications of their internal technologies and knowledge, as well as a better understanding of market opportunities. Therefore, we propose the following hypothesis:

*H2. The OI process of exploitation positively influences IP.*

2) *RACO as an Antecedent of OI*: Being on par with the competition is one of the main motivations of SMEs to venture into OI practices [4]. As stated previously, competitors play a relevant role in both OI processes since they are a source of key external knowledge for SMEs [7], [14]; in addition, working collaboratively with them facilitates the introduction of SME innovations to the market [46]. However, this paradoxical relationship with competitors, in which collaboration and competition occur simultaneously, fosters the emergence of various intraorganizational tensions; this may eventually render the OI activities that involve a competitor unfeasible and unsustainable [22], [48]. One of the main tensions derives from the risk posed by the possible opportunistic behavior from the competition [49], [50]. In detail, competitors may misappropriate core and peripheral knowledge and technologies, and thereby destroy an SME's competitive advantage in the mid term [51], [52].

However, it has recently been suggested that knowing in detail the competitors' ability to assimilate and use knowledge from external sources is one of the most effective ways to handle these tensions [22]. This entails capturing and analyzing rivals' activities and specific information on their sources of knowledge, their investments in external technology acquisition and their time-to-market, among other aspects. This organizational process has been called RACO [20], [21].

RACO allows the SME to have a broad understanding of its competitors' innovative potential and that knowledge, in turn, encourages the execution of OI processes. This is due to the fact that it provides evidence to decide when and why collaborative work with an actor—or any other given actors—would be useful, what its scope would be, and the content of an OI agenda for the acquisition and transfer of knowledge and technology [22]. RACO also helps to establish which is the critical knowledge whose flow in OI activities should be restricted and to assess *a priori* to what extent they may be appropriable and used by the competition [53]. Such process facilitates the choosing of protective measures, formal or predominantly informal in the SME [54] in order to avoid knowledge leaks [52], which ultimately represents a better configuration of the SME's organizational conditions for the execution of OI activities. Thus, the following hypotheses are proposed:

*H3. RACO has a positive influence on the OI process of acquisition.*

*H4. RACO has a positive influence on the OI process of exploitation.*

3) *EC and OI*: EC refers to the organization's ability to perceive, understand, monitor, attend to, regulate, and use the emotions of its members to achieve organizational objectives [26]–[28]. This capability is reflected in six abilities or emotional states.

1) Encouragement, referring to the ability to awaken optimism in members of the organization.

- 2) Display of freedom, which seeks to facilitate and legitimize the manifestation of emotions.
- 3) Playfulness, which refers to the ability to create settings that promote the trial of new ideas and tolerance to error.
- 4) Experiencing, referring to the ability to understand and feel the emotions of others.
- 5) Reconciliation, which seeks to balance opposing values or ideas that generate plenty of emotional agitation among the collaborators.
- 6) Identification, which refers to people's attachment to certain characteristics of the organization [27], [29].

The advances of social neurosciences and neuroeconomics in the last decade concerning the existence of a dynamic and complementary interaction between emotions and cognition [55]–[58] have shown that emotions play an important role in the process of exploration and acquisition of information from the organizational setting. They trigger another cognition system related to intuition, automatic categorization, and empathy [57], [59], which works in an automatic, fast and subconscious manner [60]. This other cognitive mode known as *reflective system*—emotionally hot or experiential—is what permits us to go beyond data and build a global, panoramic vision of a given situation in the environment through nonconscious holistic associations based on experience [59]. It also generates dissonances between emotions and analytical processes that feedback into information processing, facilitate its synthesis, and the building of expert judgment [61]. Therefore, it is very useful in dealing with uncertainty and ambiguity [62], [63] as well as in processes requiring intensive knowledge use [26].

Consequently, EC is expected to have an impact on both OI processes. As for acquisition, EC allows for a holistic understanding of the environment to quickly identify which are the key sources of innovation, intuitively recognize relevant aspects of technological trends and to act quickly, in this case, by selecting and acquiring external technologies [32], [41], [64]. Such way of processing information, implicit in the EC, also enables internal and external knowledge to be integrated in order to swiftly identify the connection of internal technologies with the market [31], [65], which positively influences the OI process of commercialization [41].

On the other hand, the development of OI activities entails a series of emotional tensions. In the first place, the literature has shown employees' irrational rejection toward both externally sourced knowledge and practices that involve external knowledge transfer [23]. This rejection occurs mainly for emotional-related reasons; among them, we can stress defending one's own ego, the conservation of group identity and social relations, interest in avoiding the capture of information that comes into conflict with organizational beliefs, and resistance to change [66], [67]. In general, it has been shown that the search for knowledge from external sources may generate fear and anxiety [68]. In organizations such as SMEs, more oriented towards involving competitors in OI processes, ambivalent emotional states such as trust, distrust, greed, and fear arise [69]. These are implicit in the developing or acquisition of competitors' technologies and knowledge, as well as in the commercialization stage of SMEs' innovations supported either directly or indirectly by this external entity [23].

TABLE I  
CHARACTERISTICS OF THE COMPANIES IN THE SAMPLE

Sector	Frequency	Percentage
Information and communications	20	16.3
Human health care activities	16	13.0
Professional, scientific and technical activities	13	11
Retailing	9	7
Food products manufacturing	8	7
Other service sectors	31	25
Other low and medium-technology manufacturing sectors	26	21
<b>Functional area of the respondent</b>		
Presidency or General Management	42	34.1
Research and Development	15	12.2
Marketing and Sales	15	12.2
Systems and Technology	13	10.6
Human Resources	10	8.1
Finances	7	5.7
Production	6	4.9
Quality Management	4	3.3
Other areas	11	8.9

Nevertheless, two EC aspects—reconciliation and playfulness—can help overcome these tensions. The former allows for balancing key information, coming from external sources, which clashes with organizational beliefs; therefore, it is essential for overcoming emotional conflicts, moderating the attachment to certain organizational assumptions, and the influencing of the values behind the rejection toward externally sourced knowledge and practices that involve external knowledge transfer [66], [70], [71]. On the other hand, playfulness—as an organizational aspect—reduces the anxiety associated with the search for information, while increasing the capacity to use it in a creative and innovative way [72], [73].

In addition, playfulness is central in the process of exploitative OI in that it enables a greater emotional commitment of the SME with new innovative ideas. The capacity of action, therefore, increases providing enough energy to find the way to develop their innovation projects [32], [71], despite the lack of resources and the few internal technological skills [42]. For such emotional commitment to occur, the SME will need to be open to the transfer of internal knowledge and collaborative work with third parties. This is necessary in order to take advantage of the resources of the environment for the introduction of their innovations in the market, e.g., greater participation in the programs offered by regional innovation systems to support SMEs in activities such as prototyping and market validation of their innovations.

In short, EC is a relevant factor in the processes of OI for the SMEs. First, because EC activates in employees the cognition-system related to intuition, automatic categorization and empathy, and allows quick and intuitive identification and interpretation of the key information in the environment in a holistic way. It also facilitates the recognition of collaboration opportunities with third parties—either for the acquisition of new knowledge or for the discovery of new applications of their internal knowledge—and the development of joint efforts to accelerate the commercialization and introduction of their innovations in the market. Second, EC relieves the emotional

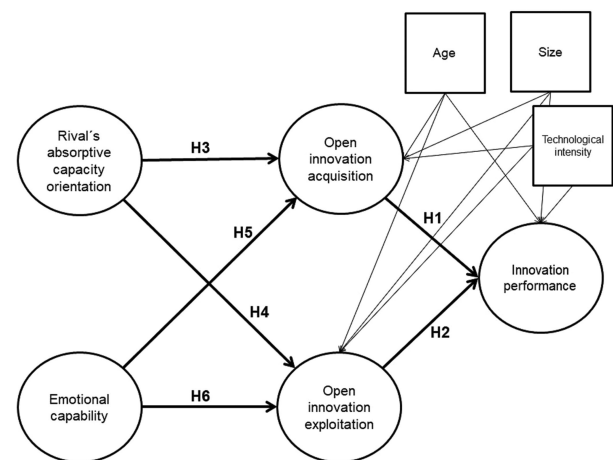


Fig. 1. Research model.

tensions implicit in the OI activities of acquisition and exploitation, because EC involves the activation of emotional states empowering the harmonization of external information or new organizational behaviors that clash with organizational beliefs. Finally, CE generates an emotional commitment of the SME with its new ideas of innovation, enforcing openness and orientation to collaborative work with third parties. The access to such external resources is required to pull the innovation projects created internally. Therefore, the following hypotheses are presented:

- H5. EC positively influences the OI process of acquisition.
- H6. EC positively influences the OI process of exploitation.

The hypotheses in our model are shown in Fig. 1.

### B. Methodology

1) *Sample and Data Collection:* Our hypothesized model was tested in a sample of low- and medium-technology manufacturing SMEs [74] and services SMEs (see Table I),

TABLE II  
RELIABILITY AND CONVERGENT VALIDITY

Constructs	Standardized loading	t value	CA	CR (pC)	VEI	pA
<b>EC</b>			0.92	0.93	0.64	0.93
EC1	0.72*	5.07				
EC2	0.79*	13.02				
EC3	0.77*	11.61				
EC4	0.80*	10.86				
EC5	0.86*	15.25				
EC6	0.80*	11.45				
EC7	0.86*	14.13				
<b>RACO</b>			0.91	0.91	0.62	0.91
RACO1	0.79*	4.69				
RACO2	0.84*	6.20				
RACO3	0.81*	6.28				
RACO4	0.78*	5.35				
RACO5	0.70*	4.92				
RACO6	0.77*	5.13				
<b>IP</b>			0.86	0.86	0.60	0.86
P1	0.72*	9.34				
P2	0.71*	8.05				
P3	0.79*	12.96				
P4	0.88*	17.88				
<b>OI Acquisition</b>			0.84	0.84	0.56	0.84
OI acquisition 1	0.72*	11.22				
OI acquisition 2	0.82*	16.02				
OI acquisition 3	0.71*	10.76				
OI acquisition 4	0.74*	10.64				
<b>OI Exploitation</b>			0.88	0.88	0.71	0.88
OI Exploitation 1	0.86*	14.34				
OI Exploitation 2	0.75*	12.52				
OI Exploitation 3	0.90*	17.58				

Notes: \* $p < 0.001$ .

located in Colombia, an emerging and technology-follower country [75], [76], where incremental innovation prevails and appropriation level is low [77], [78]. Fieldwork was conducted between November 2015 and May 2016 through a questionnaire sent by electronic mail to the management of 600 companies that voluntarily signed up in a mentoring program to develop innovation capabilities, sponsored by an institution from the regional system of innovation, which articulates companies and universities. Finally, 123 valid responses were obtained, a sample size that guarantees a satisfactory statistical power above 80% [79].

2) *Measurement Variables*: The scale developed by Hurmelinna-Laukkanen and Olander was used to measure RACO [21]. EC was measured with the scale proposed by Akgün *et al.* [29]. For IP, the scale created by Alegre *et al.* [36] and subsequently adapted by Alegre *et al.* [80] was employed. We used a Likert scale ranging from *totally disagree* (1) to *totally agree* (5) in the case of RACO and EC, whereas for IP the scale goes from *very inferior* (1) to *very superior in comparison to competitors in the last three years* (5). The study also included three control variables that have previously been shown to have an incidence on OI and IP: size, age, and technological intensity.

### 3) Data Analysis:

a) *Reliability and validity*: The reliability and validity of the measurement model were examined with structural equations by the consistent partial least squares method (PLSc) [81]. Based on the PLSc, we conducted the tests to examine the reliability and convergent validity of the items and constructs [82] (see Table II). In the case of individual reliability, we verified that all the items had a factor loading equal or greater than 0.7. We also checked that all constructs presented a Cronbach's alpha

TABLE III  
DISCRIMINANT VALIDITY

Constructs	Fornell–Larcker					HTMT				
	1	2	3	4	5	1	2	3	4	5
1. EC	<b>0.64</b>									
2. RACO	0.10	<b>0.62</b>				0.32				
3. OI	0.35	0.02	<b>0.60</b>			0.59	0.14			
4. OI Acquisition	0.53	0.15	0.51	<b>0.56</b>		0.73	0.39	0.72		
5. OI Exploitation	0.24	0.12	0.28	0.57	<b>0.71</b>	0.48	0.34	0.53	0.76	

The VEI in bold on the diagonal; squared correlations below the VEI.

TABLE IV  
STRUCTURAL EQUATIONS RESULTS

Trajectories	Coefficient	t value	Confidence intervals at 95%
<b>Direct effects</b>			
OI Acquisition -> IP	0.64**	3.66	[0.29;0.99]
OI Exploitation -> IP (R <sup>2</sup> = 0.56; Q <sup>2</sup> = 0.27)	0.06	0.32	[-0.33;0.39]
EC -> OI Acquisition (R <sup>2</sup> = 0.56; Q <sup>2</sup> = 0.31)	0.68**	8.05	[0.49;0.82]
EC -> OI Exploitation (R <sup>2</sup> = 0.34; Q <sup>2</sup> = 0.23)	0.43**	4.75	[0.24;0.59]
RACO -> OI Acquisition	0.17	1.88	[0.003;0.36]
RACO -> OI Exploitation	0.23*	2.50	[0.05;0.42]
<b>Control variables</b>			
Age -> OI Acquisition	0.11	1.41	[-0.04;0.27]
Age -> OI Exploitation	-0.10	-1.00	[-0.29;0.10]
Age -> IP	-0.07	-0.67	[-0.27;0.12]
Size -> OI Acquisition	0.06	0.90	[-0.09;0.20]
Size -> OI Exploitation	0.28**	3.25	[0.10; 0.44]
Size -> IP	-0.12	-1.51	[-0.28;0.04]
Technological intensity -> OI Acquisition	-0.17	-0.84	[-0.38;0.29]
Technological intensity -> OI Exploitation	-0.06	-0.50	[-0.25;0.22]
Technological intensity -> IP	-0.13	-0.67	[-0.29;0.32]

Notes: \* $p < 0.05$ ; \*\* $p < 0.001$ .

and a Dillon-Goldstein's (pC) or composite reliability index above 0.7, and a variance extracted index (VEI) greater than 0.5. Additionally, we calculated the new reliability indicator of the construct, the Dijkstra–Henseler (pA), and confirmed that it was above 0.7 [81].

To establish discriminant validity, we first verified meeting the Fornell–Larcker criterion; in this case, that the VEI was greater than the squared construct correlations (see Table III) [83]. However, only the two OI constructs did not meet this first criterion. Therefore, we resorted to a second criterion, the Heterotrait-Monotrait (HTMT), which has proven to be more reliable than the Fornell–Larcker. Finally, we confirmed that all HTMT values were below 0.85 or 0.90 thresholds [84].

Finally, in order to assess the bias of common method variance (CMV), we conducted Harman's single factor test [85], establishing that the variance accounted for in the first factor is 39%. This result reveals that CMV is not determinant in our database.

b) *Direct effects test*: Regarding the hypotheses test, we used structural equations by the PLSc method in order to obtain the confidence intervals at 95% and the  $t$  values of the coefficients of the different trajectories from the resampling of 4999 subsamples [86]. Table IV shows that the trajectories between the OI process of acquisition and IP ( $\beta = 0.64$ ;  $t$ -value = 3.66), EC and the OI process of acquisition ( $\beta = 0.68$ ;  $t$ -value = 8.05), EC and the OI process of exploitation ( $\beta = 0.43$ ;  $t$ -value = 4.75) and between RACO and the OI process of exploitation ( $\beta = 0.23$ ;  $t$ -value = 2.50) are significant and with a positive sign. Therefore, only H1, H4, H5, and H6 are accepted.

Added to this, the influence of the control variables is not significant in the research model, except for the relationship between size and the OI process of exploitation. We performed

additional tests to further explore potential differences between manufacturing and services firms, but we found no statistical differences.

4) *Global Fit of the Model and Analysis of Its Prediction Power*: To establish the global fit of the model, we confirmed that the normalization of the square root mean residual was below 0.08. In our study, this value is 0.06, which indicates a good fit [87]. We also evaluated the prediction power of the model. First, it was verified that the  $R^2$  of the endogenous constructs was above the minimum value of 0.1 [88]. In addition, it is observed that the model explains 56% of the IP variance, which indicates that its prediction power is above the moderate level and close to the substantial one [86]. Furthermore, we conducted the Stone-Geisser test [82] and were able to verify that the endogenous constructs present  $q^2$  values above zero (0); for IP, this value is 0.27, and for the OI processes of acquisition and exploitation, it is 0.31 and 0.23, respectively (see Table IV). These values indicate that predictive relevance is above the medium point threshold and close to the higher level [86].

## II. DISCUSSION AND CONCLUSION

In this article, we aimed to offer a new perspective to analyze the antecedents of OI by bringing various disciplines to the discussion in this field. Two organizational factors were simultaneously considered: a hard one, RACO, and a soft one, EC, which are representative of the current state of the discussions within two different theoretical traditions. RACO is a classic example of a construct based on cold cognition logic, whereas EC is at the other extreme of emotions, intuition, and experience. Nevertheless, in our empirical model, the EC effect was greater and more significant, even on both OI processes. This indicates that soft antecedents, EC in this case, can be more important in low- and medium-technology business settings with knowledge appropriation limitations. Such result may be due to the fact there is a higher level of uncertainty and risk in relation to the absorption of knowledge from the competition, implying a greater demand for soft organizational capabilities such as EC. In this sense, placing EC at the center of the discussion of OI is another contribution of the study, which to some extent differs from what has been argued by other studies which confer it a peripheral role [1].

This result also led us to rethink the role of EC in the organization. Its incidence on internal innovation activities and performance has been established in the literature [29]. However, the work suggests that EC can have a much more powerful and determining role in innovation processes involving collaborative work with third parties which, because of this condition, are subject to a higher level of emotional demand and wear due to the information volumes, the degree of uncertainty, and the risk associated with the high level of knowledge expropriation. Therefore, EC has a clear influence on constructs of an operational nature and with a clear external orientation; this has not been widely evidenced in the literature and facilitates new configurations of these organizational factors and, in the case of OI, a better way to cocreate and coexploit knowledge.

Regarding our contributions to the literature, first, the existence of a positive and significant effect of EC on both OI

processes revalidate the attempts previously made by other researchers to reevaluate the cold cognition logic prevailing in the study of OI [9], [61]. These results illustrated the leading role of EC in activating other forms of cognition boosting knowledge flows outside the boundaries of the SMEs, either to acquire new knowledge or to find new applications of their own technology with the help of third parties, as well as to accelerate the introduction of innovations in the market. In the same way, EC helps to alleviate emotional tensions associated with the exchange of knowledge with external partners and increases emotional attachment with new ideas of innovation. In turn, this leads to greater openness of the SME and orientation toward collaborative work with third parties to tap into external resources for market opportunities. EC is thus a skill that places the SME in an advantageous situation for innovation, helping to overcome some of the main innovation barriers, i.e., the lack of resources and internal technological skills [38]. This indeed constitutes an effort to strengthen the incipient link between the OI field and the so-called organizational cognitive neuroscience [25], which has had a lot of impact and repercussions on other management fields such as marketing, organizational behavior and information systems management [24]. This finding takes place at a time when there is a claim for more articulation of OI in the general literature on management and business [19], contributing to foster an interdisciplinary research perspective.

The results further show that RACO, which implies a greater understanding of the ability of the competition to assimilate and transform knowledge, does not affect the acquisition process. This fact could be related to the “not-invented-here” syndrome, which implies an irrational rejection of knowledge from external sources for reasons related to the defense of the ego, organizational identity and particularly of shared values, concepts and opinions that are embedded in the organization [67]. The negative effects of this syndrome have been reported by the literature on OI [23], and such symptoms may be affecting SMEs as they become more aware of the technological strengths of the competition.

In contrast, our results show a positive and significant impact of RACO in the process of OI of exploitation. SMEs should strengthen their strategic orientation towards the competition, which implies activating knowledge capture and dissemination mechanisms in this sector, which prioritize the search of information about its real technological potential, which is usually outside the SMEs’ reach. In other words, SMEs should have specific information available on which are the competition’s knowledge sources, its key and peripheral technologies, its investments in terms of external technology acquisition, its time-to-market, among other aspects. With a higher awareness of the SME about its competitors’ capability to assimilate and transform knowledge, it will increase their involvement in activities for technology and knowledge transfer towards third parties. Specifically, RACO boosts knowledge flows from inside out because it allows improving awareness about the risk linked to the transfer of internal knowledge out of the organizational limits and the potential opportunistic behavior of the competitor and, based on this, allows taking informal measures to protect intellectual property and prevent knowledge leaking [22].

In our view, this finding constitutes another important contribution of this article because the literature has only shown the incidence of RACO in closed or internal innovation [20], mostly considered as a strategy for the adoption of informal mechanisms for the protection of intellectual property [21]. However, in this article, RACO is proposed as a type of strategic orientation and as a knowledge process that yields important information about what the technological strengths of the competition are. This generates strategic alerts, forcing the SMEs to break their borders to invigorate knowledge flow from outside, getting involved in collaborative alliances with other parties, for instance with business consultants and other SMEs to find new market opportunities, new applications or simply to combine efforts for the commercialization of innovation.

On the other hand, this work helps to elucidate the discussion around the relationship between both OI processes and IP. We pinpointed only one of the two OI processes influencing IP in SMEs, namely acquisition, differing from other findings showing that exploitation is the OI process with more influence on IP [8], [13]. Nevertheless, this result is consistent with a recent finding suggesting that there is no link between the OI process of exploitation and IP [14]. Probably, this situation can be explained by the fact that in low- and medium-technology SMEs located in emerging countries, where R&D intensity is low and where incremental and process innovations prevail, the internal innovation capabilities may be sufficient to achieve satisfactory improvements in IP. An additional consideration regarding the lack of relationship between exploitation and innovative performance in this article has to do with our operationalization of IP, focused on product innovation: while exploitation does not boost new product development, it could be influencing other aspects of IP that were not considered in this article, such as process innovation. In this sense, some studies have shown that in spite of not having a relationship between exploitation and product innovation, the external participation of companies in alliances and joint ventures implies knowledge flows from the inside out, which eventually produce improvements in production methods and techniques [17].

Furthermore, the results around the positive impact of EC on OI suggest intensifying efforts for the development and deployment of this ability, which supposes the intervention of several organizational aspects, both soft and hard. For instance, on the technological aspect side, the adoption of visual communication tools is necessary for the OI processes of acquisition and exploitation, with the aim of promoting more intuitive ways of information processing [89]. It is also key to adopt techniques that facilitate innovation management at the organizational level while helping individuals to develop emotional intelligence and make decisions related to OI processes by combining intuition and rationality [65]. Because primary data were used in the study, the results are exempt from the controversy raised by findings obtained through panel data [7], while contributing to the incipient study of OI in low- and medium-technology SMEs [90]. This constitutes a relatively pioneering study regarding the analysis of the OI-IP relationship in the context of an emerging, technology-follower country [13].

Naturally, this study has some limitations, the most representative being related to the IP construct, which fundamentally

reflects in this work the results in terms of product innovation. This measurement somehow restricts the possibilities to generalize the results about the OI-IP relationship to all IP aspects, including process, marketing, and organizational innovation. However, product innovation remains as the main IP indicator [36]. Likewise, although the number of respondents ( $n = 123$ ) is acceptable, sample size can also be considered as a limitation.

Another possible limitation driven by the characteristic of the sample is that managers with different profiles answered the questionnaire. Yet, we believe that this particularity indeed reflects the organizational reality faced by SMEs. In this type of firms, it is usual to find that a manager for a certain functional area has to perform an extra role managing heterogeneous organizational processes, which may not be related to the core of their department. For instance, in our sample, there are marketing and sales managers that, apart from managing processes related to commercialization, also have the responsibility to manage innovation due to lack of resources and constraints to have personnel specialized in R&D and innovation [43], [91].

It is important also to note that these results are constrained to the context of low- and medium-technology SME. Acquisition appears to be the most relevant process in OI since it allows expanding internal knowledge and ideas. There would be limits to the extension of these results to other types of companies such as large firms or multinationals that, unlike SMEs, usually exhibit higher investments in R&D, greater capacity for internal innovation and tend to be more involved in OI activities of exploitation, which is required to adjust their products to the particular needs and requirements of the local markets in which they operate, often with the help of local partners [91].

As for practical implications, the results suggest further delving into the adoption of mechanisms related to the OI process of acquisition in SMEs, such as engaging customers in product development, participation in external networks, and hiring external suppliers for technological and R&D services [4]. These OI activities can be within reach of SMEs in emerging countries; they lack resources to acquire intellectual property and do not possess the technological capabilities to generate innovations internally, but thanks to their size they have greater flexibility to generate links with the environment to invigorate inward knowledge flow [42].

Future lines of research should deal with analyzing particularly the direct effect of the OI processes on all aspects of IP, that is, process, marketing and organizational innovation. It would also make sense to explore the mediation of variables such as absorptive capacity in the relation between OI and IP in SMEs, understanding that this link implies a high demand in terms of knowledge assimilation and application [92]. Moreover, it would be worth exploring the moderating effect of the “not-invented-here” and “not-shared-here” syndromes on said relationship, given the little related empirical evidence obtained in low- and medium-technology SMEs of emerging countries [23], [67].

In relation to antecedents, future research should attempt to analyze the possible mediating effects of diverse organizational factors on the RACO-OI relationship, IT [93], big data analysis capabilities [94], and knowledge management strategies [95],

among them. These could serve as a bridge between RACO and OI, given the huge challenges of this relationship regarding information processing. Another emerging variable in the current literature that could be linked to the analysis is the leakage of key knowledge, which could have a positive moderating effect since it would force to intensify RACO [52], or a negative one, because it would discourage linking OI activities [96]. As regards the soft variables, much work remains to be done about the analysis of the relationships between emotions and OI. In particular, it is necessary to strengthen the link between OI and organizational cognitive neuroscience [24], [71]. This articulation can be in two ways: theoretical or methodological. In detail, neuroscience theories can be used to resolve unanswered questions in the OI field; for instance, those related to decision making in the design of new business models, customer participation in OI through digital platforms, and the role of their emotions in that process [1]. In this sense, there are several studies that use this theoretical approach to understand the kind of decision making and IT that

could be used as a starting point for more specific studies on OI [62], [97]. A multilevel approach combining individual and organizational levels would be an interesting avenue for future research.

Finally, the link between OI and organizational cognitive neuroscience would imply the incorporation of new methodologies enabling to overcome somehow the controversy around the use of primary data or panel data [7]. Specifically, neuroscience promotes the use of such tools as magnetic resonance, tomography, eye tracking, electroencephalograms, among others [25], [98]. In this sense, some studies have employed magnetic resonance to identify brain areas and the cognitive processes that are activated when exploration and exploitation decisions are made [68], as well as to understand the role of emotions in brand assessment [99] or in IT use [100]. All these works indicate that there is a paved road allowing to conduct more specific studies on OI and that it is needed to speed up the adoption of these tools in this field of study.

APPENDIX I  
SCALE ITEMS

<b>EC</b>	
EC1	The company creates spaces that encourage collaborators to experiment with their ideas.
EC2	The employees have the ability to understand the emotions of others.
EC3	The employees react emotionally in a similar and appropriate manner regarding the feelings of others.
EC4	The employees have the ability to capture the emotions and viewpoints of others from the gestures and signals of the social context.
EC5	The employees develop mechanisms to balance their emotional differences regarding a specific issue.
EC6	The employees have the ability to perceive the mood of others without the need of having direct contact with them.
EC7	The company has the ability to balance values towards which collaborators have opposing opinions.
<b>RACO</b>	
RACO1	The main competitors have made great investments in the acquisition of new knowledge.
RACO2	The main competitors can rapidly identify and acquire the information they need.
RACO3	The main competitors try to obtain new knowledge as soon as it is available.
RACO4	The main competitors constantly try to increase the amount of their information sources.
RACO5	The organizational practices of the main competitors allow the company to simultaneously use their new and existing capabilities.
RACO6	The main competitors are good at using new knowledge in their business operation.
<b>IP</b>	
P1	Product range extension through technologically new products in the last 3 years
P2	Product range extension through technologically improved products in the last 3 years
P3	The development of new product lines in the last 3 years
P4	The development of environmentally friendly products in the last 3 years
<b>OI Acquisition</b>	
OI acquisition 1	The company often acquires technological knowledge from external sources for its internal use.
OI acquisition 2	The company often seeks external ideas to enable value creation.
OI acquisition 3	The company proactively contacts external organizations to acquire technological knowledge and improve its products.
OI acquisition 4	The company tends to build a greater number of alliances with external actors and to trust their innovations.
<b>OI Exploitation</b>	
OI Exploitation 1	The company proactively manages the outflow of its knowledge.
OI Exploitation 2	The company has implemented formal practices to sell its technological knowledge and intellectual property in the market.
OI Exploitation 3	The company often exploits technological knowledge commercially and jointly with external organizations.



## REFERENCES

- [1] M. Bogers *et al.*, "The open innovation research landscape: Established perspectives and emerging themes across different," *Ind. Innov.*, vol. 24, no. 1, pp. 8–40, 2017.
- [2] M. Bogers, H. Chesbrough, and C. Moedas, "Open innovation: Research, practices, and policies," *Calif. Manage. Rev.*, vol. 60, no. 2, pp. 5–16, 2018.
- [3] H. Chesbrough and M. Bogers, "Explicating open innovation: Clarifying an emerging paradigm for understanding innovation," in *New Frontiers in Open Innovation*, H. Chesbrough, W. Vanhaverbeke, and J. West, Eds. Oxford, U.K.: Oxford Univ. Press, 2014, pp. 3–28.
- [4] V. van de Vrande, J. P. J. de Jong, W. Vanhaverbeke, and M. de Rochemont, "Open innovation in SMEs: Trends, motives and management challenges," *Technovation*, vol. 29, no. 6, pp. 423–437, 2009.
- [5] E. K. R. E. Huizingh, "Open innovation: State of the art and future perspectives," *Technovation*, vol. 31, no. 1, pp. 2–9, 2011.
- [6] S. Popa, P. Soto-Acosta, and I. Martinez-Conesa, "Antecedents, moderators, and outcomes of innovation climate and open innovation: An empirical study in SMEs," *Technol. Forecast. Soc. Change*, vol. 118, no. 1, pp. 134–142, 2017.
- [7] F. P. Hochleitner, A. Arbussa, and G. Coenders, "Inbound open innovation in SMEs: Indicators, non-financial outcomes and entry-timing," *Technol. Anal. Strategic Manage.*, vol. 29, no. 2, pp. 204–218, 2017.
- [8] S. Lee, G. Park, B. Yoon, and J. Park, "Open innovation in SMEs—An intermediated network model," *Res. Policy*, vol. 39, no. 2, pp. 290–300, 2010.
- [9] J. West and M. Bogers, "Leveraging external sources of innovation: A review of research on open innovation," *J. Prod. Innov. Manage.*, vol. 31, no. 4, pp. 814–831, 2014.
- [10] H. L. Forbes and D. Schaefer, "Crowdsourcing in product development: Current state and future research directions," in *Proc. Int. Des. Conf.*, 2018, pp. 581–588.
- [11] M. Greco, M. Grimaldi, and L. Cricelli, "Open innovation actions and innovation performance: A literature review of European empirical evidence," *Eur. J. Innov. Manage.*, vol. 18, no. 2, pp. 150–171, 2015.
- [12] F. Michelino, E. Lamberti, A. Cammarano, and M. Caputo, "Open innovation in the pharmaceutical industry: An empirical analysis on context features, internal R&D, and financial performances," *IEEE Trans. Eng. Manage.*, vol. 62, no. 3, pp. 421–435, Aug. 2015.
- [13] M. Hossain, "A review of literature on open innovation in small and medium-sized enterprises," *J. Global Entrepreneurship Res.*, vol. 5, no. 1, May 2015, Art. no. 6.
- [14] M. Inauen and A. Schenker-Wicki, "Fostering radical innovations with open innovation," *Eur. J. Innov. Manage.*, vol. 15, no. 2, pp. 212–231, Apr. 2012.
- [15] M. Bianchi, A. Croce, C. Dell'Era, C. A. Di Benedetto, and F. Frattini, "Organizing for inbound open innovation: How external consultants and a dedicated R&D unit influence product innovation performance," *J. Prod. Innov. Manage.*, vol. 33, no. 4, pp. 492–510, 2016.
- [16] X. Zhu, M. C. Dong, J. Gu, and W. Dou, "How do informal ties drive open innovation? The contingency role of market dynamism," *IEEE Trans. Eng. Manage.*, vol. 64, no. 2, pp. 208–219, May 2017.
- [17] G. Wang, X. Tian, Y. Hu, R. D. Evans, M. Tian, and R. Wang, "Manufacturing process innovation-oriented knowledge evaluation using MCDM and fuzzy linguistic computing in an open innovation environment," *Sustainability*, vol. 9, no. 9, pp. 1–19, 2017.
- [18] G. Santoro, D. Vrontis, A. Thrassou, and L. Dezi, "The internet of things: Building a knowledge management system for open innovation and knowledge management capacity," *Technol. Forecast. Soc. Change*, vol. 136, no. 1, pp. 347–354, 2018.
- [19] J. West, A. Salter, W. Vanhaverbeke, and H. Chesbrough, "Open innovation: The next decade," *Res. Policy*, vol. 43, no. 5, pp. 805–811, 2014.
- [20] P. Hurmelinna-Laukkanen and K. Puumalainen, "Innovation performance in the shadow of expropriability—Interplay of the appropriability regime and competitors' absorptive capacity," *Int. J. Innov. Technol. Manage.*, vol. 10, no. 1, pp. 1350002–1–1350002–22, 2013.
- [21] P. Hurmelinna-Laukkanen and H. Olander, "Coping with rivals' absorptive capacity in innovation activities," *Technovation*, vol. 34, no. 1, pp. 3–11, 2014.
- [22] M. Bengtsson, T. Raza-Ullah, and V. Vanyushyn, "The coopetition paradox and tension: The moderating role of coopetition capability," *Ind. Market. Manage.*, vol. 53, pp. 19–30, 2016.
- [23] A. L. de Araújo Burcharth, M. P. Knudsen, and H. A. Søndergaard, "Neither invented nor shared here: The impact and management of attitudes for the adoption of open innovation practices," *Technovation*, vol. 34, no. 3, pp. 149–161, 2014.
- [24] M. J. R. Butler, H. L. R. O'Broin, N. Lee, and C. Senior, "How organizational cognitive neuroscience can deepen understanding of managerial decision-making: A review of the recent literature and future directions," *Int. J. Manage. Rev.*, vol. 18, no. 4, pp. 542–559, 2016.
- [25] M. J. R. Butler, N. Lee, and C. Senior, "Critical essay: Organizational cognitive neuroscience drives theoretical progress, or: The curious case of the straw man murder," *Human Relat.*, vol. 70, no. 10, pp. 1171–1190, 2017.
- [26] T. H. Reus and Y. Liu, "Rhyme and reason: Emotional capability and the performance of knowledge-intensive work groups," *Human Perform.*, vol. 17, no. 2, pp. 245–266, Apr. 2004.
- [27] Q. N. Huy, "Emotional capability, emotional intelligence, and radical change," *Acad. Manage. Rev.*, vol. 24, no. 2, pp. 325–345, 1999.
- [28] Q. N. Huy, "Emotions in strategic organization: Opportunities for impactful research," *Strategic Org.*, vol. 10, no. 3, pp. 240–247, 2012.
- [29] A. E. Akgün, H. Keskin, and J. Byrne, "Organizational emotional capability, product and process innovation, and firm performance: An empirical analysis," *J. Eng. Technol. Manage.*, vol. 26, no. 3, pp. 103–130, 2009.
- [30] Q. N. Huy, K. G. Corley, and M. S. Kraatz, "From support to mutiny: Shifting legitimacy judgments and emotional reactions impacting the implementation of radical change," *Acad. Manage. J.*, vol. 57, no. 6, pp. 1650–1680, 2014.
- [31] K. Matzler, B. Uzelac, and F. Bauer, "The role of intuition and deliberation for exploration and exploitation success," *Creat. Innov. Manage.*, vol. 23, no. 3, pp. 252–263, 2014.
- [32] C. von Koskull, T. Strandvik, and B. Tronvoll, "Emotional strategizing in service innovation," *Manage. Decis.*, vol. 54, no. 2, pp. 270–287, 2016.
- [33] P. Ritala and P. Hurmelinna-Laukkanen, "Dynamics of cooperative value creation and appropriation," in *The Routledge Companion to Coopetition Strategies*, A.-S. Fernandez, P. Chiambaretto, and W. Czakon, Eds. Evanston, IL, USA: Routledge, 2018, pp. 58–67.
- [34] J. Frishammar, U. Lichtenthaler, and J. Rundquist, "Identifying technology commercialization opportunities: The importance of integrating product development knowledge," *J. Prod. Innov. Manage.*, vol. 29, no. 4, pp. 573–589, 2012.
- [35] K.-P. Hung and C. Chou, "The impact of open innovation on firm performance: The moderating effects of internal R&D and environmental turbulence," *Technovation*, vol. 33, no. 10, pp. 368–380, 2013.
- [36] J. Alegre, R. Lapiedra, and R. Chiva, "A measurement scale for product innovation performance," *Eur. J. Innov. Manage.*, vol. 9, no. 4, pp. 333–346, 2006.
- [37] P. Sok and A. O' Cass, "Achieving superior innovation-based performance outcomes in SMEs through innovation resource–capability complementarity," *Ind. Market. Manage.*, vol. 40, no. 8, pp. 1285–1293, 2011.
- [38] P. Hurmelinna-Laukkanen, "Constituents and outcomes of absorptive capacity—appropriability regime changing the game," *Manage. Decis.*, vol. 50, no. 7, pp. 1178–1199, 2012.
- [39] R. B. Bouncken and S. Kraus, "Innovation in knowledge-intensive industries: The double-edged sword of coopetition," *J. Bus. Res.*, vol. 66, no. 10, pp. 2060–2070, 2013.
- [40] S. Brunswicker and W. Vanhaverbeke, "Open innovation in small and medium-sized enterprises (SMEs): External knowledge sourcing strategies and internal organizational facilitators," *J. Small Bus. Manage.*, vol. 53, no. 4, pp. 1241–1263, 2015.
- [41] V. Parida, M. Westerberg, and J. Frishammar, "Inbound open innovation activities in high-tech SMEs: The impact on innovation performance," *J. Small Bus. Manage.*, vol. 50, no. 2, pp. 283–309, 2012.
- [42] R. S. Reid, W. Keogh, N. Mitchell, and R. McAdam, "Implementing innovation management in manufacturing SMEs: A longitudinal study," *J. Small Bus. Enterprise Develop.*, vol. 14, no. 3, pp. 385–403, Aug. 2007.
- [43] A. Kaufmann and F. Tödting, "How effective is innovation support for SMEs? An analysis of the region of Upper Austria," *Technovation*, vol. 22, no. 3, pp. 147–159, 2002.
- [44] P. R. Walsh, "Innovation nirvana or innovation wasteland? Identifying commercialization strategies for small and medium renewable energy enterprises," *Technovation*, vol. 32, no. 1, pp. 32–42, 2012.
- [45] D. Libaers, D. Hicks, and A. L. Portery, "A taxonomy of small firm technology commercialization," *Ind. Corporate Change*, vol. 25, no. 3, pp. 371–405, 2016.

- [46] P. van Hemert, P. Nijkamp, and E. Masurel, "From innovation to commercialization through networks and agglomerations: Analysis of sources of innovation, innovation capabilities and performance of Dutch SMEs," *Ann. Regional Sci.*, vol. 50, no. 2, pp. 425–452, 2013.
- [47] P. Chiambaretto, C. Gurău, and F. Le Roy, "Coopetitive branding: Definition, typology, benefits and risks," *Ind. Market. Manage.*, vol. 57, pp. 86–96, 2016.
- [48] T. Veer, A. Lorenz, and K. Blind, "How open is too open? The mitigating role of appropriation mechanisms in R&D cooperation settings," *R&D Manage.*, vol. 46, no. S3, pp. 1113–1128, 2016.
- [49] A. Tidström, "Managing tensions in coopetition," *Ind. Market. Manage.*, vol. 43, no. 2, pp. 261–271, 2014.
- [50] J. Wu, "Cooperation with competitors and product innovation: Moderating effects of technological capability and alliances with universities," *Ind. Market. Manage.*, vol. 43, no. 2, pp. 199–209, 2014.
- [51] K. Laursen and A. J. Salter, "The paradox of openness: Appropriability, external search and collaboration," *Res. Policy*, vol. 43, no. 5, pp. 867–878, 2014.
- [52] J. Frishammar, K. Ericsson, and P. C. Patel, "The dark side of knowledge transfer: Exploring knowledge leakage in joint R&D projects," *Technovation*, vol. 41/42, pp. 75–88, 2015.
- [53] A.-S. Fernandez and P. Chiambaretto, "Managing tensions related to information in coopetition," *Ind. Market. Manage.*, vol. 53, pp. 66–76, 2016.
- [54] L. Agostini, A. Nosella, and B. Soranzo, "The impact of formal and informal appropriability regimes on SME profitability in medium high-tech industries," *Technol. Anal. Strategic Manage.*, vol. 27, no. 4, pp. 405–419, 2015.
- [55] A. Bechara, "The role of emotion in decision-making: Evidence from neurological patients with orbitofrontal damage," *Brain Cogn.*, vol. 55, no. 1, pp. 30–40, 2004.
- [56] N. Naqvi, B. Shiv, and A. Bechara, "The role of emotion in decision making: A cognitive neuroscience perspective," *Curr. Dir. Psychol. Sci.*, vol. 15, no. 5, pp. 260–264, Oct. 2006.
- [57] M. D. Lieberman, "Social cognitive neuroscience: A review of core processes," *Annu. Rev. Psychol.*, vol. 58, pp. 259–289, 2007.
- [58] J. S. Lerner, Y. Li, P. Valdesolo, and K. S. Kassam, "Emotion and decision making," *Annu. Rev. Psychol.*, vol. 66, no. 1, pp. 799–823, Jan. 2015.
- [59] C. Akinci and E. Sadler-Smith, "Intuition in management research: A historical review," *Int. J. Manage. Rev.*, vol. 14, no. 1, pp. 104–122, Jun. 2012.
- [60] E. A. Phelps, K. M. Lempert, and P. Sokol-Hessner, "Emotion and decision making: Multiple modulatory neural circuits," *Annu. Rev. Neurosci.*, vol. 37, no. 1, pp. 263–287, Jul. 2014.
- [61] G. P. Hodgkinson and M. P. Healey, "Psychological foundations of dynamic capabilities: Reflexion and reflection in strategic management," *Strategic Manage. J.*, vol. 32, no. 13, pp. 1500–1516, 2011.
- [62] L. Sayegh, W. P. Anthony, and P. L. Perrewé, "Managerial decision-making under crisis: The role of emotion in an intuitive decision process," *Hum. Resour. Manage. Rev.*, vol. 14, no. 2, pp. 179–199, 2004.
- [63] H. A. Elfenbein, "7 emotion in organizations," *Acad. Manage. Ann.*, vol. 1, no. 1, pp. 315–386, Dec. 2007.
- [64] G. P. Hodgkinson, "Reflections on the interplay between cognition, action and outcomes in industries and business markets: What have we learned so far and where might we go next?" *Ind. Market. Manage.*, vol. 48, no. 1, pp. 12–25, 2015.
- [65] K. Eling, F. Langerak, and A. Griffin, "The performance effects of combining rationality and intuition in making early new product idea evaluation decisions," *Creat. Innov. Manage.*, vol. 24, no. 3, pp. 464–477, Aug. 2015.
- [66] U. Lichtenthaler and H. Ernst, "Attitudes to externally organising knowledge management tasks: A review, reconsideration and extension of the NIH syndrome," *R&D Manage.*, vol. 36, no. 4, pp. 367–386, Sep. 2006.
- [67] J. Arias-Pérez, G. Perdomo-Charry, and C. Castaño-Ríos, "Not-invented-here syndrome and innovation performance: The confounding effect of innovation capabilities as organisational routines in service firms," *Int. J. Innov. Manage.*, vol. 21, no. 1, Nov. 2017, Art. no. 1750036.
- [68] D. Laureiro-Martínez, S. Brusoni, N. Canessa, and M. Zollo, "Understanding the exploration-exploitation dilemma: An fMRI study of attention control and decision-making performance," *Strategic Manage. J.*, vol. 36, no. 3, pp. 319–338, Dec. 2013.
- [69] T. Raza-Ullah, M. Bengtsson, and S. Kock, "The coopetition paradox and tension in coopetition at multiple levels," *Ind. Market. Manage.*, vol. 43, no. 2, pp. 189–198, 2014.
- [70] A. E. Akgün, H. Keskin, J. C. Byrne, and S. Aren, "Emotional and learning capability and their impact on product innovativeness and firm performance," *Technovation*, vol. 27, no. 9, pp. 501–513, 2007.
- [71] G. P. Hodgkinson and M. P. Healey, "Coming in from the cold: The psychological foundations of radical innovation revisited," *Ind. Market. Manage.*, vol. 43, no. 8, pp. 1306–1313, 2014.
- [72] Q. N. Huy, "An emotion-based view of strategic renewal," in *Strategy Process (Advances in Strategic Management, Volume 22)*, S. Gabriel, P. Joe, and D. Yves, Eds. Bingley, U.K.: Emerald Group Publishing Limited, 2005, pp. 3–37.
- [73] P. S. Adler and D. Obstfeld, "The role of affect in creative projects and exploratory search," *Ind. Corporate Change*, vol. 16, no. 1, pp. 19–50, Feb. 2007.
- [74] 'High-Technology' and 'Knowledge Based Services' Aggregations Based on NACE Rev. 2, Eurostat, Luxembourg, 2009.
- [75] R. E. Hoskisson, L. Eden, C. M. Lau, and M. Wright, "Strategy in emerging economies," *Acad. Manage. J.*, vol. 43, no. 3, pp. 249–267, 2000.
- [76] F. Castellacci, "Closing the technology gap?" *Rev. Develop. Econ.*, vol. 15, no. 1, pp. 180–197, 2011.
- [77] S. Dutta, B. Lanvin, and S. Wunsch-Vincent, *Global Innovation Index 2018: Energizing the World With Innovation*. Ithaca, New York, USA: Cornell Univ., 2018.
- [78] *Survey of Development and Technological Innovation in the Colombian Manufacturing Industry—EDIT VI 2011-2012*, DANE, Bogotá, Colombia, 2013.
- [79] J. Cohen, "A power primer," *Psychol. Bull.*, vol. 112, no. 1, pp. 155–159, 1992.
- [80] J. Alegre, K. Sengupta, and R. Lapiedra, "Knowledge management and innovation performance in a high-tech SMEs industry," *Int. Small Bus. J.*, vol. 31, no. 4, pp. 454–470, Oct. 2013.
- [81] T. K. Dijkstra and J. Henseler, "Consistent partial least squares path modeling," *MIS Quart.*, vol. 39, no. 2, pp. 297–316, 2015.
- [82] J. F. Hair Jr., G. T. M. Hult, C. Ringle, and M. Sarstedt, *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Los Angeles, CA, USA: Sage, 2017.
- [83] C. Fornell and D. F. Larcker, "Evaluating structural equation models with unobservable variables and measurement error," *J. Market. Res.*, vol. 18, no. 1, pp. 39–50, 1981.
- [84] J. Henseler, C. M. Ringle, and M. Sarstedt, "A new criterion for assessing discriminant validity in variance-based structural equation modeling," *J. Acad. Market. Sci.*, vol. 43, no. 1, pp. 115–135, 2015.
- [85] P. M. Podsakoff and D. W. Organ, "Self-reports in organizational research: Problems and prospects," *J. Manage.*, vol. 12, no. 4, pp. 531–544, Dec. 1986.
- [86] J. Henseler, C. M. Ringle, and R. R. Sinkovics, "The use of partial least squares path modeling in international marketing," in *New Challenges to International Marketing*, vol. 20, R. R. Sinkovics and G. Pervez, Eds. Bingley, U.K.: Emerald Group Publishing Limited, 2009, pp. 277–319.
- [87] J. Henseler, P. A. Ray, and G. Hubona, "Using PLS path modeling in new technology research: Updated guidelines," *Ind. Manage. Data Syst.*, vol. 116, no. 1, pp. 2–20, Jan. 2016.
- [88] R. Falk and N. B. Miller, *A Primer for Soft Modeling*. Akron, OH, USA: Univ. Akron, 1992.
- [89] J. Puleston, "Association of survey computing (ASC) conference, Royal Statistical Society, London, 20 November, 2015: 'Tackling data overload: making sense of complex multi-source data,'" *Int. J. Market. Res.*, vol. 58, no. 1, pp. 141–152, Jan. 2016.
- [90] O. Gassmann, E. Enkel, and H. Chesbrough, "The future of open innovation," *R&D Manage.*, vol. 40, no. 3, pp. 213–221, May 2010.
- [91] J. Cepeda and J. Arias-Pérez, "Information technology capabilities and organizational agility: The mediating effects of open innovation capabilities," *Multinatl. Bus. Rev.*, vol. 27, pp. 198–216, Aug. 2018.
- [92] T. Xia and S. Roper, "Unpacking open innovation: Absorptive capacity, exploratory and exploitative openness, and the growth of entrepreneurial biopharmaceutical firms," *J. Small Bus. Manage.*, vol. 54, no. 3, pp. 931–952, Feb. 2016.
- [93] T. Cui, H. Ye, H. H. Teo, and J. Li, "Information technology and open innovation: A strategic alignment perspective," *Inf. Manage.*, vol. 52, no. 3, pp. 348–358, 2015.

- [94] S. Akter, S. F. Wamba, A. Gunasekaran, R. Dubey, and S. J. Childe, "How to improve firm performance using big data analytics capability and business strategy alignment?" *Int. J. Prod. Econ.*, vol. 182, pp. 113–131, 2016.
- [95] C. López-Nicolás and Á. Meroño-Cerdán, "Strategic knowledge management, innovation and performance," *Int. J. Inf. Manage.*, vol. 31, no. 6, pp. 502–509, 2011.
- [96] P. Ritala, H. Olander, S. Michailova, and K. Husted, "Knowledge sharing, knowledge leaking and relative innovation performance: An empirical study," *Technovation*, vol. 35, pp. 22–31, 2015.
- [97] A. Beaudry and A. Pinsonneault, "The other side of acceptance: Studying the direct and indirect effects of emotions on information technology use," *MIS Quart.*, vol. 34, no. 4, pp. 689–710, 2010.
- [98] A. Dimoka *et al.*, "On the use of neurophysiological tools in is research: Developing a research agenda for neurois," *MIS Quart.*, vol. 36, no. 3, pp. 679–702, 2012.
- [99] T. Bakalash and H. Riemer, "Exploring Ad-elicited emotional arousal and memory for the Ad using fMRI," *J. Advertising*, vol. 42, no. 4, pp. 275–291, Oct. 2013.
- [100] S. Gregor, A. C. H. Lin, T. Gedeon, A. Riaz, and D. Zhu, "Neuroscience and a nomological network for the understanding and assessment of emotions in information systems research," *J. Manage. Inf. Syst.*, vol. 30, no. 4, pp. 13–48, Apr. 2014.