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# The interplay of leadership, absorptive capacity, and organizational learning culture in open innovation: Testing a moderated mediation model

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## ABSTRACT

Researchers have used several constructs to explain the success and failure of organizations' open innovation initiatives. Building upon the resource-based view of the firm, we develop a model to explain how leadership interacts with absorptive capacity and organizational learning culture to influence open innovation outcomes. The model is tested empirically using data sourced from managers working in diverse sectors in India. Results reveal that empowering leadership leads to enhanced open innovation outcomes through the intervention of organizational learning culture. Results, however, do not confirm a significant impact of the interaction of organizational culture and absorptive capacity on open innovation. A discussion of these findings along with implications for theory and practice is presented.

## 1. Introduction

Open innovation continues to be a favorite research area in the strategic management domain (Elmquist et al., 2009). While open innovation research has focused on identifying the factors that foster or impede open innovation (Naqshbandi et al., 2015), several aspects of open innovation management still remain under-studied (West and Bogers, 2017). Dahlander and Gann (2010) pointed out that as the emergence of open innovation models challenges firms to move past their traditional innovation paradigms, institutions would need to adopt more contemporary approaches to innovation management. Hence, shifting to modern modes of innovation invites firms to a corresponding shift in their leadership models from traditional to the contemporary (Robbins and O'Gorman, 2015).

Contingency leadership theory posits that the leadership style adopted is contingent on a firm's circumstances and set performance targets (Graeff, 1983; Sims et al., 2009). In this regard, the traditional leadership styles and their association with innovation has been the focus of several studies (Jung et al., 2003). Certain leadership styles, such as transactional leadership, directive leadership, and aversive leadership have been found to act as barriers to innovation (Avolio et al., 1999; Podsakoff et al., 2006; Sims et al., 2009). This is because these leadership styles are characterized by control, compliance, low flexibility and low innovation among employees (Sims et al., 2009), hence creating impetus for the identification of an appropriate leadership style that can foster open innovation success (Von Krogh and Von Hippel, 2003).

As open innovation deals with the inflows (inbound open innovation) and the outflows (outbound open innovation) of knowledge that involve knowledge exploration and exploitation (Xia and Roper, 2016), it requires human capital that is capable of selecting, acquiring, transforming and utilizing knowledge for innovative purposes (Tirabeni et al., 2015). Hence, open innovation requires leaders who can effectively manage human capital (Lee and Cole, 2003; Lerner and Tirole, 2001). This is possible when leaders encourage followers to participate in knowledge-based activities (Whelan et al., 2011). Additionally, in order to promote open innovation, leaders are required to trust and encourage followers to participate in innovative activities (Fleming and Waguespack, 2005). A leadership style characterized by encouragement and trust in followers to participate in innovative activities is termed as empowering leadership (Arnold et al., 2000; Sims et al., 2009; Zhang and Bartol, 2010). West and Bogers (2017) contend that the open innovation activity of an organization is interpreted, decided, and implemented by its employees. In this context, empowering leadership fosters creativity and flexibility among followers, resulting in "very high innovation" through followers' development and self-confidence (Sims et al., 2009). As empowerment is one of the crucial factors for achieving innovative outcomes (Sok and O'Casey, 2015), the first objective of this study is to examine the role of empowering leadership in open innovation success. Existing studies support the view that empowering leadership promotes innovation, however, an extant review of the literature indicates that not much is known about the role of leadership in promoting open innovation. This is particularly important since the role of leadership in open innovation is expected to differ from

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its role in the closed innovation paradigm. The leadership in the open innovation paradigm is expected to not only use the knowledge of people working in their company but also of those working in other companies. Similarly, in the open innovation model, the leadership must recognize the value of external R&D, identify best external ideas and research and control profits by creating contracts with other external entities.

In addition to examining the direct relationship between empowering leadership and open innovation, this study also proposes a mediating mechanism through which empowering leadership influences open innovation. Extant literature has highlighted mediating variables that intervene the relationship of leadership and innovation, however, the mediating mechanism of how empowering leadership will influence open innovation is yet to be explored. Past studies argue that leaders encourage followers to build and maintain a sense of community (Fleming and Waguespack, 2005), which helps them in developing knowledge-based networks where members can exchange knowledge with each other (Whelan et al. (2011). Recent research (e.g. Kratzer et al., 2017) has shown that innovation takes place in an institutional environment characterized by rules and regulations that might support or impede innovation. Since the open innovation paradigm relies on external relationships for innovation, an appropriate internal environment is a must before building relationships with external partners. Building such an internal environment can be a direct result of a leader's action. Against this backdrop, empowering leaders are known to create a culture in the firm where knowledge exploration and exploitation is encouraged (Jönsson et al., 2015). Such a culture where members have shared norms of exchanging knowledge and ideas with each other, one that promotes knowledge exploration and exploitation, is termed learning culture (Bierly and Daly, 2002; Lee and Choi, 2003; Lee and Cole, 2003; Yang, 2007b). In view of this, the second objective of this paper is to examine the mediating role of organizational learning culture in empowering leadership-open innovation relationship.

Furthermore, while a learning organizational culture promotes knowledge inflows and outflows (Lee and Choi, 2003), a firm's open innovation performance relies on its ability to explore and exploit knowledge (Naqshbandi, 2016), also known as absorptive capacity (Zahra and George, 2002). Past literature suggests that absorptive capacity is often a precondition for open innovation success (Kokshagina et al., 2017) and that firms are likely to develop a better understanding of their knowledge resources and commercialize them in the presence of higher levels of absorptive capacity (Carayannis, 2012). As a result, this study argues that a firm with a learning organizational culture is in a better position to enhance its open innovation outcomes when it has the capability to explore and exploit the relevant knowledge and resources (i.e. it possesses absorptive capacity). Firms with a suitable open innovation culture that are incapable of sourcing, acquiring, transforming and utilizing the knowledge may be unable to achieve success in open innovation. Hence, the third objective of this study is to examine the moderating role of absorptive capacity in the relationship between organizational learning culture and open innovation.

The rest of the papers unfolds as follows: the second section presents background and hypothesis development; the third section presents the methodology used. This section is followed by hypothesis testing and a discussion of the findings. The last section highlights the theoretical and practical contributions of the paper along with limitations and future research directions.

## 2. Background and hypothesis development

### 2.1. Empowering leadership and inbound open innovation

Inbound open innovation involves firms to source, evaluate, acquire and integrate knowledge into their internal systems and processes (Gassmann and Enkel, 2004). This process requires competent and proficient leaders with appropriate expertise to identify and determine

which potential knowledge sources are to be acquired and experimented with in order to effectively meet the firm's innovative strategies (Dahlander and Gann, 2010). Hence, firms require experts who are knowledgeable, motivated, confident and authorized to generate new knowledge and make decisions regarding its acquisition and use.

Past studies advocate that leaders play a critical role in shaping their subordinates' motivation to accomplish set tasks (Ribiere and Sitar, 2003). This also applies to inbound open innovation whereby leaders are expected to support their followers to create and acquire new ideas and integrate them with the firm's internal systems and processes. Of the various leadership styles, empowering leadership is known to instill confidence and trust in followers, encourage them to apply participative decision making and motivate them to perform better (Arnold et al., 2000; Zhang and Bartol, 2010). Empowering leadership is characterized by features that stimulate followers to explore innovative ideas, including leading by example, participative decision making, coaching, informing and showing concern for the members (Arnold et al., 2000). Such a leadership develops a vision and clarifies the contributions that followers are expected to make to align organizational efforts with strategic goals (Conger and Kanungo, 1988). This, in turn, instills confidence in followers and engages them in knowledge-based activities that contribute to accomplishing organizational goals. Moreover, participative decision making by leaders allows followers to share their ideas and collaborate with each other, which in turn promotes effective knowledge flows (Singh, 2008). Additionally, leaders encourage the pursuit of knowledge activities by providing recognition and rewards to knowledge workers (Rosen et al., 2007). Hence, by empowering the followers, leaders promote the creation and internalization of knowledge (Burke et al., 2006; Nonaka and Takeuchi, 1995; Yang, 2007b), which consequently promotes innovation (Gagné, 2009). In this way, leaders empower the followers to develop and acquire new ideas by exemplifying, by motivating through rewards and incentives, by clarifying the role expectations and by allowing the followers to make decisions on their own (Nonaka and Takeuchi, 1995; Rosen et al., 2007; Singh, 2008; Yang, 2007a).

Hence empowering leadership fosters a trusting environment. Such an environment enables followers from various functional departments to communicate effectively to understand market trends, evaluate the external market opportunities constructively and collaboratively, and appraise the expected benefits likely to be brought about by acquiring external knowledge (Bligh, 2017). A trusting environment also extends the followers' ability to incorporate external knowledge and integrate it successfully into organizational processes (Burke et al., 2006). Empowerment also means that the organizational culture allows its employees to take risks (Bligh, 2017), and has tolerance for failures (Manso, 2017); an important requisite for innovation. Several studies have shown that empowerment and trust positively affect innovation capability on both the individual and firm levels (Çakar and Ertürk, 2010; Ertürk, 2012). Khazanchi et al. (2007) stated that innovation requires flexibility, empowerment, control and efficiency, all at the same time. The empowering leadership style fosters an enabling culture together with appropriate structures and systems which results in favorable organizational outcomes (Ugwu et al., 2014). Based on the above discussion, it is inferred that empowering leaders facilitate the acquisition and creation of knowledge that promotes inbound open innovation in firms. This leads to the following hypothesis:

**H1.** Empowering leadership is positively associated with inbound open innovation.

### 2.2. Empowering leadership and outbound open innovation

Outbound open innovation refers to the exploitation of knowledge which allows firms to diffuse, utilize and transform knowledge for commercialization purposes (Chesbrough, 2003). To do this effectively, firms need to pay attention to the management and utilization modes of

relevant ideas (DeCarolis and Deeds, 1999), and the encouragement of employees to implement new ideas and create innovative products. This is possible under the supervision of empowering leaders, who are willing to repose their trust and confidence in their followers, and allow them to explore all possible options required for innovation (Haas and Hansen, 2005). Needless to say that a leader's vision to achieve a firm's objectives must be made clear to followers as doing so acts as a guide for the employees, motivating them to align their efforts with the organizational objectives.

Past studies advocate that empowering leaders enable followers to exploit new ideas through experimentation even when such pursuits appear risky (Williams and Sullivan, 2011). In supporting innovative ideas and solutions, leaders exemplify the desired risk-taking behavior associated with the implementation of new ideas and technology. Additionally, leaders promote these knowledge-based activities by allowing employees to participate in decision-making based on their knowledge and experience and without the direct intervention of leaders (Jung et al., 2008). Empowering leaders also appreciate their followers for making such decisions by role modelling (Haas and Hansen, 2005; Jung et al., 2008) and by acknowledging, recognizing and rewarding followers' activities that exhibit effective utilization of knowledge resources (Chang et al., 2012; Williams and Sullivan, 2011).

Based on these arguments, it is inferred that empowering leaders increase their followers' proactivity and autonomy (Martin et al., 2013; Xue et al., 2011; Yin et al., 2017) and trust their followers' commercial, technical and legal abilities (Bligh, 2017), i.e. the task proficiency to market, brand and bundle internally-produced knowledge effectively in the external market. Such activities usually strengthen the firm's strategic position and ensure optimal alignment of its resources with the objectives. This, in turn, results in the effective management of knowledge outflow, thereby promoting outbound open innovation. This discussion leads to the following hypothesis:

**H2.** Empowering leadership is positively associated with outbound open innovation.

### 2.3. *The mediating role of organizational learning culture in the association between empowering leadership and (inbound and outbound) open innovation*

Leaders shape the culture of firms through their decisions (Reinmoeller, 2004). Given the characteristics of empowering leaders, the aspects of this leadership style can promote an organizational culture that supports learning, innovation and experimentation, and the transfer and sharing of new knowledge (Pan and Scarbrough, 1999). By being a role model, the empowering leaders can set examples for followers to generate, acquire and share knowledge (Xue et al., 2011). This can create an innovation-supportive environment in which members are free to share, acquire and exchange ideas from each other and from external sources. The empowering leaders also coach the followers to find solutions to problems collaboratively (Arnold et al., 2000) which helps in developing a sense of harmony and a collective identity among members. Empowering leaders further complement this through appreciation and reward for collaborative activities. Such leaders clarify the followers' role expectations and through an effective reward system uplift the intrinsic and extrinsic motivation of the followers. These measures are likely to stimulate the followers to acquire, learn and share knowledge with other organizational members, which creates an environment where learning is the key element (Rosen et al., 2007). Similarly, by delegating decision-making authority empowering leadership allows the followers to experiment with new ideas and knowledge. Xue et al. (2011) argued that when the employees are empowered to make decisions, they are more likely to acquire adequate knowledge in order to make justifiable decisions, which in turn enhances individual learning.

Studies have shown that leaders who empower their followers to

create and apply new knowledge, and who provide an organizational culture that is conducive to knowledge acquisition, creation and sharing (Pan and Scarbrough, 1999; Rijal, 2016), achieve more effective utilization of knowledge resources, and consequently, enhance innovative, operational and financial performance (Mazur and Zaborek, 2016). Therefore, based on these arguments it is inferred that empowering leadership promotes a learning culture in firms, which allows for effective utilization and generation of new knowledge (Nonaka and Takeuchi, 1995; Woodman et al., 1993). Firms with such a culture are also effective in knowledge acquisition and exchange, which are influential factors in supporting and shaping innovation (Janz and Prasarnphanich, 2003). This view is supported by recent empirical open innovation research which shows that a favorable organizational culture positively affects open innovation outcomes (Naqshbandi et al., 2015). Many past studies have also corroborated the view that positive cultural characteristics can help an organization innovate and that culture could enhance or inhibit innovation (Ahmed, 1998). From a practitioner's view-point, Phillips (2007) reached the same conclusion suggesting that a favorable organizational culture can support innovation. In sum, the above arguments show that empowering leadership facilitates the development of an organizational learning culture that consequently promotes open innovation. This suggests an intervening role of learning culture in the association of empowering leadership and open innovation. Hence, the following hypotheses are formulated:

**H3.** Organizational learning culture mediates the association between empowering leadership and inbound open innovation.

**H4.** Organizational learning culture mediates the association between empowering leadership and outbound open innovation.

### 2.4. *The moderating role of absorptive capacity in the association between organizational learning culture and inbound open innovation*

Past studies suggest that an organizational culture shapes the innovation outcomes of firms (David and Fahey, 2000). A firm's learning culture appreciates the creation, diffusion, and internalization of new ideas among its members, and thus, supports the development of its members, and facilitates the creation and sourcing of ideas and knowledge exploration in firms (Lee and Choi, 2003). Therefore, an organizational culture that supports learning facilitates inbound open innovation. This is widely documented in recent literature on open innovation (c.f. Kaur et al., 2014; Kratzer et al., 2017; Naqshbandi and Kamel, 2017; Van de Vrande et al., 2009). At the same time, however, the firms that effectively promote learning depend on their capability to explore and recognize the value of new external knowledge, and then exploit, assimilate and apply it commercially (Cohen and Levinthal, 1990). This capability of a firm, known as absorptive capacity (Zahra and George, 2002), is crucial for sourcing and acquiring knowledge for innovation (Liao et al., 2007). A number of recent studies have highlighted the role of absorptive capacity in open innovation success. For instance, (Rangus et al., 2017) showed empirically how absorptive capacity of an organization interacted with its capacity for open innovation in order to achieve the desired firm's performance. Along similar lines, Xia and Roper (2016) showed, based on a survey conducted in several European countries and the USA, that participation in exploitative relationships in the open innovation model is more conditional on firms' absorptive capacity. Similarly, effective knowledge absorption capabilities of a firm are known to be of vital importance in open innovation effectiveness (Huang and Rice, 2009). Spithoven et al. (2010) focused on SMEs and firms in traditional industries and the role of collective research centres in building absorptive capacity at the inter-organizational level and underscored absorptive capacity as a precondition to open innovation. Along similar lines, Gambardella (1992) noted that the firms with better in-house R&D programs were more efficient in exploiting external knowledge, suggesting the role of

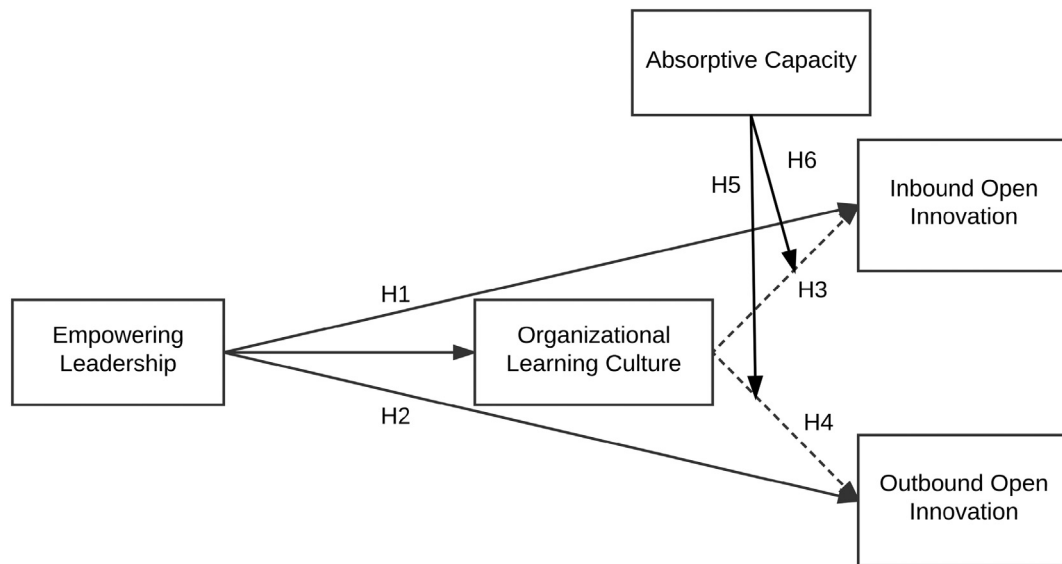


Fig. 1. Theoretical framework.

internal firm resources such as absorptive capacity.

The above body of research suggests that firms which promote a learning culture - to source, acquire, create and internalize knowledge - are conditioned by their ability to explore and exploit knowledge resources (Harrington and Guimaraes, 2005). Therefore, an organization's learning culture interacts with its ability to explore and exploit the knowledge to achieve effective sourcing and exploitation of knowledge resources. Therefore, the interaction between absorptive capacity and organizational learning culture has a significant effect on an organization's knowledge inflows. The characteristics of the organizational learning culture such as knowledge acquisition, diffusion and sharing are likely to be complemented by higher levels of absorptive capacity such that firms with higher absorptive capacity are better able to source, acquire and internalize new knowledge. In other words, it can be inferred that the interaction of a firm's learning culture with its absorptive capacity results in enhanced inbound open innovation outcomes. This leads to the following hypothesis:

**H5.** Absorptive capacity moderates the relation between organizational learning culture and inbound open innovation; such that the relationship is stronger under higher levels of absorptive capacity.

### 2.5. The moderating role of absorptive capacity in the association between organizational learning culture and outbound open innovation

Bates and Khasawneh (2005) showed that a firm's learning culture promotes innovation. Other studies have highlighted that an organizational culture that encourages knowledge sharing among its members and supports the implementation of new ideas, supports effective utilization of knowledge for commercialization (Naqshbandi and Kamel, 2017). However, in order to attain positive innovation outcomes, an organizational learning culture needs to be supported by a firm's capability to explore and exploit the knowledge (Templeton et al., 2002; Zollo and Winter, 2002). Therefore, given a firm's learning culture, it is inferred that its absorptive capacity will result in enhanced outbound open innovation outcomes (de Araújo Burcharth et al., 2014). Higher levels of absorptive capacity will promote a firm's ability to develop a better appreciation and use of knowledge resources and their commercialization (Carayannis, 2012). In other words, absorptive capacity will support a firm's ability in taking advantage of its learning culture to

apply and commercialize its knowledge resources in the external markets. This will strengthen a firm supported by its learning culture to achieve enhanced outbound open innovation outcomes. This suggests that firms with higher levels of absorptive capacity supported by an organizational learning culture achieve enhanced outbound open innovation outcomes than those firms with lower levels of absorptive capacity. This provides support for the following hypothesis:

**H6.** Absorptive capacity moderates the relation between organizational learning culture and outbound open innovation; such that the relationship is stronger under higher levels of absorptive capacity (Fig. 1).

## 3. Methods and materials

### 3.1. Sample and procedures

The data for this study were collected in India, where the government has adopted innovation-led growth and entrepreneurship development as some of the mechanisms to create more jobs and accelerate economic growth (Abhyankar, 2014). The data were collected from middle and top managers working in various firms in the manufacturing and service sectors in the North Indian states of Punjab, Haryana, Delhi and Chandigarh (UT). Service firms included those operating in banking, insurance, healthcare, shipping, information technology and telecommunication, while the manufacturing firms included automobile, textile and other industries. While engagement in open innovation is typically expected in the manufacturing sector (Van de Vrande et al., 2009), we chose both the manufacturing and the service sectors in this study since open innovation is increasingly being adopted in the service sector as well (Virlee et al., 2015).

The data were collected over a period of four months, from January–April 2017. We followed a two-stage sampling procedure. The first step started with stratified sampling whereby various service and manufacturing industries were identified. In the next step, firms within the service and the manufacturing industries were selected randomly. The sampling frame for this research was the companies listed in the National Stock Exchange (NSE 500) directory. The selected firms were contacted by telephone and email for help in data collection. Appointments were also sought which necessitated over 50 visits to



firms for questionnaire distribution and/or for clarifications on the survey. We also used an online version of the questionnaire for the respondents who preferred it. Telephonic follow-ups were made two weeks after the initial contact. A total of 450 questionnaires were distributed of which 160 questionnaires were returned; 102 through online responses and 58 in person. This represented a response rate of 35.56%. Of the ones returned in person, five questionnaires were discarded since they had > 10% missing values (Hair et al., 2010), leaving a total of 155 usable responses. All the responses received online were valid since response submission was not allowed until all the items were answered.

Seventy-seven percent of respondents worked in the service industry while 23% were in the manufacturing sector. Most (81.9%) of the surveyed firms were privately-owned while 18.1% had mixed ownership. 39.4% of the respondents occupied top management positions while 60.6% held middle management positions. Most respondents knew their organizations well as 92.3% had worked in their 'current' organization for up to 10 years while 7.7% had served for > 10 years. 86.5% of the firms had an R&D department. Most (61.9%) of the firms focused mostly on the global markets while 38.1% focused on either local or regional markets.

### 3.2. Measurements

Inbound open innovation was measured with a 6-item scale developed by Sisodiya (2008). A sample item is: "My organization actively seeks out external sources of knowledge and when developing new products". Outbound open innovation was measured using a 4-item scale (Jaworski and Kohli, 1993; Lichtenthaler, 2009). A sample item is: "Generally, in my organization all technologies are externally commercialized". For organizational learning culture, a 7-item scale developed by Marsick and Watkins (2003) was used. A sample item is: "My organization makes its lessons learned available to all employees". For absorptive capacity, we used a 6-items scale developed by Jansen et al. (2005). A sample item is: "My organization thoroughly grasps the opportunities new external knowledge offers to our organization". Empowering leadership was measured with a 12-item scale developed by Zhang and Bartol (2010). A sample item is: "My manager believes that I can handle demanding tasks". All the responses were recorded on a five-point Likert scale with answer options ranging from strongly disagree to strongly agree. All measurements items are shown in Appendix A.

### 3.3. Pilot study

The questionnaire was face-validated by three academics working at University of Dubai's College of Business; some minor changes suggested were incorporated. The questionnaire was also sent online to a sample of 30 managers. Based on the 23 returned responses, further adjustments were made to the sequence of the questions and to the language used. The instrument was tested for reliability and Cronbach's  $\alpha$  was found to be above 0.7 for all the used measures (Hair et al., 2010). Additionally, an exploratory factor analysis was performed that confirmed validity of the measures.

### 3.4. Non-response and common method bias

A comparison of the means of the first and last 40 respondents using a *t*-test (Boström et al., 1993) showed that no significant differences existed in the mean variable scores of the early and late respondents, thus ruling out non-response bias. To avoid common method bias and common method variance, questions related to different variables were mixed up with psychological separators at the questionnaire development stage. Furthermore, the presence of common method bias was ruled out by conducting Harman's single factor test (Podsakoff et al., 2003). During exploratory factor analysis, an unrotated solution was

analyzed which showed that a single constrained factor did not explain majority of the variance. In addition, in view of the limitation of Harman's single factor test as highlighted by Podsakoff et al. (2003), a confirmatory factor analysis was conducted with a single latent factor. A poor model fit was obtained, thus confirming the absence of common method bias.

### 3.5. Control variables

Previous research notes that differences between industries or sectors (West et al., 2006) or firm ownership (Li et al., 2008; Väätänen et al., 2011) can affect attitudes, behavior and thus the adoption of open innovation. In view of this, several *t*-tests were performed to check the mean differences for inbound and outbound open innovation based on industry and ownership. Across industries, no significant differences were found for inbound open innovation ( $F = 5.05, p > 0.05$ ); however significant differences were noted for outbound open innovation ( $F = 6.18, p < 0.05$ ). The results also indicated significant differences based on ownership for inbound open innovation ( $F = 1.64, p < 0.05$ ) and outbound open innovation ( $F = 7.12, p < 0.05$ ). Hence, these variables were included in the model as control variables.

Additionally, a correlational analysis revealed a positive correlation between organizational learning culture and absorptive capacity ( $r = 0.417, p < 0.01$ ), empowering leadership ( $r = 0.548, p < 0.01$ ), inbound open innovation ( $r = 0.577, p < 0.01$ ) and outbound open innovation ( $r = 0.508, r < 0.01$ ). Absorptive capacity correlated positively with empowering leadership ( $r = 0.699, p < 0.01$ ), inbound open innovation ( $r = 0.550, p < 0.01$ ) and outbound open innovation ( $r = 0.433, p < 0.01$ ). Empowering leadership showed a positive correlation with inbound open innovation ( $r = 0.646, p < 0.01$ ) and outbound open innovation ( $r = 0.517, p < 0.01$ ), while inbound open innovation also showed a positive yet slightly weaker relationship with outbound open innovation ( $r = 0.498, p < 0.01$ ) (Table 1).

### 3.6. Psychometric properties of the measures

#### 3.6.1. Exploratory factor analysis

Since the constructs of this study have not been used before within the Indian context, an exploratory factor analysis (EFA) was performed. This was done using the principal component analysis (PCA) extraction method and Varimax with Kaiser Normalization as the rotation method (Pitt and Jeantrout, 1994). The EFA performed iteratively resulted in eliminating some items due to low factor loading ( $< 0.5$ ). Doing this helped in obtaining a clearer factor structure. Empowering leadership, absorptive capacity, organizational learning culture, inbound open innovation, and outbound open innovation lost five, two, four, three and one item respectively (Hair et al., 2010). The five factors explained 74.97% of the variance with eigenvalue of at least 1. The Kaiser-Meyer-Olkin (KMO) was 0.912 indicating an acceptable sampling adequacy and Bartlett's Test of Sphericity of 2167.6 ( $p < 0.001$ ) was significant. The five factors were reliable measurements since Cronbach's  $\alpha$  ranged from 0.78 to 0.92. Based on the results of the EFA, we took a confirmatory approach and a confirmatory factor analysis was performed

**Table 1**  
Correlations and descriptive statistics.

Variables	Mean	SD	1	2	3	4
1. Empowering leadership	3.122	0.804	1			
2. Inbound OI	3.426	0.791	0.646**	1		
3. Outbound OI	3.187	0.685	0.517**	0.498**	1	
4. Absorptive capacity	3.315	0.712	0.699**	0.550**	0.433**	1
5. Organizational learning culture	3.548	0.818	0.548**	0.577**	0.508**	0.417**

\*\* Correlation is significant at the 0.01 level (2-tailed). OI, open innovation; SD, standard deviation.

**Table 2**  
Confirmatory factor analysis (CFA) and reliability of measures.

Construct	Item	Factor loading	Item total correlation	Cronbach's $\alpha$
Empowering leadership	EL1	0.822	0.760	0.924
	EL2	0.854	0.817	
	EL3	0.828	0.748	
	EL5	0.792	0.806	
	EL6	0.825	0.800	
	EL10	0.715	0.731	
Absorptive capacity	EL11	0.687	0.701	0.864
	AC2	0.791	0.713	
	AC3	0.854	0.768	
	AC4	0.764	0.710	
	AC5	0.737	0.676	
Organizational learning culture	OLC1	0.709	0.632	0.784
	OLC4	0.795	0.710	
	OLC6	0.731	0.546	
Inbound open innovation	INO1	0.727	0.670	0.859
	INO2	0.878	0.742	
	INO3	0.857	0.792	
Outbound open innovation	OUTO11	0.645	0.610	0.807
	OUTO13	0.755	0.656	
	OUTO14	0.890	0.709	

for the cleaned factors which showed a good fit: CMIN/DF = 2.22, CFI = 0.908, RMSEA = 0.089 [Table 2](#).

### 3.6.2. Convergent and discriminant validity

Convergent and discriminant validity were tested for the studied constructs. Results, posted in [Table 3](#), show evidence for both validity measures. Convergent validity was confirmed since the Composite Reliability (CR) was equal or > 0.8 and Average Variance Extracted (AVE) was 0.5 or greater for all the related variables ([Fornell and Larcker, 1981](#)). Discriminant validity was also confirmed since the square root of the AVE was greater than the inter-construct squared correlation values for all studied variables ([Fornell and Larcker, 1981](#)).

### 3.6.3. Hypothesis testing

The hypotheses were tested using a series of regression equations. This was preceded by a test of multicollinearity, which was ruled out since the variance inflation factor (VIF) was < 3 for all the independent variables. The results of regression analyses showed a significant and positive relationship of empowering leadership with inbound open innovation ( $\beta = 0.642$ ,  $t = 10.1$ ,  $p < 0.001$ ) and outbound open innovation ( $\beta = 0.489$ ,  $t = 6.88$ ,  $p < 0.001$ ), thus supporting [H1](#) and [H2](#). Delving deeper, we looked at the sector-wise results which led to the same conclusion on the relationship of empowering leadership with inbound open innovation ( $\beta = 0.653$ ,  $t = 9.16$ ,  $p < 0.001$ ) and outbound open innovation ( $\beta = 0.499$ ,  $t = 6.14$ ,  $p < 0.001$ ).

**Table 3**  
Convergent and discriminant validity.

	CR	AVE	EL	AC	OLC	INOI	OUTOI
Empowering leadership	0.921	0.626	<b>0.791</b>				
Absorptive capacity	0.867	0.62	0.772	<b>0.788</b>			
Organizational learning culture	0.79	0.556	0.69	0.495	<b>0.745</b>		
Inbound open innovation	0.863	0.678	0.733	0.644	0.69	<b>0.823</b>	
Outbound open innovation	0.811	0.593	0.611	0.572	0.67	0.594	<b>0.770</b>

Notes: CR, composite reliability; AVE, average variance extracted; the diagonal values are square root of AVE; other values are inter-construct squared correlations; EL, empowering leadership; AC, absorptive capacity; OLC, organizational learning culture; INOI, inbound open innovation; OUTOI, outbound open innovation.

Further, a series of regression equations were run to test for the mediating role of organizational learning culture in the relationships between empowering leadership and the two dimensions of open innovation. In the interest of maintaining rigor, mediation was tested using two popular approaches: the causal step approach by [Baron and Kenny \(1986\)](#) and the [Preacher and Hayes \(2008\)](#) approach. The former involved a four-step approach: first, the dependent variable is regressed on the independent variable. This is to show the direct effect. Then the mediator is regressed on the independent variable, followed by regressing the dependent variable on the mediator. In the last step, both the mediator and the independent variables are regressed on the dependent variable (indirect path) while controlling for the independent variable.

Results in [Table 4](#) show that in the first three steps, the effects of the regressors (i.e. the IV on DV and M, and M on DV) were significant indicating a possible mediating effect for both dimensions of open innovation in the service as well as manufacturing sectors. Next, the direct and indirect effects of the mediator were computed. This is done by controlling for the effect of the mediator (organizational learning culture) on the dependent variable (open innovation). The results, presented in [Table 5](#), show that the direct effect of the independent variable (empowering leadership) on the dependent variable was reduced for Inbound open innovation (from  $\beta = 0.635$  to  $\beta = 0.464$ ), and for outbound open innovation (from  $\beta = 0.441$  to  $\beta = 0.291$ ) but remained significant ( $p < 0.001$ ) for both inbound and outbound open innovation, signifying partial mediation. To test whether the reduction in the estimates was significant, we used the Sobel test which confirmed the above results (Sobel test statistic = 3.99,  $p < 0.001$  for inbound open innovation and Sobel test statistic = 3.644,  $p < 0.001$  for outbound open innovation). These findings support [H3](#) and [H4](#), indicating a mediating effect of the organizational learning culture between empowering leadership and the two dimensions of open innovation. We further compared the mediating effects based on industry type. A partial mediational role of organizational learning culture was observed in the service sector for the link between empowering leadership and dimensions of open innovation. However, for the manufacturing sector, we observed partial mediation for inbound open innovation only while full mediation was observed for outbound open innovation.

Despite the wide use of [Baron and Kenny \(1986\)](#) approach, recent research has highlighted its two critical shortcomings: a) its low statistical power and, b) it not being a direct test of statistical mediation and the indirect effect ( $a \times b$ ) not being under direct scrutiny – instead mediation is inferred by the reduction of the effect of the predictor on the outcome variable while controlling for the mediator ([Preacher and Hayes, 2004](#)). On the other hand, a modern approach, the [Preacher and Hayes \(2008\)](#) method quantifies the indirect effect as the product of coefficients  $a$  and  $b$  in direct tests of mediation hypotheses. The approach has been widely used through the social, business, and health sciences for estimating direct and indirect effects in single and multiple mediator models and for probing conditional indirect effects in moderated mediation models with a single or multiple mediators or moderators ([Hayes, 2017](#)). Hence, the above results were confirmed with the [Preacher and Hayes \(2008\)](#) approach which included the use of the bootstrap method (5000 resamples) and computation of the bias-corrected confidence intervals. The results obtained above using the [Baron and Kenny \(1986\)](#) approach were confirmed as the upper and lower confidence intervals for both the dimensions of open innovation excluded zero, indicating mediation ([Table 5](#)).

### 3.7. Moderation effects

Two hypotheses of this study proposed the moderating role of absorptive capacity in the relationship between organizational learning culture and dimensions of open innovation. We used a hierarchical multiple regression to test for the moderating roles. Accordingly, interaction terms were created (predictor  $\times$  moderator) after centering

**Table 4**  
Results of hierarchical multiple regressions for mediation.

	Inbound OI			Outbound OI			Organizational learning culture (M)		
	$\beta$	t	SE	$\beta$	t	SE	$\beta$	t	SE
<b>All firms</b>									
<b>Predictor</b>									
Empowering leadership (IV)	0.642	10.1	0.064	0.489	6.884	0.071	0.548	8.10	0.068
Adjusted R <sup>2</sup>		0.41			0.27			0.296	
F Change		102.02			47.39			65.63	
<b>Mediator</b>									
Organizational learning culture (M)	0.565	8.443	0.067	0.482	6.89	0.07			
Adjusted R <sup>2</sup>		0.329			0.271				
F Change		71.29			47.51				
<b>Service firms</b>									
<b>Predictor</b>									
Empowering leadership (IV)	0.653	9.16	0.071	0.499	6.14	0.081	0.525	6.702	0.078
Adjusted R <sup>2</sup>		0.408			0.231			0.27	
F Change		83.95			37.7			44.92	
<b>Mediator</b>									
Organizational learning culture (M)	5.44	7.0	0.777	0.435	5.23	0.083			
Adjusted R <sup>2</sup>		0.284			0.176				
F Change		49.01			14.61				
<b>Manufacturing firms</b>									
<b>Predictor</b>									
Empowering leadership (IV)	0.627	4.61	0.136	0.499	3.51	0.142	0.61	4.427	0.138
Adjusted R <sup>2</sup>		0.438			0.387			0.354	
F Change		21.25			12.32			19.59	
<b>Mediator</b>									
Organizational learning culture (M)	0.644	4.11	0.157	0.585	3.83	0.153			
Adjusted R <sup>2</sup>		0.388			0.417				
F Change		16.89			27.31				

Note 1: IV: independent variable; DV: dependent variable; OI: open innovation; mediator (M): organizational learning culture.

**Table 5**  
Mediating effects using the Preacher and Hayes (2008) method.

	Effect of IV on M (a)		Effect of M on DV (b)		Total effect of IV on DV (c)		Direct effect of IV on DV (c')		Bootstrap results for indirect effect through mediator (a * b)	
	$\beta$	t	$\beta$	t	$\beta$	t	$\beta$	t	LL 95% CI	UL 95% CI
<b>All firms</b>										
Inbound OI	0.557	8.10	0.308	4.59	0.635	10.47	0.464	6.80	0.0806	0.2722
Outbound OI	0.557	8.10	0.269	4.08	0.441	7.48	0.291	4.33	0.0743	0.2404
<b>Service firms</b>										
Inbound OI	0.51	6.70	0.262	3.57	0.579	9.11	0.445	6.26	0.0597	0.2368
Outbound OI	0.51	6.70	0.196	2.71	0.369	6.01	0.269	3.83	0.0330	0.1817
<b>Manufacturing firms</b>										
Inbound OI	0.756	4.43	0.411	2.54	0.896	5.24	0.5855	2.93	-0.0466	0.6262
Outbound OI	0.756	4.43	0.4434	2.99	0.684	4.22	0.3491	1.902	0.0540	0.5559

Note: IV, independent variable; DV, dependent variable; OI, open innovation; mediator M, organizational learning culture.

the relevant variables. Findings revealed that the interaction effect between the predictor and the moderator was not significant for inbound open innovation ( $\beta = 0.58, t = 1.36, r$ -square change = 0.007) or outbound open innovation ( $\beta = -0.864, t = -1.83, r$ -square change = 0.015), implying that H5 and H6 are not supported. However, when the models were run separately for the service and the manufacturing industries, it was found that absorptive capacity moderated the relationship between organizational learning culture and outbound open innovation in the service sector, while no such moderation was observed for inbound open innovation. We confirmed these findings using the “process macro” based on the Preacher and Hayes (2008) approach. The index of moderated mediation was not significant

for either dimension of open innovation since the values of the bootstrapped confidence interval included zero.

**4. Discussion**

This study set out to examine the association between empowering leadership and open innovation (inbound and outbound), and the mediating mechanism of organizational learning culture in these relationships. The research context of this study is India, a country where unemployment continues to be a challenge to the policy-makers. Of late, the Indian government has adopted innovation-led growth and entrepreneurship development as some of the mechanisms for job

creation (Abhyankar, 2014). This is in line with Curran and Blackburn (1994) who noted that for economic development to happen, it is critical to create, apply, and introduce innovations at different levels (individual, organizational and national).

Since the open innovation paradigm has gained increasing popularity and acceptance around the world,<sup>1</sup> it was deemed opportune to test the model developed in this study in the Indian context. The innovation ecosystem is composed of knowledge producers such as the science and technology institutions, academia, innovating individuals, and knowledge users in the public and private sectors (Jackson, 2011). In the Indian context, the former includes publicly-funded research councils and research organizations under various ministries working in diverse areas across the country. Inter-organizational collaboration among relevant stakeholders is the essence of open innovation as such collaborations often lead to innovation at reduced development expenditures, a notion that is especially important for the economic success in emerging economies such as India.

The findings of this study provide empirical support for most of the hypothesized associations. The first finding showed that empowering leadership promoted inbound open innovation. Hence firms that had leaders who encouraged their followers to carry out activities related to the creation and acquisition of knowledge achieved higher inbound open innovation outcomes. Empowering leaders model the desired behaviors among followers and motivate them to display the same behaviors while looking for new knowledge and ideas in the external markets. This finding is consistent with past studies that explained the facilitating role of empowering leadership in innovative outcomes (Bhatnagar, 2012; Zhang and Bartol, 2010). Similarly, the finding concurs with Burpitt and Bigoness (1997) who reported that innovation required empowered and motivated employees who were able to make independent decisions. Therefore, since an empowering leadership style encompasses these desired components, such as leadership style is likely to promote knowledge acquisition and sourcing, resulting in higher inbound open innovation outcomes.

The findings also showed that empowering leadership facilitated outbound open innovation. This implies that firms that had empowering leaders managed their knowledge outflows more effectively. As this study shows, empowering leaders encourage their followers/employees so that the firm benefits from its empowered employees; such benefits usually accrue through the exploitation of knowledge inflows and/or internally-developed resources in the external markets via out-licensing. Due to the infancy of this research domain, the authors could not relate this finding directly to published research. However, in general past research has shown that empowerment is necessary to achieve innovation (Bhatnagar, 2012; Çakar and Ertürk, 2010; Zhang and Bartol, 2010). Past studies have also shown that empowering leaders provide autonomy to followers to participate in decision making and motivate them to carry out tasks through intrinsic and extrinsic rewards (Xue et al., 2011). As empowering leaders repose their trust and confidence in their followers (Arnold et al., 2000), the enthused followers display risk-averse behaviors which leads to better performance in innovative activities.

This study also confirmed the mediating role of organizational learning culture in the association between empowering leadership and inbound open innovation. A learning culture is a collection of organizational conventions, values, practices and processes that encourage employees and organizations to develop knowledge and competence. It is inferred that empowering leaders in the surveyed organizations created an environment that supported the creation, exchange and utilization of new ideas, resulting in an effective learning culture that promoted knowledge inflows, and hence inbound open innovation. This finding is consistent with the work of Ogbonna and Harris (2000) who

highlighted leadership as a critical factor in developing organizational culture. Along similar lines, other studies (e.g. Slåtten et al., 2011; Xue et al., 2011) have also shown that empowering leaders create an innovation-supportive organizational climate/culture, which results in the promotion of activities related to knowledge inflows and innovation (Sarros et al., 2008).

This study also showed that empowering leadership affected organizational learning culture, which in turn affected outbound open innovation. It is thus inferred that empowering leaders develop in their firms a learning culture that facilitates knowledge exchanges among members. This, in turn, helps in the dissemination of information to organizational members who could utilize it to produce innovative solutions. Empowering leadership also promotes a learning culture by appreciating and rewarding collaborative activities. While hardly a study can be related directly to this finding, in general, the finding is supported by past studies which noted that empowering leaders enhanced employee motivation by encouraging and rewarding them (Tung and Chang, 2011). Such leaders also promoted the sharing of ideas among organizational members (Srivastava et al., 2006; Xue et al., 2011), which consequently resulted in improved innovative outcomes. It is note-worthy, however, that organizational learning culture by and large partially mediated the relationships between empowering leadership and dimensions of open innovation. This leads us to conclude that organizational learning culture played an important role in open innovation, however it probably was not the sole mediator. Past research has discussed other possible mediating factors. For instance, Oke et al. (2009) studied the power of the context that can affect the link between leadership styles and innovation. Context refers to the types of cultural, formal and informal processes and systems within an organization, which enable effective coordination between organizational units to facilitate innovation processes at various stages. Denti and Hemlin (2012) highlighted the role of several mechanisms used by leaders to induce innovative behavior at the individual, team and organizational levels. In this regard, the individual level mediators include external work contacts i.e. the number and frequency of contacts (De Jong and Den Hartog, 2010), and the leader's decision to seek or reject such external contacts. Another possible factor that can mediate the leadership-open innovation link is the individual's degree of personal initiative and proactiveness, and the employees' attitude towards the exploitation of knowledge assets (de Araújo Burcharth et al., 2014) which leaders can influence to enhance innovation outcomes (Frohman, 1999; Seibert et al., 2001). It may be interesting to evaluate the impact of these and other possible mediating variables on the studied relationships in future research.

This study could not confirm the moderating role of absorptive capacity in organizational learning culture-inbound open innovation relationship. Thus, this study cannot infer, as hypothesized, that a learning organizational culture has a greater positive impact on inbound open innovation under higher levels of absorptive capacity. Many studies (e.g. Gann, 2001; Muscio, 2007) have posited that firms often show weak levels of absorptive capacity due to weak or limited investment in R&D, and inadequate qualification of their employees to engage effectively in R&D-related or open innovation activities (Spithoven et al., 2010). In view of the absence of any specific study on the moderational role of absorptive capacity, it is difficult to relate this finding to any similar study. However Kokshagina et al. (2017) note that in the case of absorptive capacity being absent internally, the open innovation intermediaries may develop absorptive capacity for the firm. It is in light of this that the absence of moderational role of absorptive capacity in this study may be explained since this study did not focus on absorptive capacity of open innovation intermediaries or external partners such as suppliers. It thus needs to be further investigated as to whether a firm's capability to explore, absorb and exploit new knowledge i.e. absorptive capacity (Zahra and George, 2002), interacted with its culture that facilitated effective sourcing, diffusing, sharing and internalizing of new knowledge, to enhance its ability to

<sup>1</sup> von Briel and Recker (2017) reported 78% of the large American and European organizations as adopters of the open innovation model.



source and acquire knowledge for innovation (Liao et al., 2008), i.e. inbound open innovation.

Similarly, the findings confirmed that an organization's learning culture and its absorptive capacity do not interact to result in higher outbound open innovation outcomes. Therefore, albeit hypothesized above, it will be misplaced to conclude that a firm possessing higher levels of dynamic capability pertaining to knowledge creation and utilization (i.e. absorptive capacity) and one that encourages knowledge sharing among its members, implements new ideas and stresses on continuous learning (learning organizational culture) is likely to be more successful in knowledge commercialization i.e. outbound open innovation. This findings somewhat contradicts Carayannis (2012) who placed high importance on absorptive capacity and noted that higher levels of absorptive capacity helps a firm in understanding the knowledge received, unlocking it and capturing the intrinsic value of such knowledge and finally applying it for commercial purposes. In general, however, the absence of the moderating role of absorptive capacity needs to be investigated further. In this regard, concepts related to absorptive capacity such as desorptive capacity ["an organization's ability to identify technology transfer opportunities based on a firm's outward technology transfer strategy, and to facilitate the technology's application at the recipient" (Lichtenthaler and Lichtenthaler, 2010)] need to be accounted for. Besides, it must be noted that different absorptive capacities are required for inbound and outbound open innovation, with the latter focusing on supplier absorptive capacity where absorptive capacity is leveraged differently than the former case.

This points to intricate reasons that can answer why absorptive capacity did not moderate the relationship between organizational learning culture and open innovation in this study.

## 5. Conclusion and contributions

By drawing on a comprehensive model of open innovation, this study contributes to theory and practice. The findings of this study can potentially provide inputs to the policy-makers in India and help the country realize its innovation-led growth and development. The study extends research in the area of leadership, culture, absorptive capacity and open innovation. Moreover, it clarifies the process and a conditional factor in the association between empowering leadership and open innovation, thus presenting an advanced model in this domain.

The theoretical contribution of this study is three-fold. First, it contributes to the extant literature in the areas of leadership, organizational culture and open innovation. Past studies (see Jung et al., 2003; Sarros et al., 2008) have attempted to connect these areas, however, such models in the area of open innovation did not exist. This study thus is a step forward to focus the attention of researchers in this area. Second, this study established the influence of empowering leadership on open innovation. Although the extant literature has highlighted the role of leadership in shaping innovation (Rosing et al., 2011), this study is one of the first in the area of open innovation to draw the linkages with empowering leadership and test them empirically. The study thus sheds light on the role of empowering leadership in open innovation. Third, this study has brought clarity to the

leadership-open innovation link by explaining the mediating mechanism of organizational learning culture. It also contributes by validating past studies that have examined the role of empowering leadership in promoting a culture that supports knowledge inflows and outflows (Xue et al., 2011).

From a practitioner's point-of-view, this study is expected to provide insights to decision-makers, desirous of achieving excellence in the open innovation paradigm. In addition, a better understanding of the role of empowering leadership in promoting open innovation can provide insights to leaders in order to choose an appropriate leadership style and achieve desired open innovation outcomes. The critical role of innovation for organizations to survive in the market is undisputed. While research has identified several factors that promote open innovation (Naqshbandi and Kaur, 2011), it fell short of identifying the type of leadership that supports open innovation. It is, therefore, important for firms to identify and promote leadership styles that are conducive to open innovation (Fleming and Waguespack, 2007).

In view of this, this study provides insights to firms that are looking for an appropriate leadership model in their journey towards achieving higher open innovation performance. As a recommendation, this study posits that firms should promote empowering leadership in order to achieve higher inbound and outbound open innovation outcomes. As open innovation requires more open and flexible management of activities (von Hippel and von Krogh, 2003), firms should appoint flexible leaders who provide autonomy to followers in decision-making and encourage them by exemplifying desired behaviors and motivating them through intrinsic and extrinsic rewards. At the same time, firms should appreciate leaders who encourage their followers to take risks and participate in knowledge-based activities. Additionally, firms should assist their leaders in developing a culture that fosters learning and exchange of new ideas and information. Such a culture where learning is promoted and rewarded develops an interest in employees to generate and acquire new ideas and experiment with them. Hence, firms looking for excellence in the open innovation paradigm should enable their empowering leaders to promote a learning culture.

## 6. Limitations and future research

This study has some limitations. This study explored the mediating role of learning culture, however, it did not highlight how different dimensions of the organizational learning culture influence open innovation (Marsick and Watkins, 2003). The different dimensions could be related differently to open innovation types (inbound and outbound open innovation), leaving pending an interesting future research gap. In addition, since this study was not able to confirm the moderating role of absorptive capacity despite theoretical justifications, future research may test the moderating role of absorptive capacity in different contexts to check if context plays a role. Future research may also spotlight other leadership styles that may promote or impede open innovation. Lastly, since we used cross-sectional data to test the model developed in this study, future research may test the model using longitudinal data to determine causality with greater confidence.

## Appendix A

### *Empowering leadership* (Zhang and Bartol, 2010)

My manager helps me understand how my objectives and goals relate to that of the organization.

My manager helps me understand the importance of my work to the overall effectiveness of the organization.

My manager helps me understand how my job fits into the bigger picture.

My manager makes many decisions together with me.

My manager often consults me on strategic decisions.

My manager solicits my opinion on decisions that may affect me.

My manager believes that I can handle demanding tasks.

My manager believes in my ability to improve even when I make mistakes.

My manager expresses confidence in my ability to perform at a high level.  
 My manager allows me to do my job my way.  
 My manager makes it more efficient for me to do my job by keeping the rules and regulations simple.  
 My manager allows me to make important decisions quickly to satisfy client needs.

#### **Open innovation** (Lichtenthaler, 2009; Sisodiya, 2008)

My organization constantly scans the external environment for inputs such as technology, information, ideas, knowledge, etc.  
 My organization actively seeks out external sources of knowledge and technology (e.g., research groups, universities, suppliers, customers, competitors, etc.) when developing new products.  
 My organization believes it is good to use external sources (e. g., research groups, universities, suppliers, customers, competitors, etc.) to complement its own R&D.  
 My organization often brings in externally developed knowledge and technology to use in conjunction with our own R&D.  
 My organization seeks out technologies and patents from other firms, research groups, or universities.  
 My organization purchases external intellectual property to use in our own R&D.  
 Generally, in my organization all technologies are externally commercialized (i.e. sold to outside firms).  
 In my organization, external technology commercialization is restricted to technologies that are not used internally.  
 In my organization, external technology commercialization is restricted to relatively mature and proven technologies.  
 In my organization, external technology commercialization is restricted to non-core technologies.

#### **Organizational learning culture** (Marsick and Watkins, 2003)

In my organization, people are rewarded for learning.  
 In my organization, people spend time building trust with each other.  
 In my organization, teams/groups revise their thinking as a result of group discussions or information collected.  
 My organization makes its lessons learned available to all employees.  
 My organization recognizes people for taking initiative.  
 My organization works together with the outside community to meet mutual needs.  
 In my organization, leaders continually look for opportunities to learn.

#### **Absorptive capacity** (Jansen et al., 2005)

New opportunities to serve our clients are understood rapidly by my organization.  
 My organization analyzes and interprets changing market demands promptly.  
 Employees in my organization record and store newly acquired knowledge for future reference.  
 My organization quickly recognizes the usefulness of new external knowledge to existing knowledge.  
 My organization incorporates external technological knowledge into our firm.  
 My organization thoroughly grasps the opportunities new external knowledge offers our organization.  
 In my organization employees meet periodically to discuss consequences of market trends and new product development.  
 Employees in my organization are clearly aware of how the firm's activities should be performed.  
 My organization constantly reviews how to better exploit external knowledge.  
 In my organization employees share a common language to refer to our products and services.

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