

THE MODERATOR EFFECT OF INTER-FIRM KNOWLEDGE SHARING ON ABSORPTION CAPACITY AND INNOVATIVE CAPABILITIES IN SMALL AND MEDIUM ENTERPRISESⁱ

EFEITO MODERADOR DO COMPARTILHAMENTO DE CONHECIMENTOS INTERFIRMÁRIOS NA CAPACIDADE ABSORTIVA E CAPACIDADES INOVADORAS EM PEQUENAS E MÉDIAS EMPRESAS

EFFECTO MODERADOR DE LA INTERFIRMA DE COMPARTIR CONOCIMIENTOS SOBRE LA CAPACIDAD ABSORTIVA Y LAS CAPACIDADES INNOVADORAS EN LAS PEQUEÑAS Y MEDIANAS EMPRESAS

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ABSTRACT

This study examines the moderator function of inter-firm knowledge-sharing on absorption capacity and innovative capabilities in small and medium enterprises in the Information Technology and Communication (ITC) sector. We propose a two-mode inter-firm knowledge sharing model to classify firms into the stages of development or maturity. We used structural equations modeling by partial least squares (PLS) and PLS multi-group analysis (PLS-MGA). The empirical field used to test the model was a group of small and medium enterprises (SMEs) in the ITC sector in Brazil. Data were collected from 300 SMEs, using self-reporting measures were used. The analysis confirmed a positive moderator effect of inter-firm knowledge sharing on the relationship between absorption capacity and innovative capabilities. The effect of absorption capacity on innovative capabilities was found to be stronger for those firms in the maturity stage of inter-firm knowledge sharing. The findings of this study have implications for research and practice, shedding new light on managerial and strategic actions for generating innovations in SMEs.

Keywords: Absorptive Capacity. Interfirm Knowledge-Sharing. Innovative Capability.

RESUMO

Este estudo examina a função moderadora do compartilhamento interfirma de conhecimento sobre capacidade absorptiva e capacidades inovadoras em pequenas e médias empresas do setor de Tecnologia da Informação e Comunicação (TIC). Propomos um modelo de compartilhamento de conhecimento entre empresas de dois modos para classificar as empresas em estágios de desenvolvimento ou maturidade. Utilizamos a modelagem de equações estruturais por mínimos quadrados parciais (PLS) e análise multigrupos PLS (PLS-MGA). O campo empírico para testar o modelo foi um conjunto de pequenas e médias empresas (PMEs) do setor de TIC no Brasil. Os dados foram coletados de 300 PME e empregaram medidas de autorrelato. A análise confirma um efeito moderador do compartilhamento de conhecimento entre empresas em uma relação positiva entre capacidade absorptiva e capacidades inovadoras. O efeito da capacidade absorptiva em capacidades inovadoras é mais forte para as empresas no estágio de maturidade do compartilhamento de conhecimento entre empresas. Os resultados do estudo fornecem implicações para a pesquisa e a prática, lançando nova luz sobre as ações gerenciais e estratégicas para gerar inovações nas PME.

Palavras-chave: Capacidade absorptiva. Compartilhamento de conhecimento. Capacidade inovadora.

RESUMEN

Este estudio examina la función moderadora del intercambio de conocimientos entre empresas sobre capacidad de absorción y capacidades innovadoras en pequeñas y medianas empresas del sector de Tecnología de la Información y Comunicación (ITC). Proponemos un modelo de intercambio de conocimientos entre empresas de dos modos para clasificar las empresas en etapas de desarrollo o maduras. Utilizamos modelos de ecuaciones estructurales por mínimos cuadrados parciales (PLS) y análisis multigrupo de PLS (PLS-MGA). El campo empírico para probar el modelo fue un conjunto de pequeñas y medianas empresas (PYME) del sector del ITC en Brasil. Los datos se obtuvieron de 300 PYMES y se emplearon medidas de autoinforme. El análisis confirma un efecto moderador del intercambio de conocimientos entre empresas en una relación positiva entre la capacidad de absorción y las capacidades innovadoras. El efecto de la capacidad de absorción en las capacidades innovadoras es más fuerte para aquellas empresas en la etapa de madurez del intercambio de conocimientos entre empresas. Los resultados del estudio proporcionan implicaciones para la investigación y la práctica, arrojando nueva luz sobre las acciones gerenciales y estratégicas para generar innovaciones en las PYMES.

Palabras clave: Capacidad de absorción. Interfirmar el intercambio de conocimientos. Capacidad innovadora.

1 INTRODUCTION

This study examines the moderator function of interfirm knowledge-sharing on absorptive capacity and innovative capabilities in small and medium enterprises in the Information Technology and Communication (ITC) sector. The existing literature emphasizes that particular structures of resources and routines, knowledge strategies, complementary assets, and strategic collaborations influence the development of innovative capabilities (Powell, Koput, & Smith, 1996; Schilling, 2015; Apriliyanti & Alon, 2017). Nevertheless, a more particular approach is required to explore in-depth variables and moderating factors influencing the relationship between organizational processes and innovative capabilities.

The scientific debate on strategies for promoting absorptive capacity and the development of innovative capabilities in organizations has remained a consistent topic over the years (Zahra & George, 2002; Flatten *et al.*, 2011; Zou, Ertug & George, 2017). Organizational capabilities are the result of complex, detailed, analytical processes, and are dependent on preexisting knowledge. Scenarios, technologies or customers' expectations may change, demanding different strategies that encompass new knowledge (Eisenhardt & Martin, 2000; Eisenhardt & Santos, 2000; Omri, 2015; Rahmandad & Repenning, 2016).

Absorptive capacity is defined as the capacity of the organization to collect, combine and apply external knowledge, promoting organizational innovation through incremental and radical innovations (Cohen & Levinthal, 1990; Apriliyanti & Alon, 2017).

Innovative capabilities with regard to transformations are aligned with the contexts and markets in which a firm operates. Consequently, they are dependent on the organization's ability to explore knowledge internally and to understand the stages in the process of transforming knowledge and converting it into new products or services (Tsai, 2001; Kale, 2012).

Interfirm knowledge-sharing is a process that enables innovation capabilities. The critical concern of this process is to understand the dynamism of the organizational resources and capabilities involved, their origins, and their behavior over time. The need to manage tasks involves a capability that is coordinated by individuals or teams (Helfat and Peteraf, 2003). This ability to create knowledge enables the firm to deal with technological turbulence and intense competition, providing it with leverage for innovative capability in response to the rapid technological changes. (Su, Peng, & Xie, 2015; Tseng, 2016).

Interfirm knowledge-sharing influence innovative capabilities. In the ITC sector, companies require constant information flux and capabilities in acquiring and transferring knowledge to leverage innovations (Kashan & Mohannak, 2017). Innovation requires updating in line with technological patterns established at industry level (Jiang *et al.*, 2016). Knowledge-sharing can provide access to complementary resources and capacities, which is usually critical to organization innovativeness (Kogut & Zander, 1992; Hung, 2015; Wang *et al.*, 2015). Innovation in the ITC sector occurs in the context of multiple patterns of inter-operationality and compatibility. The development of new hardware or software is related to such patterns of the different components that will be part of innovation. Consequently, ITC companies need to share knowledge of their products and innovations with clients, partners, and suppliers about innovations and operational patterns. (Rikkiev & Mäkinen, 2013; Winter *et al.*, 2018).

In this context, we propose that interfirm knowledge sharing is a positive moderator factor in the relation between absorptive capacity and innovative capability in ITC companies. To depict the features of this relationship, we propose a two-mode interfirm knowledge-sharing model to classify firms into *development stage* or *mature stage*. For this, we have proposed a theoretical framework by researching two hypothesis, as described below.

2 ABSORPTIVE CAPACITY AND INNOVATIVE CAPABILITIES

Absorptive capacity refers to a firm's capacity to identify technical and scientific knowledge available in the external environment; its potential to assimilate external knowledge and internalize it; its effectiveness in organizing knowledge and transforming it into something that is useful to society; and, its potential gains from the application of that knowledge (Cohen & Levinthal, 1990; Zahra & George, 2002; Jansen, Van Den Bosch, & Volberda, 2005; Lane, Koka, & Pathak, 2006; Oh & Anchor, 2017).

From the perspective of the concept of dynamic capacities, absorptive capacity is derived from a collection of organizational routines and strategic processes adopted within organizations that acquire, assimilate, transform, and exploit knowledge. Consequently, the combination of these four dimensions can build new strategic competencies (Camisón & Fóres, 2010; Flatten *et al.*, 2011).

Innovation can be seen as the result of a collection of strategies and actions that organizations can implement. Such strategies can include products and means of differentiation through price, alliances, and networks, and use of new personnel, organizational and managerial categories. Innovation may be the result of limited objectives that are described by changes defined in terms of performance characteristics, including tools, materials and other resources, skills, and acquired knowledge (Hauknes, 1998; Guan & Ma, 2003; Jiménez-Jiménez & Sanz-Valle, 2011; Omri, 2015; Wang *et al.*, 2015).

An organization needs a combination of innovation capacities that can influence its performance. Each organization has a capacity that is predominant in its operations. It may be innovative not only because of its performance in a given capacity, but because of advantages that derive from its operations, management structure, or market strategies (Christensen, 1995; Guan & Ma, 2003).

Innovative capability is an organization's capacity to exploit knowledge internally and its understanding of the stages of the process of transforming knowledge and converting it into new products or services. In order for an organization to generate innovations from internal or external knowledge, it must possess sufficient prior knowledge, which will determine commercial opportunities. Innovative capability encompasses the stages of the process of transferring knowledge and converting it into new products or services. It is a result of acquisition of new knowledge, of the stimulus afforded by learning and exploitation of external knowledge. It is related to a collection of organizational characteristics that facilitate and support its innovation strategies (Tsai, 2001; Kale, 2012; Wang *et al.*, 2015). Innovative capability is enhanced the more the people involved in the organization share their knowledge and stimulate the generation of new insights (Jiménez-Jiménez & Sanz-Valle, 2011; Kale, 2012).

It has been observed that organizations recognized as innovative possess a minimum set of capacities to enable them to conduct their principal activities. It is understood that for an organization to create an innovative organizational context, it needs to possess a specific set of creative capacities so that it can conduct its activities and generate new ideas (OECD, 2005; Miranda & Figueiredo, 2010; Kale, 2012; Ciutiene & Thattakath, 2014).

2.1 INTERFIRM KNOWLEDGE-SHARING

Knowledge sharing with external partners depends both on knowledge elements network and social network links. Knowledge elements networks are a set of linked knowledges, similar or complementary and comprehensible to those accessing these knowledges. Social networks are compounded by other firms, universities, partners or other actors that establish some kind of mutual relationship that facilitates the flow of knowledge. These two networks are, in nature, not linked. When firms seek for complementary assets of knowledge to innovate, they do so based on their knowledge domain and the search for knowledge elements networks. These networks can be found in scientific or technological databases, internal databases or other forms of explicit knowledge sharing. But access to this complementary knowledge requires social network links and inter-firm knowledge sharing routines (Dyer & Singh, 1998; Dyer & Kale, 2007; Wang *et al.*, 2014).

Information sharing refers to communication with other team members. The sharing information is of limited value if the information is not successfully integrated into team practices, which ultimately translate into improved decision making and overall performance. This performance depends on the distribution of knowledge within the group and the patterns of social relationships among group members (Jackson, Yi, & Liu, 2013; Oh & Anchor, 2017).

Interfirm knowledge sharing routines can be viewed as a dynamic capacity when firms combine knowledge to innovate. Relational capability facilitates the sharing of tacit knowledge among the partners and make collaborations more likely to succeed (Kashan & Mohannak, 2017). Organizations that have mastered relational capability can attract potential partners and enable external collaborations. This, in turn, enables them to access and incorporate resources for greater competitive advantage (Wang *et al.*, 2015).

Firms need a two-way dynamic flow of knowledge from networking partners and stakeholders in order to anticipate changes and respond quickly to opportunities. In the ITC sector companies must continually cultivate both internal and external knowledge to survive in a dynamic and complex environment. (Mu, Peng and Love, 2008; Oh and Anchor, 2017). However, studies demonstrate that interfirm relationships do not always maintain the flow of knowledge in both directions. Some companies are more oriented towards entrance flows and the internal use of knowledge while others seek to transfer knowledge to the external environment (Kamuriwo, Baden-Fuller, & Zhang, 2017).

We propose a two-mode interfirm knowledge-sharing model to classify firms into development or mature stages (mode 1 and mode 2). Organizations at the development - mode 1 - of interfirm knowledge sharing are those that

develop routines of identifying, acquiring, and generating new knowledge, from both the internal and external environments. This is a fundamental step towards the future creation of products, improvement of processes, and optimization of management and development of new relations with the market. The interfirm knowledge sharing is highly informal, with no specific routines or patterns of interaction and sharing.

Once in the maturity stage - mode 2 - organizations realize that dynamic capacities might not reside exclusively within firms, but can be co-created relationally with other parties in the business ecosystem. Firms at the maturity stage are sharing knowledge that has already been acquired, from both the internal and external environments. It has various partnerships, such as: alliances with IT suppliers, and agreements with universities, laboratories and research centers, for the development of new solutions and technologies (Capaldo, 2007). The ability to explore and exploit the network structure of partnerships provides favorable conditions for firms sharing and co-create important complementary assets of knowledge (Vargo, Maglio, & Akaka, 2008).

2.2 MODEL AND HYPOTHESIS

The research model adopted in this investigation includes the dimensions of Absorptive Capacity, based on Zahra and George (2002) and Camisón and Forés (2010); Innovation Capability, based on Gallouj (2002) and Jimenez-Jimenez and Sanz-Vale (2011). Interfirm Knowledge Sharing Stages based on Dyer and Singh (1998) (see Figure 1).

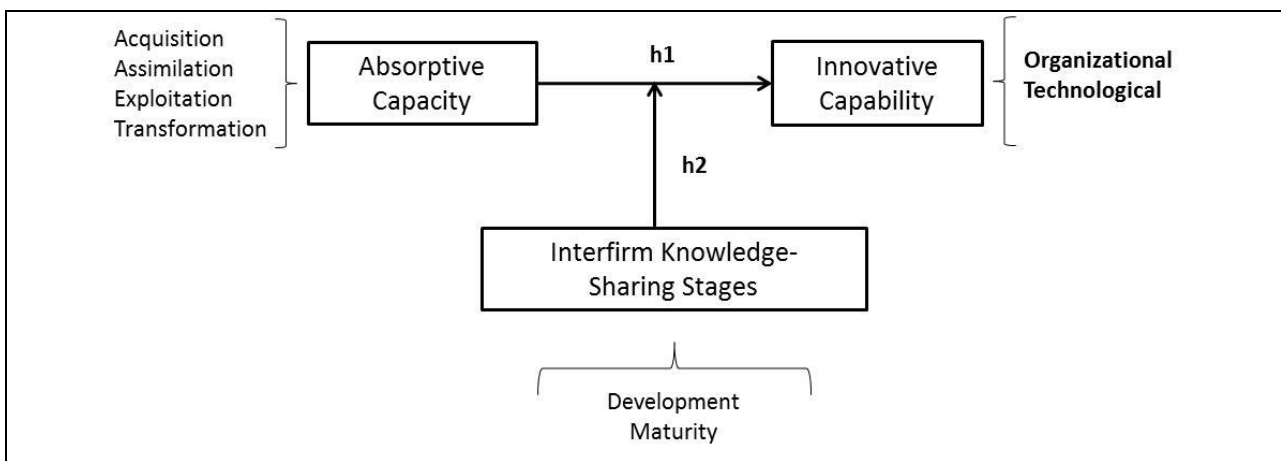


Figure 1. Proposed Research Framework
Source: Research Data

Firms create more innovative capability when related to absorptive capacity, which is embedded in their dynamic processes. When the absorptive capacity comes from specific organizational characteristics, the innovation processes occurs in the day-to-day activities.

Innovation processes involve exploiting opportunities for new or improved products, processes, or services. These opportunities arise from technical developments or changes in the market, or a combination of both. This brings us to the first hypothesis proposed in this study:

H1: Absorptive capacity has a positive influence on innovative capability in organizations which are intensive in formal cognitive structures required by complex problem-solving.

Interfirm Knowledge-Sharing defines the firm's maturity in establishing routines for knowledge transfer with partners. More mature interfirm knowledge-sharing stages will impact on the development of new resources and capacities for the generation of innovation and new organizational objectives. These changes influence the need to seek new knowledge and increase interaction among actors. More sophisticated and complex knowledge is available to firms in the maturity stage, potentializing the absorptive capacity to generate more innovativeness. Consequently, the second hypothesis proposed in this study regarding the moderation effect is:

H2: Organizations in the maturity stage, including Interfirm Knowledge-Sharing, will have greater impact of absorptive capacity on innovative capability than organizations in development stage.

The proposition implicit in this model is that organizations defined as in the maturity stage can generate greater innovative capability when related to the dimensions of absorptive capacity.

3 RESEARCH METHOD

We collected data from a sample of firms operating in the ITC sector in the state of Santa Catarina, Brazil. This region was chosen because it is one of the most important regions for innovation in the Brazilian ITC industry. A sample of 300 firms was randomly selected, comprising 5.9 % of the total population of 5099 firms. For each firm, an electronic questionnaire was sent to the highest-level executive responsible for innovation. The respondents were explicitly assured that their anonymity would be maintained.

Absorptive capacity was operationalized as a second-order construct, as per the models proposed by Zahra and George (2002) and Camisón and Forés (2010). It is made up of four dimensions, as follows: acquisition, assimilation, transformation, and exploitation. Innovative capability was operationalized as a second-order construct, as per the models proposed by Gallouj (2002) and Jimenez-Jimenez and Sanz-Vale (2011), made up of the dimensions: product, process, organizational aspects, and market. The variables for both constructs were measured using 5-point Likert response scales ranging from 1 = disagree completely to 5 = agree completely.

The knowledge-Sharing stages were identified using a binary variable to denote whether the firm was in the development stage (stage=0) or the maturity stage (stage=1):

a) in the **development stage** the organization is at the stage of identifying, acquiring, and managing new knowledge, both in the internal and external environments, which will be fundamental in the future for product creation, improvement of processes, optimization of management, and development of new relations with the market in which it does business, in this case, the ITC sector.

b) in the **maturity stage** organization is at the stage of sharing knowledge already acquired, in both the internal and external environments. It has various partnerships, such as: alliances with ITC suppliers and agreements with universities, laboratories, and research centers, for the development of new solutions and technologies. An instrument containing descriptions of the characteristics expected at each stage was provided so that the respondents could correctly identify the stage their organization was at (Appendix A).

In order to test for categorical moderating effects, the moderating variable was used to divide the data into subsets. Then the same theoretical model was estimated for each of the different subsets, thereby testing for differences between identical models estimated for different subsets (Hair *et al.*, 2014).

The final instrument was subjected to content validation and pretesting with specialists and executives from firms in the same empirical field, but which were not part of the sample. The measurement model was validated by confirmatory factor analysis using structural equations modeling by PLS (Hair *et al.*, 2014). The PLS method has been recommended for researching multiple dimensions of ACAP, regarding second order constructs. (Ali, Seny, Kan, & Sarstedt, 2016).

The structural equation modelling was performed through the test steps recommended by Hair *et al.*, (2014): convergent validity; internal consistency (CA) and composite reliability (CR); discriminant validity, relevance or predictive validity parameters (Q2) and effect size or Cohen's Kappa (f^2).

4 RESULTS AND ANALYSIS OF THE DATA

The survey of these firms from the ITC, software, and service industry revealed that of the entire sample of 300 firms, the core business for 190 (63.3%) of the firms was software development, 147 (49%) sold software and products, 48 (16%) of the firms provided support and hardware maintenance services, 23 (7.7%) organizations developed network infrastructure projects, and 43 (14.3%) organizations operated in other subsectors of the ITC sector. Table 1 lists further descriptive details of the firms surveyed.

Table 1.
Description of organizations surveyed

Description	Response option chosen	N	%
Number of employees	Up to 9 employees	142	47.3
	From 10 to 49	116	38.7
	From 50 to 99	19	6.3
	100 employees or more	23	7.7
Time in the business	From 1 to 3 years	7	2.3
	From 3 to 10 years	86	28.7
	More than 10 years	207	69.0
Qualifications and experience of top manager	Secondary education	23	7.67
	Degree	227	75.67
	Postgraduate	23	7.67
	Did not respond	27	9.0
Firm's area of business	Regional	78	26.0
	State	54	18.0
	National	180	60.0
	International	37	12.3
Gross annual revenue	Less than R\$ 240 thousand	58	19.3
	From R\$ 240 thousand to R\$ 2.4 million	126	42.0
	From R\$ 2.4 million to R\$ 16 million	28	9.3
	More than R\$ 16 million	5	1.7
	Unable to say	83	27.7

Source: Research Data

In relation to the stages of Interfirm Knowledge Sharing, the organizations exhibited a balanced distribution. Of the 300 organizations surveyed, 133 (44.3%) stated that they were at the development stage, i.e., they were at the stage of identifying, acquiring, and generating new knowledge, whether in the internal or external environments, which will be relevant in the future for product creation, process improvement, management optimization, and the development of new relations with the market, primarily focused on the IT sector.

The remaining 167 (55.7%) organizations stated that they were at the maturity stage. In other words they were at the stage of sharing the knowledge already acquired, whether in the internal or external environment. Firms in this group considered that they had a range of different partnerships, such as alliances with IT suppliers, and agreements with universities, laboratories, and research centers, for development of new solutions and technologies.

4.1 ANALYSIS OF THE MEASUREMENT MODEL

The measurement model was evaluated using confirmatory factor analysis. The reliability of the indicators was tested against the criterion of loadings greater than 0.5 (Hair Jr. *et al.*, 2014). Constructs were assessed using the indicators Compound Reliability (CR) and Cronbach's Alpha (CA). Values greater than 0.60 for CA and 0.70 for CR were considered acceptable. (Hair Jr. *et al.*, 2014).

Convergent validity was assessed against the criterion proposed by Fornell and Larcker, whereby the Average Variance Extracted (AVE) for each construct should be greater than 0.5 (Henseler, Ringle and Sinkovics, 2009) (Table 2).

Table 2.
Evaluation of the Measurement Model

	AVE	Composite Reliability	R Square	Cronbach's Alpha	r = root (AVE)
AC (2° order)	0.3473	0.8791	-	-	0.5893
Acquisition AC	0.5499	0.7819	0.4973	0.5929	0.7415
Assimilation AC	0.5067	0.7550	0.7254	0.5143	0.7119
Exploitation AC	0.5049	0.8015	0.6778	0.6727	0.7105

(Continua)

(Conclusão)

	AVE	Composite Reliability	R Square	Cronbach's Alpha	r = root (AVE)
Transformation AC	0.5360	0.8220	0.7436	0.7121	0.7321
IC (2 ^o order)	0.3891	0.8149	-	-	0.6237
Organizational IC	0.5410	0.8241	0.7975	0.7159	0.7356
Technological IC	0.5711	0.7993	0.5869	0.6235	0.7557

Source: Research Data

Discriminant validity was tested by comparing the square roots of the AVE values for each construct with their correlations with other variables in the model (Fornell and Larcker, 1981). In Table 3, the bold values along the diagonal represent the AVE values.

Table 3.
Correlations of Latent Variables

Correlations of Latent Variables						
	Acquisition	Assimilation	Organizational IC	Technological IC	Exploitation	Transformation
Acquisition	0.7415					
Assimilation	0.5686	0.7119				
Organizational IC	0.5506	0.6141	0.7356			
Technological IC	0.5223	0.4702	0.3949	0.7557		
Exploitation	0.4108	0.5847	0.4918	0.3784	0.7105	
Transformation	0.4361	0.6559	0.5659	0.3325	0.6243	0.7321

Source: Research Data

A procedure described by Podsakoff *et al.* (2003) was adopted to evaluate the risk of Common Method Bias, using the common method factor technique in the PLS structural equations modeling analysis. Almost all loadings on the common method factor were without significance. The mean variances of the indicators linked to their substantive constructs were substantially greater than the variances of the indicators linked to the common method factor, at a ratio of 28:1 (substantive constructs = 0.550; common method=0.020). While there is no consensus in the literature as yet, the tests indicate that in this study, the presence of Common Method Bias does not impart significant risks (Conway & Lance, 2010).

4.2 RESULTS OF THE MODEL PATH ANALYSIS

The effect size (f^2), and relevance or predicted validity (Q^2) were evaluated, checking the accuracy of the adjusted model. Both analyses indicated a good fit to the model (see Table 4 and 5).

Table 4.
Commonality and redundancy for each construct

Construct	Effect size (f^2)	Predictive Validity (Q^2)
Acquisition	0.147531	0.267978
Assimilation	0.044102	0.343941
Organizational IC	0.249037	0.434661
Technological IC	0.164360	0.357331
Exploitation	0.190891	0.339809
Transformation	0.232783	0.378492

Source: Research Data

Table 5.
Hypothesis testing

Hypothesis	Relationship	Std beta	Std error	t-value	Decision
H1	CA->CI	0.724	0.034	21.18*	Supported

Note: * significance $p < 0.001$

Source: Research Data

Figure 2 illustrates the relationship between each construct and their component variables for the constructs absorptive capacity, comprising the dimensions acquisition, assimilation, transformation, and exploitation, and innovative capability, comprising the dimensions product, process, market, and organization, in line with the model proposed earlier. Factor loadings are shown and the cutoff set in Smart PLS was > 0.5 .

The first subset studied comprised firms that identified themselves as being at the development stage. These organizations were at the stage of identifying, acquiring, and managing new knowledge, in both the internal and external environments. They understand that this is fundamental for them to create products, improve processes, optimize management, and develop new relations with the market in the future (Figure 2).

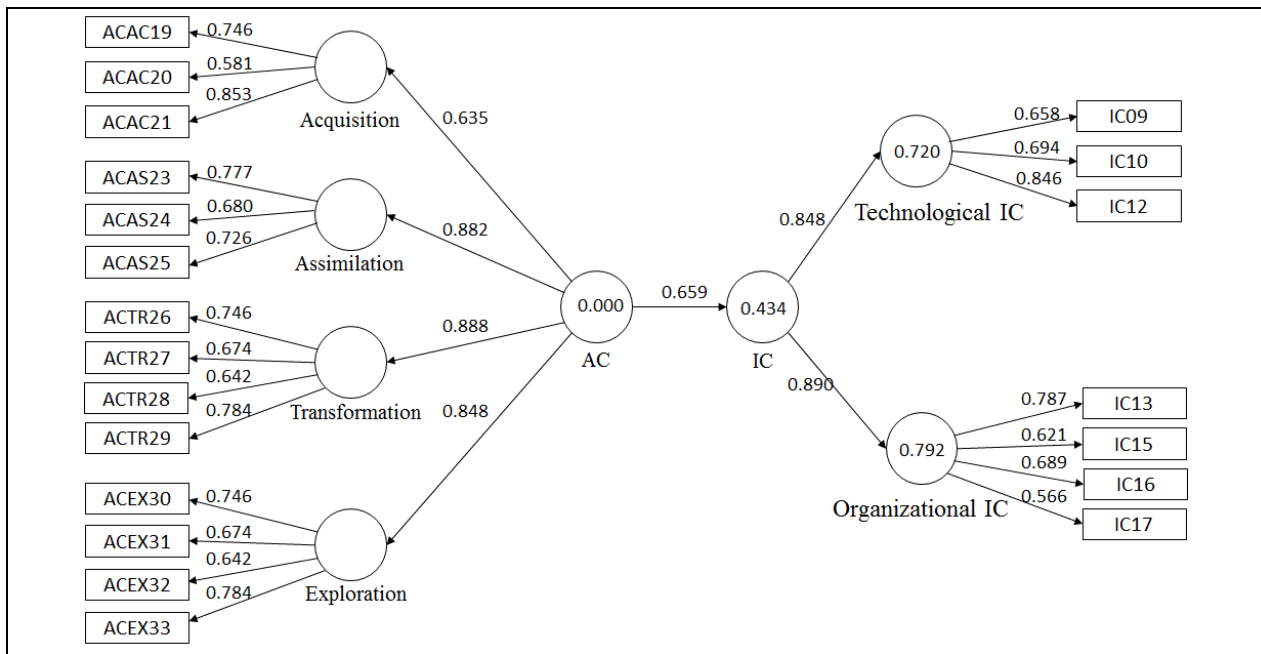


Figure 2. Subset of firms at the development stage
Source: Research Data

It can be observed from Figure 2 that a relationship is established and a positive moderating effect revealed when the constructs absorptive capacity and innovative capability are related to the development stage of organizational capacities. Of note is the factor loading for the analysis of the constructs absorptive capacity and innovative capability as moderated by the development stage (0.659). The following dimensions were also analyzed: acquisition (0.6352), assimilation (0.8815), exploitation (0.8485), transformation (0.8877), process and product innovation (technological) (0.8485) and organizational and market innovation (0.89), as shown below in Table 2.

The second subset studied comprises firms that identified themselves as being at the maturity stage of the Interfirm Knowledge-Sharing, which is a stage at which they share knowledge already acquired, both in the internal and external environments. These organizations have a range of different partnerships, such as alliances with IT suppliers and agreements with universities, laboratories, and research centers, seeking to develop new solutions and technologies (Figure 3).

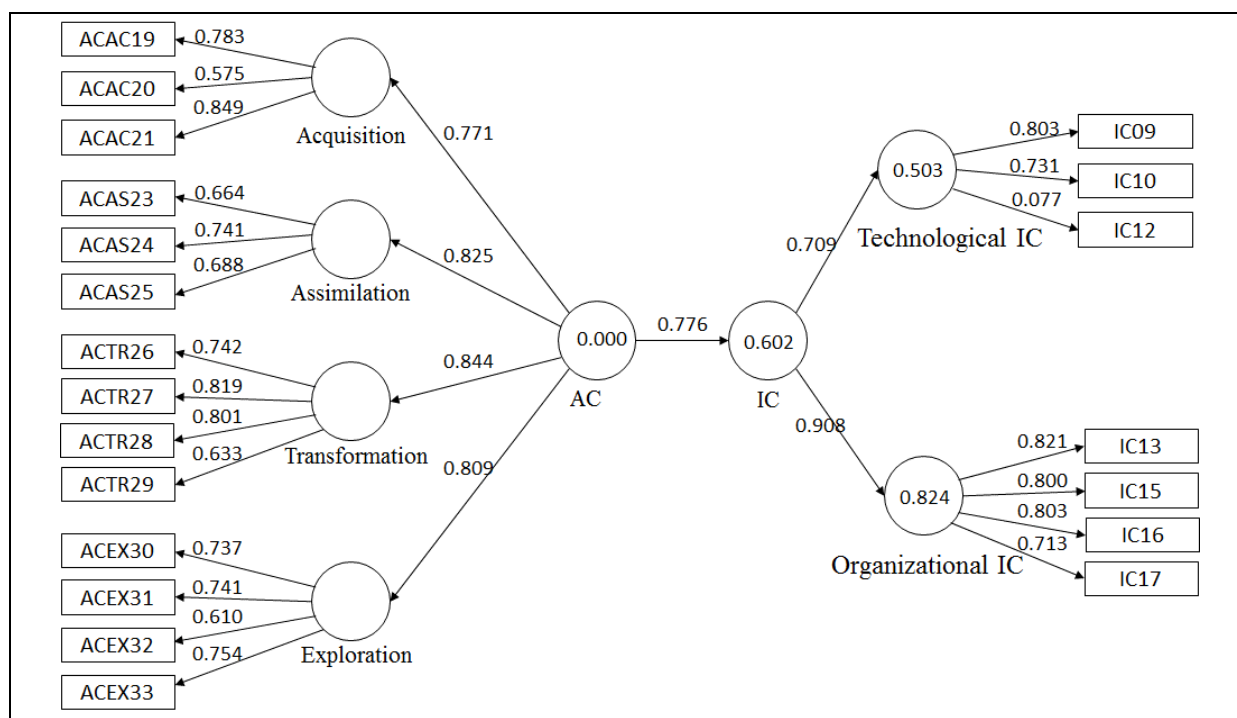


Figure 3. Subset of firms at the maturity stage
Source: Research Data

It can be observed from Figure 3 that a relationship is established and a positive moderating effect is present when the constructs absorptive capacity and innovative capability are related to the maturity stage of organizational capacities. Of note is that the factor loading identified is greater than for the first group (firms at the development stage) when the constructs absorptive capacity and innovative capability are analyzed (0.776).

It can also be observed that a factor loading with a less powerful moderating effect was estimated for the relationship between the construct innovative capability and the dimension process and product innovation (technological) (0.709). In relation to the other dimensions analyzed, the factor loadings established for acquisition (0.771), assimilation (0.825), transformation (0.844), exploitation (0.809), and organizational and market innovation (0.908) are as shown in Table 6.

Table 6.
Relationships established with the moderating variable

	Subset 1	Subset 2	Dif	P
AC -> Acquisition	0.635	0.771	0.136	0.919812
AC -> Assimilation	0.882	0.825	-0.057	0.101675
AC -> Transformation	0.888	0.844	-0.044	0.187976
AC -> Exploitation	0.848	0.809	-0.039	0.191678
AC -> IC	0.659	0.776	0.117	0.953289*
IC -> Org. IC	0.890	0.908	0.018	0.692067
IC -> Tech. IC	0.848	0.709	-0.139	0.028715*

Source: Research Data

Table 5 lists the factor loadings for the two subsets, where subset 1 is the development stage and subset 2 is the maturity stage. It also shows the differences between equivalent factor loadings in the two subsets and the p values indicating the statistical significance of the differences between means for the factor loadings. The p values were calculated using the bootstrapping procedure and indicate the proportion between the two samples. In this case, the p values should be greater than 0.95 or smaller than 0.05 (Henseler, Ringle and Sinkovics, 2009).

There is a greater moderating effect when the constructs absorptive capacity and innovative capability are related to the maturity stage, with a difference of 0.117, equating to a p value of 0.953, in relation to the development

stage. Additionally, the values for the dimensions representing product and process innovation (technological) are lower for the firms in the maturity stage, with a difference of - 0.139 and a p value of 0.028.

The p value shows how in many cases, there is a difference from the mean, i.e., in how many cases the mean for subset 1 is greater or smaller than the mean for subset 2. In the case of the dimensions representing product and process innovation (technological), since the difference was negative, the value of 0.028 indicates that in 97% of cases, the mean of subset 2 was smaller than that of subset 1. In this case, the variable (technological) exhibits a lower weighting when moderated by the Interfirm Knowledge-Sharing stages.

Based on the study data and the tests conducted, it was confirmed that the capacity development stage does moderate the relationship between absorptive capacity and innovation capability and that the maturity stage also moderates the relationship between the two constructs. However, the moderating effect is greater when the constructs absorptive capacity and innovation capability are related to the maturity stage.

It can be observed from Table 4 that there is a greater moderating effect when the constructs absorptive capacity and innovative capability are related to the maturity stage, with a difference of 0.117 and a p value of 0.953. Additionally, the results for the maturity stage subset show that the values for dimensions related to product and process innovation (technological) are lower, with a difference of - 0.139 and a p value of 0.028.

The features shown in Table 5 may imply that at the maturity stage, these organizations may not be so concerned with developing new technologies or processes, or releasing new products and services onto the market, but are more concerned with organizational and market aspects. These are elements related to the concern with valuing employees, generating new ideas, participation in events, fairs, and national and international congresses, and training team members, who are considered responsible for the growth and maturation of the firm. This a stage at which the organizations already have a consolidated product and continue maintaining strong alliances with universities, research centers, suppliers or laboratories and are concerned with strengthening their resources and capacities with organizational and market-related elements.

The capacity development stage, in contrast to the maturity stage, is dependent on the team's experience and the choices made between a set of alternatives. Attempts are made to combine the experiences and knowledge accumulated over time. At this point, organizations are seeking success with products or services, whilst also considering there is utility in seeking the external knowledge necessary for routines and processes, as a means of understanding market demands (Zahra & George, 2002).

Figure 4 below presents the proposed theoretical model, which is based on the constructs studied and includes the results of the applied research.

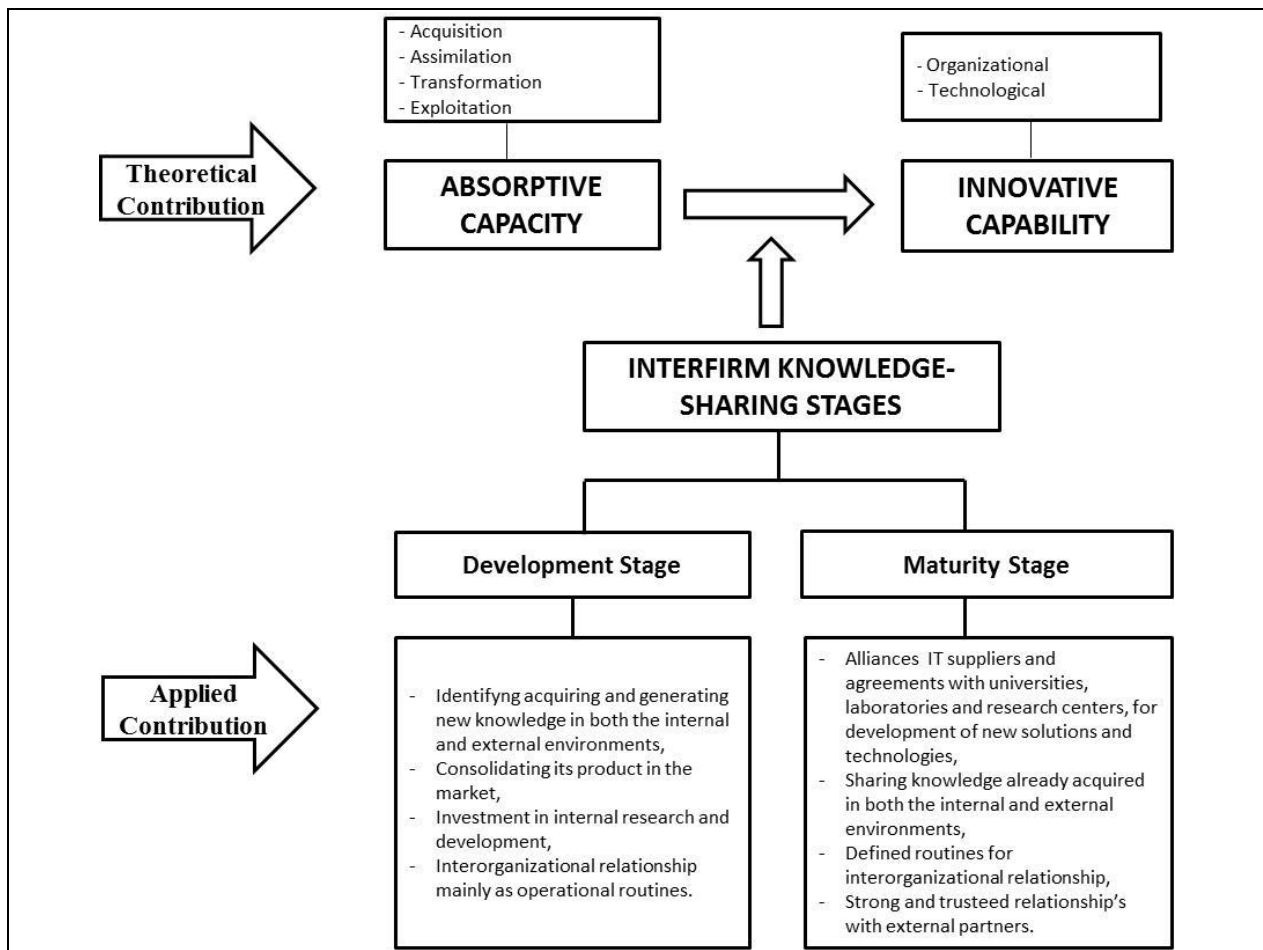


Figure 4. Combination of strategic resources in ITC sector.

Source: Research Data

It is understood that it is possible to combine acquired knowledge and transform the organization's capacities. This is the time to adjust and replicate resources, skills, and competencies to different existing product lines or to new market niches. When seeking new alternatives, the organization may also choose to imitate a capability that exists in a different organization or to develop a capability from scratch.

The organization should constantly share the knowledge acquired, in the internal and external environments, and seek alliances with suppliers, universities, laboratories and research centers. These strategic actions will require the improvement of its resources and develop new solutions and technologies. Along these lines, it is worth highlighting that possible changes in organizations' capacity stages will impact on development of new resources and capacities for generating innovation in those organizations, and it will be necessary to seek new knowledge and promote greater interaction between different actors.

5 FINAL COMMENTS

The objective of this study was to analyze the moderator effect of Interfirm Knowledge-Sharing on the impact of absorptive capacity into creation of innovation capabilities in the Information Technology and Communication (ITC) sector. A theoretical model was proposed based on the theoretical construct of absorptive capacity; on the construct of innovation capability, and on a proposed construct employing two stages of Interfirm Knowledge-Sharing: development and maturity.

The data analysis revealed a positive relation between the constructs absorptive capacity and innovative capability, which confirms the first hypothesis of this study (H1). It was also observed that a relationship was established and a positive moderating effect was present when the constructs absorptive capacity and innovative capability were linked to organizations at the capabilities development stage (0.659). Notwithstanding, it was observed that the relationship was more robust, with a difference of 0.117, when the constructs absorptive capacity and innovation

capability were linked to the maturity stage, which confirms the second hypothesis (H2). Additionally, it was also found that among firms at the maturity stage, the values for dimensions representing product and process innovation (technological) were lower. This implies that organizations at the maturity stage may not be so concerned with developing new technologies or processes, or with launching new products and services on the market, but rather, with organizational and market-related elements.

Based on the data presented and discussed, a combination of characteristics was observed at the maturity stage. The statistical tests confirmed that there is a positive relationship between the constructs absorptive capacity and innovative capability, moderated by with greater moderation by the maturity stage.

The most common core business among the subset of firms at the maturity stage was software development. These organizations range from small, through the medium, to large, and are of note because they have been operating in the ITC market for more than ten years, both nationally and internationally.

These organizations at the maturity stage are also differentiated by the mechanisms for valuing their employees, and also by the generation of new ideas, participation in national and international events, fairs, and congresses, emphasizing investment in research and development of new solutions and technologies. They are also characterized by their possession of defined routines for improving their processes, and for improving current products or developing new products with support from their partners. They are active in the market seeking, new knowledge, partnerships, and alliances, and they train the members of their teams, whom they consider responsible for the growth and maturation of the organization.

Following on from this study, it would be of interest to investigate organizations that internationalize their operations, for which an adapted instrument is suggested, that contains a construct to capture international involvement. It would be useful to determine how the association between absorptive capacity and innovation capacity behaves when related to international involvement by organizations in this industry.

This study has highlighted the importance of combining and sharing acquired knowledge as a means for replicating resources to different product lines or new market niches, and of imitating existing capacities or developing new ones. It underscores the importance of optimizing existing resources and developing new solutions and technologies, and of valuing and training team members. Along these lines, possible changes in organizations' relational capacity stages will impact on development of new resources and capacities, as a means of generating innovation.

Limitations: Interorganizational Knowledge-Sharing was measured in a categorical way, by two characteristic stages. This simplifies the richer gradient of possibilities of interorganizational linkages although there is an integration between the different stages that should be investigated for managerial decision making.

REFERENCES

- Ali, M., Seny Kan, K. A. & Sarstedt, M. (2016). Direct and configurational paths of absorptive capacity and organizational innovation to successful organizational performance. *Journal of Business Research*, 69(11), 5317–5323.
- Aprilyanti, I. and Alon, I. (2017). Bibliometric Analysis of Absorptive Capacity. *International Business Review*, 26(5): 896–907.
- Barney, J. Is the resource-based “view” a useful perspective for strategic management research? yes. (2001). *Academy of Management Review*, 26 (1), 41-56.
- Barney, J. & Hesterly, W. (2007). *Administração estratégica e vantagem competitiva*. São Paulo: Prentice Hall.
- Cabrita, M. do R. (2009). Intellectual capital: a phenomenon of interrelationships. *International Journal of Business and Systems Research*, 3(2), 229–256.
- Camisón, C. & Forés, B. (2010). Knowledge absorptive capacity: New insights for its conceptualization and measurement. *Journal of Business Research*, 63, 707–715.
- Capaldo, A. (2007). Network structure and innovation: The leveraging of a dual network as a distinctive relational capability. *Strategic Management Journal*, 28(6), 585–608.
- Christensen, J. F. (1995). Asset profiles for technological innovation. *Research Policy*, 24 (5), 727-745.
- Ciutiene, R. & Thattakath, E. (2014). Influence of dynamic capabilities in creating disruptive innovation. *Economics and Business*. 26.
- Cohen, W. & Levinthal, D. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 1 (35), 128-152.

- Conway, J. M. & Lance, C. E. (2010). What Reviewers Should Expect from Authors Regarding Common Method Bias in Organizational Research. *Journal of Business and Psychology*, 25(3), 325–334.
- Dyer, J. H. & Kale, P. (2007). Relational capabilities: drivers and implications. In: Helfat, C. (Org.) *Dynamic Capabilities: understanding strategic change in organizations*. UK: Blackwell Publishing, 65-79.
- Dyer, J. H. & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, 23(4), 660–679.
- Eisenhardt, K. & Santos, F. (2000). Knowledge-Based View: A New Theory of Strategy? In: Pettigrew, A., Thomas, H. and Whittington, R. (Eds.). *Handbook of Strategy and Management*. London: Sage Publications.
- Flatten, T. C., Engelen, A., Zahra, S. A. and Brettel, M. (2011). A measure of absorptive capacity: Scale development and validation. *European Management Journal*, 29(2), 98–116.
- Fornell, C. & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 39–50.
- Gallouj, F. (2002). *Innovation in the service economy: the new wealth of nations*. Cheltenham: Edward Elgar.
- Grant, R. M. (1996). Toward a knowledge-based theory of the firm: Knowledge-based Theory of the Firm. *Strategic Management Journal*, 17(S2), 109–122.
- Guan, J. & Ma, N. (2003). Innovative capability and export performance of Chinese firms. *Technovation*, 23(9), 737–747.
- Hair Jr., J., Hult, G., Ringle, C. & Sarstedt, M. (2014). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Los Angeles: SAGE.
- Hauknes, J. (1998). *Services in innovation: innovation in services*. Oslo: STEP group, STEP, Storgaten.
- Helfat, C. E. & Peteraf, M. A. (2003). The dynamic resource-based view: capability lifecycles. *Strategic Management Journal*, 24 (10), 997–1010.
- Henseler, J., Ringle, C. & Sinkovics, R. (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing*, 20, 277–319.
- Hung, H. (2015). Influence of knowledge networking, knowledge base, and knowledge strategy on innovation capability. *Int. J. Business and Systems Research*, 2(9), pp.138-153.
- Jackson, J.D., Yi, M.Y. & Liu, L.C. (2013). The effects of information sharing, collective efficacy and team conflict on system development team performance. *Int. J. Business and Systems Research*, 3 (7), pp.318–337.
- Jansen, J., Van Den Bosch, F. & Volberda, H. (2005). Managing potential and realized absorptive capacity: how do organizational antecedent's matter? *Academy of Management Journal*, 6 (48), 999-1015.
- Jiang, H., Zhao, S., Li, Z. & Chen, Y. (2016). Interaction between technology standardization and technology development: a coupling effect study. *Information Technology and Management*, 17(3), 229–243.
- Jiménez-Jiménez, D. & Sanz-Valle, R. (2011). Innovation, organizational learning, and performance. *Journal of Business Research*, 64, 408-417.
- Kale, D. (2012). Innovative capability development in the Indian pharmaceutical industry. *International Journal of Innovation and Technology Management*, 29 (2).
- Kamuriwo, D. S., Baden-Fuller, C. & Zhang, J. (2017). Knowledge Development Approaches and Breakthrough Innovations in Technology-Based New Firms: Knowledge Development Approaches. *Journal of Product Innovation Management*, 34(4), 492–508.
- Kashan, A. J. & Mohannak, K. (2017). The Role of Knowledge Integration in Capability Development and Emergence of Innovation Ecosystem. *International Journal of Innovation and Technology Management*, 14(05).
- Kogut, B. & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, 3 (3), 383- 397.
- Lane, P., Koka, B. & Pathak, S. (2006). The reification of absorptive capacity: a critical review and rejuvenation of the construct. *Academy of Management Review*, 31 (4), 833-863.
- Miranda, E. & Figueiredo, P. (2010). Dinâmica da acumulação de capacidades inovadoras: evidências de empresas de empresas de software no Rio de Janeiro e em São Paulo. *Revista de Administração de Empresas*, São Paulo, 50 (1), 75-93, Jan/Mar
- Mu, J., Peng, G., & Love, E. (2008). Interfirm networks, social capital, and knowledge flow. *Journal of Knowledge Management*, 12(4), 86–100.
- OECD. (2005). *Manual de Oslo: diretrizes para coleta e interpretação de dados sobre inovação*. 3. ed. [S.l.]: OCDE.
- Oh, K. & Anchor, J. (2017). Factors affecting reverse knowledge transfer from subsidiaries to multinational companies: Focusing on the transference of local Market information. *Canadian Journal of Administrative Sciences*.
- Omri, W. (2015). Innovative behavior and venture performance of SMEs: the moderating effect of environmental dynamism. *European Journal of Innovation Management*, 18 (2), 195-217.

- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y. & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903.
- Powell, W. W.; Koput, K. W. & Smith-Doerr, L. (1996). Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology. *Administrative Science Quarterly*, 41(1), 116–145.
- Rahmandad, H. & Repenning, N. (2016). Capability erosion dynamics. *Strategic Management Journal*, 37, 649-672.
- Rikkiev, A. & Makinen, S. (2013). Technology convergence and intercompany R&D collaboration across business ecosystems boundaries. *International Journal of Innovation and Technology Management*, 10(4).
- Schilling, M. A. (2015). Technology Shocks, Technological Collaboration, and Innovation Outcomes. *Organization Science*, 26(3), 668–686.
- Su, Z., Peng, M. & Xie, E. (2015). Strategy Tripod Perspective on Knowledge Creation Capability. *British Journal of Management*, 1–19.
- Tsai, W. (2001). Knowledge transfer in intraorganizational networks: effects network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal*, 44 (5).
- Tseng, S. (2016). Knowledge management capability, customer relationship management, and service quality. *Journal of Enterprise Information Management*, 2 (29), 202-221.
- Vargo, S. L., Maglio, P. P. & Akaka, M. A. (2008). On value and value co-creation: A service systems and service logic perspective. *European Management Journal*, 26(3), 145–152.
- Wang, C., Rodan, S., Fruin, M. & Xu, X. (2014). Knowledge Networks, Collaboration Networks, and Exploratory Innovation. *Academy of Management Journal*, 57(2), 484–514.
- Wang, G., Dou, W., Zhu, W. & Zhou, N. (2015). The effects of firm capabilities on external collaboration and performance: The moderating role of market turbulence. *Journal of Business Research*, 68(9), 1928–1936.
- Wang, H., Zhao, J., Li, Y., Li, C. (2015). Network centrality, organizational innovation, and performance: a meta-analysis. *Canadian Journal of Administrative Sciences*, 32, 146–159.
- Wernerfelt, B. (1984). The Resource-based View of the Firm. *Strategic Management Journal*, 5, 171-180.
- Winter, J., Battisti, S., Burström, T. & Luukkainen, S. (2018). Exploring the Success Factors of Mobile Business Ecosystems. *International Journal of Innovation and Technology Management*, 15(03).
- Winter, S. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, 24 (10), 991-995, Oct.
- Zahra, S. A. & George, G. (2002). Absorptive capacity: a review, reconceptualization, and extension. *Academy of Management Review*, 17 (2), 185-203.
- Zou, T. & George, G. (2017). The Capacity to Innovate: A Meta-Analysis of Absorptive Capacity and Its Performance Implications. *Academy of Management Proceedings*, (1).

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