

The Differential Relationship between Absorptive Capacity and Product Innovativeness: A Theoretically Derived Framework

İpek Koçoğlu¹, Ali Ekber Akgün¹ & Halit Keskin¹

¹ Gebze Technical University, Faculty of Management, Strategy Department, Gebze/Kocaeli, Turkey

Correspondence: İpek Koçoğlu, Faculty of Management, Gebze Technical University, Gebze/Kocaeli, 41400, Turkey. Tel: 90-262-605-1413. E-mail: ikocoglu@gtu.edu.tr

Received: May 11, 2015

Accepted: June 2, 2015

Online Published: June 25, 2015

doi:10.5539/ibr.v8n7p108

URL: <http://dx.doi.org/10.5539/ibr.v8n7p108>

Abstract

The concept of absorptive capacity is one of the main drivers of new product development. However, absorptive capacity has been treated as a concrete, uni-dimensional proxy targeting R&D context. Explicitly, absorptive capacity variables namely; acquisition, assimilation, transformation, and utilization of external information/knowledge have rarely been theoretically analyzed in relation to firm product innovativeness in the new product development (NPD) literature. Addressing this particular gap in the literature, we develop a conceptual model encapsulating the simultaneous but differential interrelationships between absorptive capacity variables and product innovation in particular. This study contributes to the literature in three ways. First, the theoretical framework proposed highlights the effects of absorptive capacity variables on product innovation. Hence the focus is, on distinguishing product innovation from other innovation types, and building a theoretical background for the relationship of absorptive capacity variables and product innovativeness. Second, based on the extended reconceptualization of absorptive capacity of Zahra and George (2002) this study aims to assess the differential roles of absorptive capacity variables in NPD efforts. Thus we propose the multidimensional operationalization of the construct through; acquisition, assimilation, transformation and utilization capabilities embedded within firm's absorptive capacity. Third, this research integrates absorptive capacity literature to the knowledge management literature through offering a theoretical framework where absorptive capacity is a process consisting of organizational routines which not only acquires but also assimilates, transforms and exploits the knowledge leaning on the basic determinants of knowledge management.

Keywords: absorptive capacity, new product development context, product innovation, acquisition, assimilation, transformation, utilization, conceptual model

1. Introduction

Organizations facing dynamic and turbulent environments which consist of rapid technological advancement, competition at the global level, and quickly changing customer needs, investigate new ways to leverage their new product development (NPD) processes (Zahay, Griffin, & Fredericks, 2004). At this point, the NPD literature highlights the critical role of absorptive capacity, which refers to the ability of an organization to recognize the value of external information/knowledge (Note 1), to assimilate and apply it, for promoting the product innovativeness of firms (Stock, Greis, & Fischer, 2001; Abecassis-Moedas & Mahmoud-Jouini, 2008; Chen, Lin, & Chang, 2009; Tranekjer & Knudsen, 2012). Indeed, no firm can entirely rely on its own internal knowledge capacity and sources to be more responsive, sensitive and flexible in adapting to their new competitive landscapes, and therefore need to combine inflows and outflows of information/knowledge through the absorption of new external information/knowledge (Camisón & Forés, 2011). The complementary knowledge which is different from firm's existing knowledge base and yet related to it is to be further decodified and integrated to the existing technology, products, processes, skills, strategies and competences for a multitude of innovation outcomes (Gebauer, Worch, & Truffer, 2012). Hence a dynamic capability which drives a firm's ability to actively target, acquire, disseminate and exploit knowledge becomes critical in the effectiveness of NPD.

Nevertheless, the growing body of literature on absorptive capacity mainly focuses on firm innovativeness in general as an outcome of absorptive capacity (Cepeda-Carrion, Cegarra-Navarro, & Jiménez-Jiménez, 2012; Chen et al., 2009; Jiménez-Barrionuevo, Garica-Morales, & Molina, 2011; Escribano, Fosfuri, & Tribó, 2009;

Todorova & Durisin, 2007) rather than product innovativeness in particular with the exception of a few studies (Stock et al., 2001; Abecassis-Moedas & Mahmoud-Jouini, 2008; Murovec & Prodan, 2009; Ebers & Maurer, 2014). Thus scholars have identified the relatively limited effort to explicitly specify product innovation as a realized outcome of absorptive capacity (Abecassis-Moeda & Mahmoud-Jouini, 2008; Murovec & Prodan, 2009). Stock et al. (2001, p. 78) asserts that “A potentially relevant construct that has received comparatively little attention with respect to product development is absorptive capacity.... the relationship between absorptive capacity and new product development has been explored in a relatively small subset.” Further Kostopoulos, Papalexandris, Papachroni and Ioannou (2011, p. 1335), for instance, wrote that “Research on absorptive capacity outcomes still lacks integrative examinations of innovation... while extant work falls short in explaining the interrelationship between them.”

The *innovativeness* construct mostly comprises either the spending on R&D per volume of sales (Nieto & Quevedo, 2005; Jiménez-Barrionuevo et al., 2011), similarly the percentage of new or improved products per annual sales (Escribano et al., 2009; Fosfuri & Tribó, 2008), or the supportiveness and permeability of the firm to innovation including the encouragement and appraisal of novel ideas, openness to novelty in organizational programmes, and seeking for technical innovations (Cepeda-Carrion et al., 2012) in the NPD literature so far. However, *product innovation* efforts entail different strategies and have different inputs as well as outcomes (Pavitt, 1984; Martinez-Ros & Labeaga, 2009). For example, according to the study of Pavitt (1984) that identifies between sources of knowledge inputs (i.e. intra-firm, other firm, public infrastructure) for product and process innovations among different sectors, the product innovation is dependent on the internal knowledge (e.g., R&D and patent intensity) of the firm whereas process innovations are related to the scale and complexity of its process technology (i.e. size of production plant, capital/labor ratio).

Specifically, despite the fact that Cohen and Levinthal (1989, 1990) propose a theoretical framework where absorptive capacity leads to innovative capabilities, and some studies in the literature attempt to explore the relationship between absorptive capacity and product innovativeness (Stock et al., 2001; Ebers & Maurer, 2014), there is a limited understanding on how absorptive capacity initiate product development efforts from within through the differential roles of its different dimensions. It would be remarkable to elucidate that Cohen and Levinthal (1990) in their seminal article acknowledged that while absorptive capacity is critical in recognizing the value of external knowledge, firm's internal and path dependent knowledge base could also restrain the firm in leveraging the outside sources of knowledge. Cohen and Levinthal (1990, p. 133) particularly suggest that “...any particular body of expertise could become sufficiently overlapping and specialized that it impedes the incorporation of outside knowledge and results in the pathology of the not-invented-here (NIH) syndrome.” This argument recognizes that the internal stickiness created by specialized knowledge could have varying effects on leveraging knowledge combination, reconfiguration, assimilation, transformation and utilization for NPD. Indeed differential relationship between absorptive capacity dimensions and product innovation is a rather doubtful argument which needs to be clarified in the NPD literature (Kostopoulos et al., 2011). Yet we propose that dimensions of absorptive capacity may have differential impact on product innovativeness. Hence, to allow a systematic evaluation of the diverse interpretations, supporting assumptions and relationships among absorptive capacity, there is a need to specify how it is conceptualized, operationalized and relates differentially to firm outcomes, specifically; product innovativeness.

Since its introduction, absorptive capacity have been the focus of a vast research effort, however pertinent research considers the construct as taken for granted in depending upon R&D context (Bierly III, Damanpour, & Santoro, 2009). This is reflected along the literature in two ways. First, for instance although research on absorptive capacity has grown rich to link the construct with various complex organizational phenomena, prior NPD literature has failed to consider absorptive capacity empirically as a multidimensional construct leading to the reification of the concept (Lane, Koka, & Pathak, 2006). The research has until recently almost exclusively operationalized absorptive capacity through uni-dimensional, quantitative proxies which are indicator of prior knowledge base, such as R&D investment and personnel, patents and academic publications (Mowery et al., 1996; Vueglers, 1997; Stock et al., 2001; Tsai, 2001; Lane & Lubatkin, 2006). Second, although past studies agree on the definition and multidimensional nature of absorptive capacity (Note 2) in theoretical arguments, they study the inter-relations among those dimensions in a linear way. Yet in order to understand the relationship between absorptive capacity and firm product innovativeness, the dimensions of absorptive capacity should be clarified and investigated *simultaneously* (Fosfuri & Tribó, 2008). In this study, we put forward that absorptive capacity is not a single construct or measure, rather it is a *process* involving the dynamic interaction of acquisition, assimilation, transformation and utilization constructs. Such that these constructs are iterative in that each factor contributes to the development of each other, and the reciprocating interactions among the constructs

bring to life the concept of absorptive capacity. Therefore, ignoring, or minimizing, one or more of its components is likely to reduce the real impact of absorptive capacity on product innovation.

This article aims to make the role of absorptive capacity in the NPD context explicit and place an emphasis on the differential relationship absorptive capacity dimensions have with product innovativeness particularly. Therefore, this study: 1) theoretically evaluates the role of co-variant absorptive capacity variables (e.g., knowledge acquisition, assimilation, transformation and utilization) on the firm product innovativeness in particular, 2) challenges the uni-dimensional conceptualization of absorptive capacity, and 3) rely on the process-based conceptualization of absorptive capacity to include the simultaneous effects of acquisition, assimilation, transformation and utilization.

2. Background

Since the publication of Cohen and Levinthal's (1989, 1990) research on absorptive capacity, the ability of organizations to absorb knowledge, attracted considerable attention (Camisón & Forés, 2010). Literature includes many studies investigating the nature and dimensions (Cohen & Levinthal, 1989, 1990; Lane & Lubatkin, 1998; Zahra & George, 2002), measurement and validation (Jiménez-Barrionuevo et al., 2011; Flatten, Engelen, Zahra, & Brettel, 2011), antecedents (Camisón & Forés, 2011, Harrington & Guimaraes, 2005; Murovec & Prodan, 2009) and the consequences of absorptive capacity (Haro-Dominguez, Arias-Aranda, Llorens-Montes, & Ruiz-Moreno, 2007; Kostopoulos et al., 2011; Nieto & Quevedo, 2005; Tu, Vonderembse, Ragu-Nathan, & Sharkey, 2006). Due to the flexible nature of absorptive capacity many studies approach absorptive capacity at different levels: individual (Cohen & Levinthal, 1990), intra-organizational (Szulanski, 1996), organizational (Cohen & Levinthal, 1990; Schmidt, 2010), learning dyad (Lane & Lubatkin, 1998), intra-district (Boari & Lipparini, 1999; Camisón & Forés, 2011) and inter-alliance (George, Zahra, Wheatley, & Khan, 2001; Lee, Liang, & Liu, 2010; Mowery et al., 1996).

2.1 Evolution of Absorptive Capacity

Absorptive capacity first proposed by Adler (1965), appeared as a macro-economic concept defining the ability of the economy to utilize and absorb external information and resources (c.f. Tu et al., 2006). However, due to its multidisciplinary nature, the use absorptive capacity has not been limited to the economy perspective and expanded throughout many fields of research such as organizational learning, industrial economics, resource based view, and dynamic capabilities (Schmidt, 2010; Zahra & George, 2002). Hence, Cohen and Levinthal (1989) first came up with the absorptive capacity at the firm level, originating from the economists' debate that presents new information as the only output of R&D. The authors suggested that R&D not only generates new information but improves firm's ability to identify, assimilate and exploit existing information from the environment and they call it a firm's absorptive capacity. The study particularly focuses on technological knowledge and the dual role of R&D as the generator of new knowledge and absorptive capacity. Cohen and Levinthal (1990, p. 128) in a later study revised the initial definition of absorptive capacity as "... an ability to recognize the value of new information, assimilate it, and apply it to commercial ends" and diversified individual and organizational absorptive capacities. The definition proposed here highlights three capabilities namely; the recognition of value, assimilation and application of external knowledge which constitute the three components of absorptive capacity (Van den Bosch, Van Wijk, & Volberda, 2003) as shown in Figure 1.

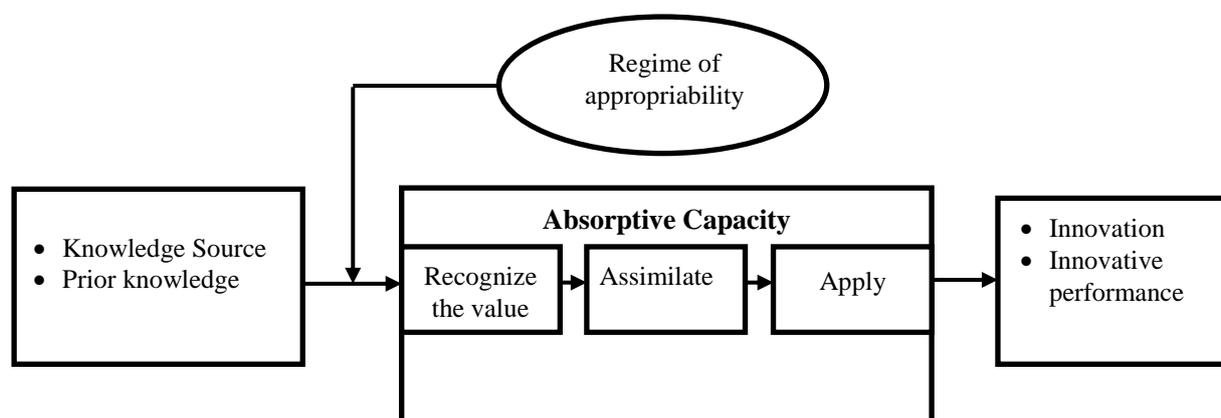


Figure 1. A model of absorptive capacity based on Cohen and Levinthal (1990)

Expanding from the operational definition of Cohen and Levinthal (1990), consequent studies in the literature regarding the concept of absorptive capacity commonly lean on the ability to value knowledge through past experience and investment, ability to assimilate and ability to apply. Literature has few attempts to revise and expand this definition, which results in a consensus regarding the concept (Camisón & Forés, 2010). Indeed the definition of absorptive capacity has minimal divergence from this original definition of Cohen and Levinthal (1990). Cohen and Levinthal (1989), implicitly highlights that absorptive capacity in addition to its primarily focused role in the literature—the external knowledge acquisition—(Chou, 2005; Gebauer et al., 2012; Jiménez-Barrionuevo et al., 2011; Tu et al., 2006), entails a mostly undermined ability—the internal knowledge creation process (Nonaka, 1994) through the assimilation and transformation of collective knowledge (Harrington & Guimares, 2005), for enhanced product innovation efforts. Although studies agree on the definition and multidimensional nature of the absorptive capacity, some research effort is devoted to its reconceptualization (George et al., 2001; Lane & Lubatkin, 1998; Zahra & George, 2002; Lane et al., 2006).

2.2 The Reconceptualization of Absorptive Capacity

One of the first attempts to redefine absorptive capacity is Lane and Lubatkin's (1998) study which regards the concept from an inter-organizational context. The authors introduce a new term coined as relative absorptive capacity. The main difference of relative absorptive capacity from its original ancestor is that it acknowledges various levels of absorptive capacity and its relativity. The authors shift the unit of analysis from organizational level to the pairs of organizations (i.e. student and teacher firms) and define relative absorptive capacity as "the ability of a firm to learn from another firm which is jointly determined by the relative characteristics of the student firm and the teacher firm". According to this view conscious and deliberate management activity is not sufficient to establish inter-organizational learning, rather firms need to recognize and value new external knowledge, assimilate it and utilize it for commercial ends (Lane & Lubatkin, 1998).

Among the fundamental attempts to move absorptive capacity construct away from the original conceptualization is proposing a relational view of absorptive capacity. First Szulanski (1996) examined absorptive capacity within a unit level (i.e. department) to show that the absorption of knowledge is dependent on the motivation and causal ambiguity of the knowledge transferred between units. Dyer and Singh (1998) expanded this relational view and suggested that absorptive capacity of firms is based on social interactions, collaboration and individual relationships. Hence in this perspective absorptive capacity is seen as an iterative process of relational exchange, in contrast to the conventional understanding of absorptive capacity proposed by Cohen and Levinthal (1990) as one-directional learning. Similarly Lane, Salk, and Lyles (2001) focus on joint learning assumes that the transfer of knowledge between the "knowledge absorbing partners" does not insist upon overlapping knowledge bases. These redefinitions of absorptive capacity to include different perspectives were each worthy insights within the field however did not manage to integrate and form a reconceptualization (Murovec & Prodan, 2009).

Furthermore, studies elaborating different conceptualizations and operationalizations of absorptive capacity are ambiguous, such that; these studies neither clarify why these different conceptualizations or dimensions are needed nor how they differ from each other. Hence one of the highly adopted reconceptualizations of absorptive capacity is developed by Zahra and George (2002). The authors inquire "what drives performance differences within the same industry?" which is central in the understanding of a firm's absorptive capacity. Zahra and George (2002) grounds the absorptive capacity construct in the dynamic capabilities literature and underlines that absorptive capacity as a firm's dynamic capability enable the firms to reconfigure its resource base, adapt to dynamic market conditions and achieve competitive advantage. Accordingly absorptive capacity is defined as "...a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability" (Zahra & George, 2002, p. 186). The four capabilities mentioned in the definition namely; acquisition, assimilation, transformation and exploitation constitute the dimensions of absorptive capacity which according to Zahra and George (2002) display differential but complementary roles in achieving various organizational outcomes. Hence this research reformulates absorptive capacity as a four-dimensional model, instead of the traditional three-dimensional model of absorptive capacity. Moreover, it posits that these four dimensions establish the two subsets of absorptive capacity explicitly; potential absorptive capacity and realized absorptive capacity. The first two dimensions of acquisition and assimilation represent the potential absorptive capacity whereas the last two; transformation and exploitation build up to form realized absorptive capacity (Huang, Lin, Wu, & Yu, 2015).

Zahra and George (2002) makes an insightful exploration to present how the four dimensions of absorptive capacity build upon each other and make absorptive capacity an integrative dynamic capability that cultivates innovative organizational outcomes. Accordingly they propose that realized absorptive capacity and potential

absorptive capacity relate to each other through a ratio specified as efficiency factor which is translated as the extent to which firms are able to create value from their potential knowledge base through transforming and exploiting the acquired and assimilated external knowledge. Particularly, if the realized absorptive capacity of firms is high then the degree of value creation from the absorbed knowledge through the existing knowledge base is fostered resulting in performance increase.

Additionally, the proposed model of absorptive capacity consisting of four components recurrently building into two subsets namely realized and potential absorptive capacities, incorporate the role of three dynamics which respectively influence (1) the emergence/development of firm's absorptive capacity, (2) the establishment of a shared understanding and integration of externally absorbed knowledge leading to its exploitation and (3) the achievement of competitive advantage. These dynamics are orderly named as; (i) activation triggers, (ii) social integration mechanisms, and (iii) regimes of appropriability. This framework is shown in Figure 2.

Activation triggers are presented as influencing the responses a firm gives to external stimuli, such that enabling the firms to achieve intensified learning skills and efforts. For instance crises, due to their dangerous and threatening nature stimulate firms to explore, acquire and internalize external knowledge. Activation triggers can be internal or external and manifested in varying intensities. As the intensity of the trigger increases the likelihood of organizations to allocate resources for the assimilation and exploitation of outside knowledge rises (Zahra & George, 2002).

Social integration mechanisms, enhances the exploitation of knowledge acquired and assimilated into the firm through enabling the effective sharing and integration of knowledge. These mechanisms can be embodied through formal ways such as rules, policies, coordinators, and informal ways such as social networks and collaborations. Therefore firms need to boost intra-firm connectedness through investing in structures establishing employee interaction, creative action and flow of information (Zahra & George, 2002).

Lastly regimes of appropriability are expressed through institutional and industry dynamics enable firms to protect the benefits gained through new products and processes in the competitive market. Strong regimes of appropriability warrant the protection of firm's knowledge assets hence translating into greater returns from absorptive capacity and particularly realized absorptive capacity. On the contrary in weak regimes of appropriability the protection of firms' intangible assets is more difficult. In weak regimes of appropriability, the presence of isolating mechanisms that prevent the imitation of firms' resources, products and capabilities allow firms to sustain their competitive advantage (Zahra & George, 2002).

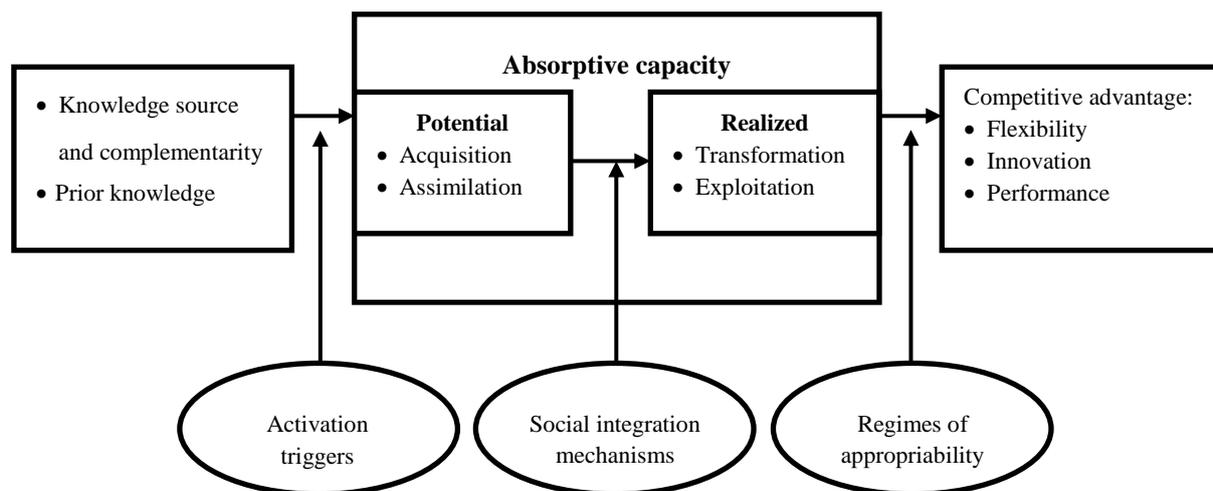


Figure 2. A model of absorptive capacity based on Zahra and George (2002)

2.3 Operationalization of Absorptive Capacity

As suggested by Volberda, Foss, and Lyles (2010, p. 932) "aspects that are 'distinctly organizational' shape a firm's absorptive capacity beyond the sum of employee's individual absorptive capacities." It is therefore necessary to bear in mind that simply adding the knowledge base of the individuals working in the organization

does not lead to the absorptive capacity at the organizational level (Van Den Bosch et al., 2003). Indeed, the narrow focus of the absorptive capacity literature up to date mainly underlining the R&D based operationalization of the concept (Van Den Bosch et al., 2003), calls the attention to the non-R&D context feeding absorptive capacity, which requires further investigation (Matusik & Heeley, 2005).

Some researchers evaluate absorptive capacity in two dimensions, relating the first dimension to the evaluation, acquisition and assimilation of external knowledge and the second dimension to the dissemination and application of this acquired knowledge (George et al., 2001; Heeley, 1997; Kim, 1998). George et al. (2001) considers absorptive capacity as two dimensions and defines it as the firm's ability to evaluate/assimilate and apply knowledge received from external sources such as suppliers, customers, competitors and alliance partners.

Various other researchers (Lane & Lubatkin, 1998; Lane et al., 2001; Matusik & Heeley, 2005; Szulanski, 1996) capture three dimensions of absorptive capacity, such as; the ability to understand, assimilate and apply external knowledge. Lane and Lubatkin (1998) evaluate absorptive capacity as three dimensions namely; ability to understand, assimilate and apply external knowledge. The authors have been pioneers to reinterpret absorptive capacity and develop the relative absorptive capacity concept; as a firm's capacity to equally learn from all other organizations based on the similarities of the student (receiver), and the teacher (sender) firms' knowledge bases, organizational structures (know-how), and compensation policies and dominant logics (know why). Lane and Lubatkin's (1998) study has been one of the preliminary researches to expand the conventional approach that absorptive capacity is measured through the firm's internal R&D, and its spending. It reveals that these constructs explain only 4% of variance in inter-organizational learning as absorptive capacity measures and enlarges the debate to inter-organizational learning level.

On the other hand, one of the most comprehensive researches in the literature regarding the re-conceptualization of absorptive capacity is that of Zahra and George (2002) where the authors adopt a process perspective of absorptive capacity and distinguish between firm's realized and potential absorptive capacities building the theoretical framework on the dynamic capabilities of the firm. Zahra and George (2002, p. 186) have noted that absorptive capacity is "a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to generate a dynamic organizational capability". Accordingly the study enlarges the concept and identifies four dimensions of absorptive capacity namely; acquisition, assimilation as part of potential absorptive capacity; transformation and utilization, as part of realized absorptive capacity. Similarly, Jansen, Van Den Bosch and Volberda (2005) and Todorova and Durisin (2007) adopt the four dimensions subsumed under the two components; realized and potential absorptive capacities. And many studies in the scale development, validation and empirical measurement of absorptive capacity use these dimensions (Flatten et al., 2011; Jiménez-Barrionuevo et al., 2011; Camisón & Forés, 2010; Todorova & Durisin, 2007).

2.3.1 Dimensions of Absorptive Capacity

This study follows the reconceptualization of the absorptive capacity developed by Zahra and George (2002) identifying the dimensions as: acquisition which is "the firm's ability to identify and acquire externally generated knowledge" (p. 189), assimilation; as the analysis, interpretation and internalization of externally obtained knowledge through organizational mechanisms such as routines and processes, transformation; as the ability to combine prior knowledge and newly acquired and assimilated knowledge, and utilization (exploitation); as the firm's capability to incorporate the transformed knowledge into its operations in order to enlarge and improve existing competencies to generate new ones. This reconceptualization enables the researchers to refine the model incorporating the different components, antecedents and consequences of absorptive capacity.

Here, acquisition and assimilation dimensions leverage firms' abilities to receive and recognize the value of external knowledge which are labeled as potential absorptive capacity. The transformation and utilization dimensions instead, serve to leverage the absorbed knowledge as the primary source of performance improvements and are labeled as realized absorptive capacity (Zahra & George, 2002). The potential absorptive capacity enables the firm to be receptive to the outside knowledge, explicitly to identify the degree of value associated in relation to the firm's existing range of activities, products, processes and technologies. Whereas, realized absorptive capacity serves to leverage the knowledge absorbed through transformation and utilization, particularly leading to commercialization of absorbed knowledge, profit generation and increased firm performance (Zahra & George, 2002).

Unlike previous studies, which indicate sequential relationships among the described dimensions of absorptive capacity and hence running the risk of masking the individual effects of the components on the firm innovativeness, we argue that those dimensions are simultaneously occurring and covariant. Covariance refers to the co-occurrence of acquisition, assimilation, transformation and utilization constructs (for instance, acquisition

leads to assimilation and vice versa). This approach explains how absorptive capacity comes about; it encompasses a definite set of events or occurrences, and points out constructs of which absorptive capacity is a function (Ebers & Maurer, 2014). Specifically, this perspective describes the activities or experiences of individuals or organizations and specifies what happens within absorptive capacity (Akgün, Keskin, & Byrne, 2009). In a sense, also as shown in Figure 3 adapted from Andersén and Kask (2012), each dimension represents facets of absorptive capacity that could be a separate construct but remain as the integral parts of absorptive capacity.

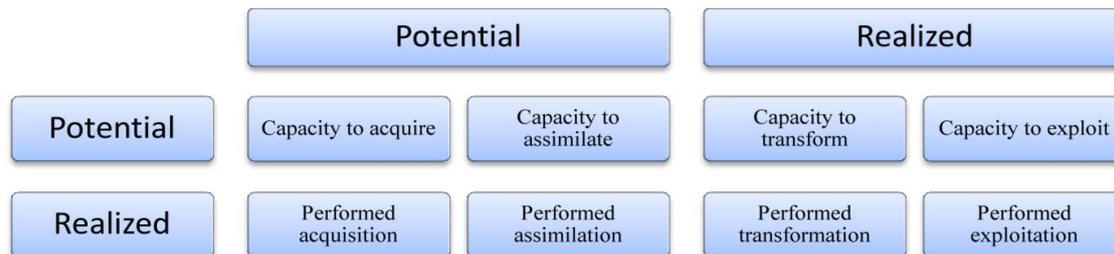


Figure 3. Absorptive capacity dimensions

3. Conceptual Model Development

3.1 Absorptive Capacity and Firm Product Innovativeness

Especially, the scholars argued that through absorptive capacity, firms leverage their product innovativeness by; 1) establishing collaborative networks with external actors; 2) being aware of and identifying the new technological trends and knowledge (Nieto & Quevedo, 2005; Pandza & Holt, 2007; Haro-Dominguez et al., 2007), 3) realizing the similarities between external knowledge and their existing knowledge base, (Abecassis-Moedas & Mahmoud-Jouini, 2008; Lane et al., 2001), and 3) unifying technological knowledge in their outside environments with their internal functions, strategy development and decision making (Murovec & Prodan, 2009; Müller-Seitz, 2012).

We contend that absorptive capacity is positively related to new product development efforts by aiding in developing closer external relationships and cooperation with customers, suppliers, dealers, and even competitors (Murovec & Prodan, 2009). This is such that, greater involvement in the relationships with external partners increases the breadth and depth of information which firms have access to (Murovec & Prodan, 2009), eliminates the risk of being trapped in myopia or rigidities through enabling access to a wider set of knowledge (Pandza & Holt, 2007), thus it promotes effective NPD (Stock et al., 2001). For instance, it is important for firms to build a network of collaborative connections with external actors, such as customers, suppliers, dealers, and even competitors, which allow firms to gain control in the search and selective permeability of knowledge into organizational boundaries (Chen et al., 2009). The recognition and absorption of new and related external knowledge, generates motivations which lead organizations to set continuous relationships with their external network partners, and establish technological cooperation agreements (Koch & Strotmann, 2008; Murovec & Prodan, 2009). Here, reliable, fast and qualified knowledge sharing among the relationship network allows firms to effectively organize and alleviate resources that are targeted to specific customer needs and wants, stimulating product innovation process (Chen et al., 2009). Specifically Nieto and Quevedo (2005) assert that absorptive capacity generates an awareness of the recent technological and scientific advancements cooperate with external parties and provide the ability to benefit from the pool of technological opportunities. Indeed, accumulation of technological knowledge, improvement of technical skills and expertise leverage firm product innovativeness (Haro-Dominguez et al., 2007; Tsai et al., 2011).

Next, absorptive capacity allows firms to borrow and exploit outside knowledge that may not be ready to use for innovation process, but which constitutes the basis for subsequent R&D (Cohen & Levinthal, 1989). Firms, as active searchers, scan the environment for new and useful knowledge, filter and judge alternatives encountered, and following the acquisition of that necessary knowledge (i.e. findings of a research, results of a project outside the firm), it is provided to R&D as an input to be processed (Pandza & Holt, 2007). Hence acquisition efforts develop high quality boundary spanning and knowledge processing systems, resulting in the recognition of unique knowledge for further exploitation. Utilization creates a deeper understanding on the outside technologies

and businesses which enables firms to differentiate themselves from the external environment.

Finally, absorptive capacity endeavors to promote the speed, frequency and magnitude of product innovation by acting as a conduit of inter-organizational information/knowledge sharing (Kostopoulos et al., 2011). Assimilation enables the coordination, systematization and socialization of external knowledge. For instance; assimilation leverages cross-functional interfaces, social linkages, and participative decision making enabling the firm to respond faster to environmental demands as well as developing new products more effectively (Gebauer et al., 2012). Further, a firm's absorptive capacity promotes the new product development endeavors by acting as a medium through which newly acquired information is communicated between different units or departments of the firm (Kostopoulos et al., 2011; Müller-Seitz, 2012). Transformation, allows the communicated knowledge to be combined to the firm's existing knowledge base (Lane et al., 2006). Consequently, the complementary information embedded in different organizational units or departments can be translated into new products through transformation and assimilation of external information (Zahra & George, 2002). Therefore, as shown in Figure 4 we propose that;

P1: Acquisition is positively related to firm product innovativeness.

P2: Assimilation is positively related to firm product innovativeness.

P3: Transformation is positively related to firm product innovativeness.

P4: Utilization is positively related to firm product innovativeness.

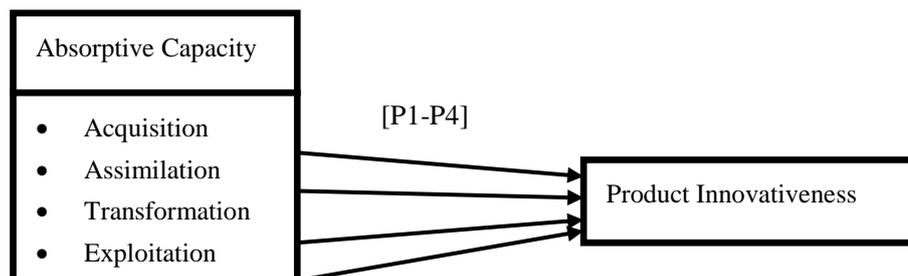


Figure 4. Proposed research model

4. Discussion and Implications

This study offers a threefold contribution to the NPD literature by proposing a conceptual model in which the absorptive capacity variables simultaneously and differentially affect product innovativeness. By highlighting the roles of distinctive absorptive capacity variables, this research provides a framework for researchers and managers to concentrate on the different dimensions of absorptive capacity since they have varying effects on NPD efforts.

First, this study demonstrated the theoretical relationship of acquisition, assimilation, transformation and utilization of external knowledge with product innovativeness. Especially it is proposed that when organizations successfully recognize the value of externally encountered knowledge and acquires it, to further interpret and assimilate, modify, adapt and transform and utilize that external information/knowledge; those firms develop better and faster new products than their competitors. In a sense, absorptive capacity variables help firms to envisage the future and imagine how the new products can be created, before all the necessary knowledge, circumstances or conditions exist. Also, it appears that absorptive capacity enables firms to anticipate the potential developmental path(s) of the technological know-how by recognizing the context around technology and market related information/knowledge, and changes in its environment.

Second, the conceptual model we develop extends the existing literature on absorptive capacity by proposing that absorptive capacity ought not to be regarded solely in R&D context. Investments in R&D strengthen the organizational capabilities, making the imitation of outputs more difficult but this main argument in the absorptive capacity literature should not be regarded as the lack of R&D in firms would lead to a diminishing absorptive capacity. Yet R&D proxies (i.e. investment, patents, citations, employees) though not the only determinants of absorptive capacity are to be considered one of the indicators. Thus, this study denotes that non-R&D efforts are also revelatory in determining the absorptive capacity and NPD relationship. The proposed conceptual model further contributes to the emerging research suggesting that absorptive capacity variables have

distinct but complementary effects on new product development (Ebers & Maurer, 2014) and highlights the non-linear and simultaneous roles of absorptive capacity variables.

Third, this study highlights that absorptive capacity establishes the necessary platform to enable synergistic combination of data and thrives the creative and effective NPD efforts of the employees. Here, absorptive capacity contributes to the knowledge management strategy of the organizations through its ability to recognize the value and necessity of the externally encountered knowledge, share it across the organizational departments, transform it to a common understanding, and apply it for commercial purposes. In particular, it appears that absorptive capacity fulfills the critical success factors needed for effective knowledge management by building collective knowledge acquisition standards on the basis of organization's unique needs, and facilitating the dissemination of stored and acquired knowledge for firm activities. This supports the previous theoretical arguments. Indeed, as explicitly claimed by Gourlay (2006), the managerial authority deciding on whether the knowledge should be created or not as in Nonaka's knowledge creation model does not justify knowledge acquisition, assimilation, transformation and utilization of knowledge since absorptive capacity is a collective process throughout the entire organization. On the opposite knowledge is a collective construct that for its utilization it has to be shaped through a shared meaning and transformed in collaboration with the members using it. Also, parallel with Gourlay's (2006) acknowledgement regarding the creation/conversion of the two types of knowledge; (1) the knowledge-how (i.e. non-reflection everyday life-world knowledge that cannot be referred to as independent of its owner or the situation which it's created through) and (2) knowledge-that (i.e. reflective knowledge of and about things in the symbolic form explicit in nature and detached from its individual owner, subjectified as documents and scientific knowledge), is essential. Particularly, the interaction between human activities and practices need to be emphasized rather than the relation of the two kinds of knowledge (i.e. tacit and explicit). It is seen that absorptive capacity strengthened by previously retained history of events built through formal or informal interactions, reflective or non-reflective everyday-life experience is the means through which knowledge is acquired, transformed and exploited. Therein, it is evident that absorptive capacity not only about the acquisition and assimilation of knowledge but also about its transformation and utilization enables the intra-organizational connectedness, socialization, and coordination in communities of practice which are the main determinants of knowledge management.

Based on this research, management should provide a work environment where organizational knowledge base, standard procedures, and routines are enhanced. Here, organizations should become aware that they should effectively manage existing tacit knowledge within the boundaries of the firm to continuously create new knowledge and combine it with the existing one, which results in successful innovations. Further, management should generate strong linkages with the outside environment, encourage professional relationships with other firms, and establish network alliances in order to have access to alternative knowledge sources, and increase the knowledge sharing through involvement in continuous cooperation efforts. Besides, management should concentrate on the homogeneous diffusion of knowledge throughout the firm, and establish a trust-based and collaborative environment in order for every single entity in the firm to access and exploit the existing and newly acquired knowledge.

4.1 Future Research

Moreover, the use of the information technology for the development, maintenance, and use of the organizational memory is still a matter of concern for managers, and may be included for the development of the model. The concept of absorptive capacity triggers the opportunity for future research. First, since absorptive capacity literature misses the empirical examination of the relationship between absorptive capacity variables and NPD in particular, the proposed theoretical model warrants an empirical investigation. Second, for the purpose of expanding the antecedents of absorptive capacity, the extent to which organizational structure, social, cultural, and technical aspects of the organization context (e.g. social relationships, trust, culture etc.) facilitate or inhibit the establishment of absorptive capacity in organizations can be investigated. Indeed, from a managerial perspective, the drivers of absorptive capacity need to be empirically investigated in depth. This will help managers to understand how to improve a firm's absorptive capacity for a successful product development and process implementation effort. Third, the presented model in this study does not capture the mediators which may possibly influence the relationship between absorptive capacity variables and product innovativeness such as organizational learning and organizational responsiveness, and thus future studies may be extended to include these possible mediating effects (Leal-Rodríguez, Ariza-Montes, Roldán, & Leal-Millán, 2014). Fourth, future studies can incorporate alternative consequences to the model as the outcomes of absorptive capacity. The interrelationships between absorptive capacity variables, and competitive advantage -as a dependent variable- in addition to the product innovation, can be empirically tested in order to develop a richer framework for the study.

Indeed, since dynamic capabilities hold common characteristics, considering absorptive capacity as a dynamic capability implies that (1) even if organizations follow unique paths in achieving a specific dynamic capability the outcome may be similar (i.e. equifinal), (2) the presence of the important commonalities in terms of 'best practices' can render a dynamic capability efficient in various organizations/sectors despite the difference in its form and details and (3) dynamic capabilities do not hold the inimitability and non-substitutability conditions (Eisenhardt & Martin, 2000). Therefore as Eisenhardt and Martin (2000) highlight, the sustainable competitive advantage lying beneath dynamic capabilities (e.g. absorptive capacity) is not always because they are heterogeneous, inimitable and non-substitutable (e.g. in moderately dynamic markets) but because they serve to create new resource configurations by a path-breaking strategic logic of change and predicting the timing of change (e.g. in high-velocity markets) instead of always using the path dependent strategic logic of enhancing existing resource configurations as in moderately dynamic markets. Fifth, despite the views supporting that higher absorptive capacity is needed for higher innovative outcomes, studies could further consider external dynamics such as i-) the varying amount and value of the knowledge encountered in the environment, ii-) the level of intellectual property rights' protection, iii-) complexity of the knowledge, iv-) sectoral competitiveness, and v-) price elasticity (Lane et al., 2006). Finally, environmental and organizational contingencies, such as environmental turbulence and uncertainty, management style and processes, power etc., may be considered to capture the possible moderating effects in the model.

5. Conclusion

Absorptive capacity is one of the main drivers of product innovation in firms. However, how a firm's absorptive capacity can be translated into its new product development efforts and how different absorptive capacity variables can be leveraged to drive product innovativeness is missing and should be further elaborated in the NPD literature. In this study, we propose that absorptive capacity variables have differential and simultaneous effects on firm product development efforts in particular. We contend that most of the research regards absorptive capacity as a uni-dimensional construct and measures it through R&D based proxies thus diminishing the value it can offer from differing perspectives. Although we do not hold that this underestimation of the construct is intentional, it becomes apparent that it results in restraining the research on absorptive capacity to offer limited explanation to "why some firms are better able to leverage their product innovativeness through higher absorptive capacity?" However, distinguishing between different dimensions of absorptive capacity may prove to be fruitful in understanding the process-based and capability view of absorptive capacity as suggested by Zahra and George's (2002) reconceptualization of the construct. Hence, our proposition that distinct absorptive capacity variables may have differential effects on product innovativeness in particular is echoed in the empirical literature such that the different dimensions of absorptive capacity have distinct antecedents and complement each other in affecting innovation outcomes (Ebers & Maurer, 2014). Furthermore, from a theoretical standpoint, this paper provides the motivation for distinguishing product innovation from other types of innovation [e.g. process innovation (Damanpour, 2010) and considers absorptive capacity as a process-based variable having varying effects on product innovativeness. Yet this research just scratches the surface of this important, but understudied, subject. Future researchers will find the area of absorptive capacity and new product development rich and fruitful.

References

- Abecassis-Moedas, C., & Mahmoud-Jouini, S. B. (2008). Absorptive capacity and source-recipient complementarity in designing new products: An empirically derived framework. *Journal of Product Innovation Management*, 25, 473-490. <http://dx.doi.org/10.1111/j.1540-5885.2008.00315.x>
- Adler, J. H. (1965). *Absorptive capacity: The concept and its determinants*. Washington, DC: Brookings Institution.
- Akgün, A. E., Keskin, H., & Byrne, J. (2009). Organizational emotional capability, product and process innovation, and firm performance: An empirical analysis. *Journal of Engineering and Technology Management*, 26, 103-130. <http://dx.doi.org/10.1016/j.jengtecman.2009.06.008>
- Andersén, J., & Kask, J. (2012). Asymmetrically realized absorptive capacity and relationship durability. *Management Decision*, 50, 43-57. <http://dx.doi.org/10.1108/00251741211194868>
- Bierly III, P. E., Damanpour, F., & Santoro, M. D. (2009). The application of external knowledge: Organizational conditions for exploration and exploitation. *Journal of Management Studies*, 46, 481-509. <http://dx.doi.org/10.1111/j.1467-6486.2009.00829.x>
- Boari, C., & Lipparini, A. (1999). Networks within industrial districts: Organising knowledge creation and

- transfer by means of moderate hierarchies. *Journal of Management and Governance*, 3, 339-360. <http://dx.doi.org/10.1023/A:1009989028605>
- Camisón, C., & Forés, B. (2010). Knowledge absorptive capacity: New insights for its conceptualization and measurement. *Journal of Business Research*, 63, 707-715. <http://dx.doi.org/10.1016/j.jbusres.2009.04.022>
- Camisón, C., & Forés, B. (2011). Knowledge creation and absorptive capacity: The effect of intra-district shared competences. *Scandinavian Journal of Management*, 27, 66-86. <http://dx.doi.org/10.1016/j.scaman.2010.11.006>
- Cepeda-Carrion, G., Cegarra-Navarro, J. G., & Jiménez-Jiménez, D. (2012). The effect of absorptive capacity on innovativeness: Context and information systems capability as catalysts. *British Journal of Management*, 23, 110-129.
- Chen, Y. S., Lin, M. J. J., & Chang, C. H. (2009). The positive effects of relationship learning and absorptive capacity on innovation performance and competitive advantage in industrial markets. *Industrial Marketing Management*, 38, 152-158. <http://dx.doi.org/10.1016/j.indmarman.2008.12.003>
- Chou, S. W. (2005). Knowledge creation: Absorptive capacity, organizational mechanisms, and knowledge storage/retrieval capabilities. *Journal of Information Science*, 31, 453-465. <http://dx.doi.org/10.1177/0165551505057005>
- Cohen, W. M., & Levinthal, D. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35, 128-152. <http://dx.doi.org/10.2307/2393553>
- Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: The Two Faces of R&D. *The Economic Journal*, 99, 569-596. <http://dx.doi.org/10.2307/2233763>
- Damanpour, F. (2010). An integration of research findings of effects of firm size and market competition on product and process innovations. *British Journal of Management*, 21, 996-1010. <http://dx.doi.org/10.1111/j.1467-8551.2009.00628.x>
- Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, 23, 660-679.
- Ebers, M., & Maurer, I. (2014). Connections count: How relational embeddedness and relational empowerment foster absorptive capacity. *Research Policy*, 43, 318-332. <http://dx.doi.org/10.1016/j.respol.2013.10.017>
- Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities what are they? *Strategic Management Journal*, 21, 1105-1121. [http://dx.doi.org/10.1002/1097-0266\(200010/11\)21:10/11<1105::AID-SMJ133>3.0.CO;2-E](http://dx.doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::AID-SMJ133>3.0.CO;2-E)
- Escribano, A., Fosfuri, A., & Tribó, J. A. (2009). Managing external knowledge flows: The moderating role of absorptive capacity. *Research Policy*, 38, 96-105. <http://dx.doi.org/10.1016/j.respol.2008.10.022>
- Flatten, T. C., Engelen, A., Zahra, S. A., & Brettel, M. (2011). A measure of absorptive capacity: Scale development and validation. *European Management Journal*, 29, 98-116. <http://dx.doi.org/10.1016/j.emj.2010.11.002>
- Fosfuri, A., & Tribó, J. A. (2008). Exploring the antecedents of potential absorptive capacity and its impact on innovation performance. *Omega*, 36, 173-187. <http://dx.doi.org/10.1016/j.omega.2006.06.012>
- Gebauer, H., Worch, H., & Truffer, B. (2012). Absorptive capacity, learning processes and combinative capabilities as determinants of strategic innovation. *European Management Journal*, 30, 57-73. <http://dx.doi.org/10.1016/j.emj.2011.10.004>
- George, G., Zahra, S. A., Wheatley, K. K., & Khan, R. (2001). The effects of alliance portfolio characteristics and absorptive capacity on performance: A study of biotechnology firms. *Journal of High Technology Management Research*, 12, 205-226. [http://dx.doi.org/10.1016/S1047-8310\(01\)00037-2](http://dx.doi.org/10.1016/S1047-8310(01)00037-2)
- Gourlay, S. (2006). Conceptualizing knowledge creation: A critique of Nonaka's theory. *Journal of Management Studies*, 43, 1415-1436. <http://dx.doi.org/10.1111/j.1467-6486.2006.00637.x>
- Haro-Dominguez, M. C., Arias-Aranda, D., Llorens-Montes, F. J., & Ruiz-Moreno, A. (2007). The impact of absorptive capacity on technological acquisitions engineering consulting companies. *Technovation*, 27, 417-425. <http://dx.doi.org/10.1016/j.technovation.2007.04.003>
- Harrington, S. J., & Guimaraes, T. (2005). Corporate culture, absorptive capacity and IT success. *Information and Organization*, 15, 39-63. <http://dx.doi.org/10.1016/j.infoandorg.2004.10.002>
- Heeley, M. B. (1997). Appropriating rents from external knowledge: The impact of absorptive capacity on firm

- sales growth and research productivity. *Frontiers of Entrepreneurship Research*, 17, 390-404.
- Huang, K. F., Lin, K. H., Wu, L. Y., & Yu, P. H. (2015). Absorptive capacity and autonomous R&D climate roles in firm innovation. *Journal of Business Research*, 68, 87-94. <http://dx.doi.org/10.1016/j.jbusres.2014.05.002>
- Jansen, J., Van Den Bosch, F. A. J., & Volberda, H. W. (2005). Managing potential and realized absorptive capacity: How do organizational antecedents matter? *The Academy of Management Journal*, 48, 999-1015. <http://dx.doi.org/10.5465/AMJ.2005.19573106>
- Jiménez-Barrionuevo, M. M., García-Morales, V. J., & Molina, L. M. (2011). Validation of an instrument to measure absorptive capacity. *Technovation*, 31, 190-202. <http://dx.doi.org/10.1016/j.technovation.2010.12.002>
- Kim, L. (1998). Crisis construction and organizational learning: Capability building in catching-up at Hyundai Motor. *Organization Science*, 9, 506-521. <http://dx.doi.org/10.1287/orsc.9.4.506>
- Koch, A., & Strotmann, H. (2008). Absorptive capacity and innovation in the knowledge intensive business service sector. *Economics of Innovation and New Technology*, 17, 511-531. <http://dx.doi.org/10.1080/10438590701222987>
- Kostopoulos, K., Papalexandris, A., Papachroni, M., & Ioannou, G. (2011). Absorptive capacity, innovation, and financial performance. *Journal of Business Research*, 64, 1335-1343. <http://dx.doi.org/10.1016/j.jbusres.2010.12.005>
- Lane, P. J., & Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal*, 19, 461-477. [http://dx.doi.org/10.1002/\(SICI\)1097-0266\(199805\)19:5<461::AID-SMJ953>3.0.CO;2-L](http://dx.doi.org/10.1002/(SICI)1097-0266(199805)19:5<461::AID-SMJ953>3.0.CO;2-L)
- Lane, P. J., Koka, B. R., & Pathak, S. (2006). The reification of absorptive capacity: A critical review and rejuvenation of the construct. *Academy of Management Review*, 31, 833-863. <http://dx.doi.org/10.5465/AMR.2006.22527456>
- Lane, P. J., Salk, J. E., & Lyles, M. A. (2001). Absorptive capacity, learning and performance in international joint ventures. *Strategic Management Journal*, 22, 1139-1161. <http://dx.doi.org/10.1002/smj.206>
- Leal-Rodríguez, A. L., Roldán, J. L., Ariza-Montes, J. A., & Leal-Millán, A. (2014). From potential absorptive capacity to innovation outcomes in project teams: The conditional mediating role of the realized absorptive capacity in a relational learning context. *International Journal of Project Management*, 32, 894-907. <http://dx.doi.org/10.1016/j.ijproman.2014.01.005>
- Lee, S. C., Liang, H., & Liu, C. Y. (2010). The effects of absorptive capacity, knowledge sourcing strategy, and alliance forms on firm performance. *The Service Industries Journal*, 30, 2421-2440. <http://dx.doi.org/10.1080/02642060802635551>
- Martinez-Ros, E., & Labeaga, J. M. (2009). Product and process innovation: Persistence and complementarities. *European Management Review*, 6, 64-75. <http://dx.doi.org/10.1057/emr.2009.4>
- Matusik, S. F., & Heeley, M. B. (2005). Absorptive capacity in the software industry: Identifying dimensions that affect knowledge and knowledge creation activities. *Journal of Management*, 31, 549-572. <http://dx.doi.org/10.1177/0149206304272293>
- Mowery, D. C., Oxley, J. E., & Silverman, B. S. (1996). Strategic alliances and interfirm knowledge transfer. *Strategic Management Journal*, 17, 77-91. <http://dx.doi.org/10.1002/smj.4250171108>
- Müller-Seitz, G. (2012). Absorptive and desorptive capacity-related practices at the network level – The case of SEMATECH. *R&D Management*, 42, 90-99. <http://dx.doi.org/10.1111/j.1467-9310.2011.00668.x>
- Murovec, N., & Prodan, I. (2009). Absorptive capacity, its determinants, and influence on innovation output: Cross cultural validation of the structural model. *Technovation* 29, 859-872. <http://dx.doi.org/10.1016/j.technovation.2009.05.010>
- Nieto, M., & Quevedo, P. (2005). Absorptive capacity, technological opportunity, knowledge spillovers, and innovative effort. *Technovation*, 25, 1141-1157. <http://dx.doi.org/10.1016/j.technovation.2004.05.001>
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5, 14-37. <http://dx.doi.org/10.1287/orsc.5.1.14>
- Pandza, K., & Holt, R. (2007). Absorptive and transformative capacities in nanotechnology innovation systems. *Journal of Engineering Technology Management*, 24, 347-365.

- <http://dx.doi.org/10.1016/j.jengtecman.2007.09.007>
- Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy*, 13, 343-373. [http://dx.doi.org/10.1016/0048-7333\(84\)90018-0](http://dx.doi.org/10.1016/0048-7333(84)90018-0)
- Schmidt, T. (2010). Absorptive capacity - one size fits all? A firm-level analysis of absorptive capacity for different kinds of knowledge. *Managerial and Decision Economics*, 31, 1-18.
- Stock, G. N., Greis, N. P., & Fischer, W. A. (2001). Absorptive capacity and new product development. *Journal of High Technology Management Research*, 12, 77-91. [http://dx.doi.org/10.1016/S1047-8310\(00\)00040-7](http://dx.doi.org/10.1016/S1047-8310(00)00040-7)
- Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal*, 17, 27-43. <http://dx.doi.org/10.1002/smj.4250171105>
- Todorova, G., & Durisin, B. (2007). Absorptive capacity: Valuing a Reconceptualization. *Academy of Management Review*, 32, 774-786. <http://dx.doi.org/10.5465/AMR.2007.25275513>
- Tranekjer, T. L., & Knudsen, M. P. (2012). The (unknown) providers to other firms' new product development: What's in it for them? *Journal of Product Innovation Management*, 29, 986-999. <http://dx.doi.org/10.1111/j.1540-5885.2012.00974.x>
- Tsai, W. (2001). Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal*, 44, 996-1004. <http://dx.doi.org/10.2307/3069443>
- Tu, Q., Vonderembse, M. A., Ragu-Nathan, T. S., & Sharkey, T. W. (2006). Absorptive capacity: Enhancing the assimilation of time-based manufacturing practices. *Journal of Operations Management*, 24, 692-710. <http://dx.doi.org/10.1016/j.jom.2005.05.004>
- Van Den Bosch, F. A. J., Van Wijk, R., & Volberda, H. W. (2003). *Absorptive capacity: Antecedents, models and outcomes*. ERIM Report Series Reference No. ERS-2003-035-STR. Retrieved from <http://ssrn.com/abstract=411675>
- Veugelers, R. (1997). Internal R&D expenditures and external technology sourcing. *Research Policy*, 26, 303-315. [http://dx.doi.org/10.1016/S0048-7333\(97\)00019-X](http://dx.doi.org/10.1016/S0048-7333(97)00019-X)
- Volberda, H. W., Foss, N. J., & Lyles, M. A. (2010). Absorbing the concept of absorptive capacity: How to realize its potential in the organization field. *Organization Science*, 21, 931-951. <http://dx.doi.org/10.1287/orsc.1090.0503>
- Zahay, D., Griffin, A., & Fredericks, E. (2004). Sources, uses, and forms of data in the new product development process. *Industrial Marketing Management*, 33, 657-666. <http://dx.doi.org/10.1016/j.indmarman.2003.10.002>
- Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, 27, 185-203.

Notes

Note 1. We use the term of information and knowledge interchangeably in this study.

Note 2. Consistent with the management literature, we adapt the four dimensions or variables of Zahra and George (2002) including; acquisition which is the firm's ability to identify and acquire externally generated information/knowledge; assimilation as the analysis, interpretation and internalization of externally obtained information/knowledge through organizational mechanisms such as routines and processes; transformation as the ability to combine prior information/knowledge and newly acquired and assimilated information/knowledge; and utilization as the firm's capability to incorporate the transformed information/knowledge into its operations in order to enlarge and improve existing competencies to generate new ones.

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/3.0/>).