

# **Technological Capability Improvement as Result of the Entrepreneur's Search for Innovation in the SMEs in Colombia**

**Yonni Angel Cuero Acosta**  
**University of Leipzig**

**Md. Noor Un Nabi**  
**University of Leipzig**

**Utz Dornberger**  
**University of Leipzig**

*The improvement of technological capability (TC) is not only a firm-level issue; it is similarly important to the catching-up process and improving national competitiveness. Previous works on TC have generally not paid much attention to the improvement of TC in the micro and small and medium enterprises (SMEs). This paper shows how the mediator role of entrepreneurial orientation (EO) on the relationship between networking capability (NC) and absorptive capacity (AC) of firms contributes significantly to the improvement of TC in the micro and SMEs in Colombia.*

## **INTRODUCTION**

A number of studies in the field of technological capabilities (TC) have only been carried out in large companies in developed countries (Ortega, 2009) or come from newly industrializing economies (NIEs) (Ernst & Kim, 2002; Hobday & Rush, 2007; Kim & et al., 1987; Panda & Ramanathan, 1996). In this sense there is a gap in the literature about the analysis of the TC in micro, small and medium size enterprises (SMEs) in emerging economies (Giuliani & et al., 2005; Romijn, 1999). The concept of TC has been studied as a process with various foci, such as development, acquisition or building up of TC, and the TC's impact has mainly investigated in relation to firms' performance (Acha, 2000; Eternad & Lee, 2001; Lee & et al., 2001; Afuah, 2002; Schoenecker & Swanson, 2002; Vanhaverbeke, 2002; Tsai, 2004; Zahra & et al., 2007). So far, however, there has been little discussion about how to improve TC at the firm level.

Various authors have contributed to define TC. They describe TC as the possession of certain resources or abilities. For instance Figueredo (2002) sees TC as "resources needed to generate and manage improvement in processes and production organization, products, equipment, and engineering projects" (Figueredo, 2002, p.74). This definition places TC at the same level of importance as resources, while other authors differentiate between resources and capabilities<sup>1</sup>. As thinking about TC evolved, it became clear that it is not just a store of knowledge but an ability which can be used. In this sense Panda and Ramanathan 1996 defined TC as "a set of functional abilities, reflected in the firm's performance through various technological activities and whose ultimate purpose is firm-level value management by

developing difficult-to-copy organizational abilities” (Panda & Ramanathan, 1996, p.562). From this perspective TC has the ability to enhance another capability such as marketing capability, but what gives an advantage to the firm is the understanding of how the new enhanced capability works. Following this line, Ortega (2009) points out that TC is the firm’s ability to perform technical functions, to develop new products and processes and to operate the firm’s facilities effectively. It is necessary to highlight the fact that the main goal of TC is to have an impact on products and/or processes. TC is not found exclusively at the production plant level, but can also be found at various levels of the organization; for example Morrison, Pietrobelli and Rabelloti (2007) analyze TC as “skills-technical, managerial or organizational- that firms need in order to utilize efficiently the hardware (equipment) and software (information) of technology and to accomplish any process of technological change” (Morrison, et.al., 2007, p.5). Likewise, Hobday and Rush (2007) point out the process of accumulation of knowledge, experience and skills; furthermore these authors sees TC as a key element to using technology within a firm, as well as to achieving competitive advantage. Their definition of TC is “the accumulated knowledge, skill, experience and organizational base which enable a firm to acquire, develop and use technology to achieve competitive advantage” (Hobday & Rush, 2007, p.1341).

The above definitions highlight various issues about TC at the firm level. Because this research investigates at the firm level, the definition of TC must be rewritten to include the features that a firm has to confront in the use of technology. For this reason this paper will use the Linsu Kim’s definition. Kim (1997) defined TC as “the ability to make effective use of technological knowledge in efforts to assimilate, use, adapt, and change existing technologies, which may result in development of technology and development of new products and process in response to changing economic environment” (Kim, 1997, p.86). For this study the use of such definition is important because it posits the broadest role of TC at the firm level. Because of the relevance of knowledge to enhance TC, it is important to go back one step in the analysis to understand how firms can obtain this knowledge and how they can put that knowledge to use in a practical way which can support the improvement of TC. Firms have their own partners as external sources of technical knowledge. Normally companies network to have access to information or knowledge that can advance their technological development. Additionally, firms have to be entrepreneurial during their activities to overcome their competitors. This entrepreneurial attitude steers the way in which firms use the acquired knowledge from external sources and put that knowledge into process and products. This scenario describes the reality that micro and SMEs confront on a daily basis.

This paper focuses on exploration of the factors that contribute to the improvement of TC within micro and SMEs in Colombia. In doing so, the main contribution of this paper is the analysis of *entrepreneurial orientation (EO)* as a mediator on the relationship between *networking capability (NC)* and *absorptive capacity (AC)*. A firm can have a useful network of partners as well as the ability to efficiently absorb and apply knowledge, but it is the firm’s EO that intervenes to maximize the interaction between both capabilities and their results. This study examines EO, NC and AC because their characteristics (that promote improvement, adaptation and innovation) can enhance the positive effect of AC on a firm's TC. This paper particularly investigates the micro and SMEs which are technology intensive in their operations and which are tagged with the large firms in different industries as their suppliers. These firms generally produce tailor-made products and offer customized solutions to their clients. These companies are known as the technology-intensive suppliers (t-suppliers)<sup>2</sup> (Dornberger & Torres, 2006), which are noted for their contribution to expanding the backward linkage bases (Hirschman, 1958) of different industries in different parts of the world and for there by adding momentum to the national catching-up process (Herniesnemi & et al., 1996; Ramos, 2001; De Obschatko, 1997).

This paper is organized as follows: the next two sections offer the theoretical foundation for the model regarding the connection between NC, EO, AC and TC. The methodology section presents the procedures used to test the hypothesis, and the next section reports the results of the analysis. The discussion section considers the theoretical and practical implications of the findings. The paper ends with the conclusions developed from the results obtained.

## CONCEPTUAL FRAMEWORK

Increased economic development is a priority for all countries, especially for those with emerging economies. This can be achieved through industrialization. A key element for industrialization is the acquisition of technological capability (Kim, 1999a). Industrialization can advance within a country when the country's firms progress technologically. While markets constantly change in terms of technology (technological change), firms have to develop skills to respond to this change. In this regard firms have to carry out technological learning to accumulate TC and to be able to maintain their competitiveness. The concepts of technological change and of technological learning are quite relevant for emerging countries. The concept of technological change developed as a result of thought about evolutionary economic theory. The latter, which is found at the firm level, is investigated through capability literature, which is one subset of the evolutionary approach (Romijn, 1999). Thus, under this theoretical perspective it is understood that a company's response to the market's technological changing environment is through the internal capabilities that the company develops, in this case TC.

This paper investigates TC at the firm level. At this level such capability is acquired through learning. Learning is the core of economic development where the TC plays a fundamental role (Nelson & Winter, 1982; Kim, 1999a). TC is accumulated and embodied in skills, knowledge, experience and organizational systems (Arvanitis & Villavicencio, 1998; Bell & Pavitt, 1993, 1995; Cassen, 1996; Cortes de Castro & Figueredo, 2005; Dutrénit, 2004; Figueiredo, 2002, 2007; Jonker & et al., 2006; Kumar & Kumar, 2008; Romijn, 1999; Romijn & Albaradejo, 2002; Westphal & et al., 1985). The accumulation of TC is described by Dutrénit (2004) as the learning processes involved in the gradual building up of a minimum base of technological knowledge to be able to carry out innovative activities. The nature of the technology strategy followed by firms, the processes of knowledge management inside firms and the characteristics of the national innovation systems determine the level of TC development in the firm (Kim, 1997), while national TC building is more associated with government intervention in terms of the incentives regimes, the factor markets and the institutions that support knowledge and technology development (Lall, 2000; Lall & Pietrobelli, 2002). In a much broader sense, TC development can be conceptualized in different levels for instance at the acquisitive, operative, adaptive, innovative, and supportive and marketing level (Lall, 1992; Bell & Pavitt, 1995; Panda & Ramanathan, 1996; Guifu & Hongjia, 2009). From the perspective of these authors TC can be interpreted as basic or acquisition level when, for instance, a firm has the ability to acquire equipment, blueprints and technical knowledge, intermediate or operative level when the firm has the ability to operate and to manage these elements. Finally the advanced level is achieved when the firm has the ability to improve the possessed technology, and to be able to develop new products or processes.

Rooted in the concept of TC at the firm level, this paper proposes an approach which can explain how micro and SMEs can improve this capability. Specifically, this work draws attention to the need for a comprehensive view of the interaction between factors which can improve a firm's existing TC. Hence, the focus here investigates the mediator role played by EO on a firm's knowledge sources. TC's main input is technological knowledge. Micro and SMEs can acquire knowledge from either external or internal sources. When considering external sources, this paper looks at the relationships between firms and their partners in networks. In this sense NC complements TC. For instance NC's focus is the study of relationships in the sharing of resources and capabilities among firms. Once TC has been acquired by a firm, the major value of this achievement can be seen when the firm is able to put the TC into products and processes. This process can be the starting point for innovations within the firms (Kim, 1999a); however, this process does not appear as a consequence of the TC's acquisition. It has to be created, coordinated and supervised by the entrepreneur<sup>3</sup>. It is at this moment that EO plays a fundamental role in the process in which firms can accumulate, develop or improve TC. EO represents all the decisions which have to be made to steer the technological way that a firm follows. At the firm level TC has been viewed as the acquisition of knowledge as well as the integration of this knowledge into different levels of the organization with the objective of introducing diversity and distinctiveness into the organization in comparison to the competitors in the market (Leonard-Barton, 1995; Prahalad & Hamel, 1990). It is

relevant to investigate the firm's AC in order to understand the acquisition and integration of knowledge which is requisite to increase TC. AC is the ability to use knowledge in a complementary way that can foster the TC.

NC enables a firm to connect its own resources to those of other firms by building relationships (Walter & et al., 2006). NC can be defined as the organization's ability to develop, use and maintain relationships with external partners (Walter & et al., 2006). The relationship between two or more firms is a strategic action that shares resources and capabilities among the parties. This strategic action is the activity that can support the entrepreneurial decision-making process in such a way as to improve TC. Through NC entrepreneurs can have access to the experience of others, which can prevent them from making mistakes that others have made; moreover, entrepreneurs can learn how to be more efficient in the use of their own resources to develop capabilities. Indeed, the knowledge that comes from other firms through relationships makes the NC a supporting factor for EO, too. NC describes how firms join efforts to achieve goals that each firm, acting alone, could not attain easily (Mohr & Spekman, 1994). From the perspective of a single firm, a network provides a set of relationships with various organizations, including customers, suppliers, competitors or public research institutions, relationships which are connected with each other and which create a wider network structure (Cook & Emerson, 1978). NC boosts a firm's abilities to develop and utilize inter-organizational relationships to gain access to various resources held by other actors. This study will use three categories: coordination, relational skills and partner knowledge. *Coordination* refers to the coordination between collaborating firms (Mohr & Spekman, 1994). *Relational skills* include such aspects as communication ability, extraversion, conflict management skills, empathy, emotional stability, self-reflection, sense of justice and cooperativeness (Marshall & et al., 2003) *Partner knowledge* refers to the organized and structured information about a firm's upstream and downstream partners and competitors (Walter & et al., 2006). Partner knowledge allows firms to reduce transaction control costs with their partners. Partner knowledge supports firms' position inside a network, thus entrepreneurs can receive immense support from NC.

Once an entrepreneur has received support from partners, he/she can have a better vision to orient the firm technological path. This paper analyzes the mediator effect of EO on the relationship between NC and AC. Even though NC, EO and AC are capabilities at the firm level, there must be a distinction between the role and the status of each of these capabilities within the firm. This paper assumes that the entrepreneur is the person who decides which kind of relationship should be implemented with external sources, as well as with who. Likewise the entrepreneur establishes the way in which knowledge should be integrated within the different levels of the firm; in other words the orientation of the entrepreneur is the feature which can enhance the AC. Actions that are often viewed in the literature as examples of entrepreneurship are: First when an established organization enters a new business; second when an individual or individuals defend new product ideas within a firm context and third when an entrepreneurial philosophy permeates an entire organization's operations (Covin & Miles, 1999). The third situation is well-known in the literature as entrepreneurial orientation or EO. "EO refers to the processes, practices, and decision-making activities that lead to new entry" (Lumpkin & Dess, 1996, p.136). This research studies the influence of EO in the technological development inside a firm. The assumption is that an entrepreneur with the knowledge that comes from his/her business network can guide the role that AC plays within the firm. EO stimulates AC because the entrepreneur has to share his/her own knowledge with the firm's personnel. The entrepreneur's orientation contributes to increase the acquisition of knowledge which is related to technological aspects in the firm. Entrepreneurs have to assume risks and to have initiative to obtain innovation. For these reasons entrepreneurs are the first source of internal knowledge within micro and SMEs.

The idea of a new entry into the market refers to the offers that a company makes for a market; however, it is necessary to differentiate between entrepreneurship and EO. "That is, new entry explains what entrepreneurship consists of, and entrepreneurial orientation describes how new entry is undertaken" (Lumpkin & Dess, 1996, p.136). Thus it is clear that EO implies a willingness to innovate to rejuvenate market offerings, to take risks to try out new and uncertain products, services and markets and to be more proactive than competitors toward new marketplace opportunities (Covin & Slevin, 1989, 1990, 1991;

Knight, 1997; Namen & Slevin, 1993; Wiklund, 1999; Wiklund & Shepherd, 2005; Zahra, 1993; Zahra & Covin, 1995). At the firm level researches have agreed that EO is based in three dimensions: innovation, proactivity and moderate risk-taking (Miller, 1983; Wiklund, 1999). Innovation can materialize both in the creation of new resources and in new ways of combining available resources (Zahra & et al., 1999). Proactiveness refers to the firm's response to market opportunities and implies an opportunity-seeking perspective (Lumpkin & Dess, 2001; Kreiser, 2002). Risk-taking propensity denotes the willingness to make investments in projects that have uncertain outcomes (Lumpkin & Dess, 1996). In micro and small firms due to their structure, the decisions about routines and acquisition of knowledge are steered by the entrepreneur.

Cohen and Levinthal (1989) define AC as the ability to learn from external knowledge through processes of knowledge identification, assimilation and exploitation. The same authors redefine the absorptive capacity construct as the capacity of a firm to value, assimilate and apply, for commercial ends, knowledge from external sources (Cohen & Levinthal, 1990). Modern economies are not based on capital and labor as much as they are based on knowledge, which has become the key factor of development (Davenport & Prusak, 1998). Firms need to acquire knowledge from external sources to use this knowledge at different levels of the organizations. In a dynamic and turbulent environment knowledge represents a critical resource to create value and to develop and sustain competitive advantages (Teece & et al., 1997). AC contributes to the creation and development of competitive advantage through the management of external knowledge (Camison & Forés, 2010). Additionally Zahra and George (2002) link AC to a set of organizational routines and strategic processes through which firms acquire, assimilate, transform and apply knowledge with the aim of creating a dynamic organizational capacity. The strengthening of the firm's performance comes from this dynamism where the main activities of AC are related to the management of knowledge. This feature makes AC a column of the improvement TC. This paper investigates AC as a key factor which facilitates the improvement of TC within the firm because TC's main component is knowledge and this knowledge must be integrated into the whole organization. "An organization's absorptive capacity will depend on the absorptive capacity of its individual members.... A firm's absorptive capacity is not, however, simply the sum of the absorptive capacities of its employees" (Cohen & Levinthal, 1990, p.131). Once the AC of a company has received the influence of EO, AC contributes to the improvement of the TC that the company already has.

## **Hypothesis**

Knowledge accumulation and learning inside the firm depends on a set of subjective and objective routines targeted to bring knowledge inside the firm from outside, exploiting the knowledge inside the firm, generate learning from the exploitation of knowledge, internalize the learning inside the firm and apply the learning further to generate a more advanced level of knowledge. Based on this line of thought and on the theoretical background, this paper proposes a new method of analyzing the factors which contribute to the improvement of TC. The proposed model consists of the study of the interplay between NC, EO and AC as prerequisite for the improvement of TC. The model states that EO has a positive mediator role on the relationship between NC and AC. EO benefits from the knowledge that comes from relationships with other firms. Entrepreneurs' philosophy, vision and the way of operating greatly influence the determination of what routines the firm sets to maintain the connectivity between a firm and its external environment, such as market, institutions and other agents who are the repositories of the extant and potential knowledge. The knowledge obtained from relationships with other firms heightens EO; thus, the entrepreneur can share his vision and knowledge with all of the organization's departments to make decisions in terms of how to improve the firm's TC. The EO also influences the other set of objective routines that set out the way the firm internalizes knowledge and learning produced inside the firm. This internal process of absorption of and application of knowledge is the operationalization of AC which is a key element for the improvement of TC. Thus EO can foster and enhance AC. It should be noted that there is no literature to support this attempt to employ EO as a mediator variable. This is a new exploratory perspective of the EO approach. The hypothesis which this paper tests is the mediator model

itself. The model assumes that the mediator role played by EO on the relationship between NC and AC allows the AC to have a positive impact on the improvement of TC.

## Methodology

### *Operational Definition of the Constructs and Their Measurements*

Table 1 contains the operationalization of the constructs that have been used in this paper as well as their corresponding indicators and their measurements.

**TABLE 1**  
**OPERATIONALIZATION OF THE CONSTRUCTS**

<b>Constructs</b>	<b>Operational definition</b>	<b>Components</b>	<b>Number of indicators*</b>
Entrepreneurial Orientation (EO)	Firm's behavior demonstrating procativeness, risk taking propensity, innovativeness and competitive aggressiveness	Innovation (INNO) Proactiveness and Competitive aggressiveness (PCA)	09
	(Ripolles & et al., 2007; Miller, 1983; Lumpkin & Dess, 1996)	Risk taking (RISKT)	
Absorptive capacity (AC)	Firm's ability to learn from external knowledge through processes of knowledge identification, assimilation, and exploitation	Assimilation (ASSIM) Transformation (TRANM)	11
	(Cohen & Levinthal, 1989; Camison & Forés, 2010)	Application (APLIC)	
Networking capability (NC)	Ability to develop relationship with, coordinate the interaction with and gather knowledge about the partners and agents outside the firm  (Walter & et al., 2006)	Coordination (COORD)	09
		Relational skills (RELS)  Partner knowledge (PAKN)	
Technological capability (TC)	Combination of technology acquiring capability (TAC), technology operational capability (TOC) and technology shifting capability (TSC)  (Guifu & Hongjia, 2009)	Technology acquiring capability (TAC)	10
		Technology operational capability (TOC)  Technology shifting capability (TSC)	

\*All indicators were measured with a 1-7 point Likert scale: 1= totally disagree. 2= disagree. 3= partially disagree. 4= indifferent. 5= partially agree. 6= agree. 7= totally agree.

### *Sample and Data*

Micro and SMEs based in Cali (Colombia) and engaged in production of technology-intensive products or specialized knowledge-intensive solutions acting as suppliers to large firms were included in this research. For instance these firms produce rollers to clean rice, tailor-made spare parts, industrial furnaces and tailor-made metalwork. The Cali Chamber of Commerce has provided listing of 280 such firms, of which 114 were operating. 114 firms were contacted during the period of September -December 2010 with an invitation to fill in a questionnaire designed for this research, 85 questionnaires were returned. Five questionnaires were incomplete, and 80 questionnaires were finally retained, making the sample size 80, which represents 70 percent of the population. All of the 80 companies are machinery manufacturers. The sample is made up of 59 micro enterprises, 20 small enterprises and 1 medium-sized enterprise<sup>4</sup>. Average employment size of the sampled firms was 9, while the maximum was 60. Average age of the sampled enterprises was 12, while the maximum was 51.

### *Analytical Methods*

Both descriptive and inferential statistics have been applied to analyze the collected data. Bivariate correlation, linear multiple regressions and a mediation model were applied to draw inferences from the data. First after the data collection, it was applied descriptive analysis of the constructs. Second correlation analysis was applied to learn the relationships between constructs. Third to understand in which way EO, NC and AC work to support the improvement of TC, it was necessary to analyze the mediation effect. This mediation effect presented significant results which support the theoretical foundation of this paper. According to the literature review, the mediation effect of EO has not been tested before.

## **RESULTS**

### **Quality Criteria of the Model**

Table 2 shows the quality criteria of the model. The constructs are superior to the criteria of 0.85 in the composite reliability. The R Square ( $R^2$ ) for the relationship between the constructs NC and EO is 0.1409, this shows that NC can explain the strengthening of EO; the  $R^2$  between EO and AC is 0.3101 and between AC and TC is 0.4519. These two relationships are statistically significant. Also the results of the AVE and the composite reliability of the constructs are substantially higher. The mediator model and its statistics results are shown in the Figure 2.

**TABLE 2**  
**QUALITY CRITERIA OF THE MODEL**

	$R^2$	Redundancy	AVE	Composite Reliability	Communality
NC	0.0000	0.0000	0.6730	0.9486	0.6730
EO	0.1409	0.0660	0.5117	0.8788	0.5117
AC	0.3101	0.1506	0.5234	0.8679	0.5234
TC	0.4519	0.2564	0.5719	0.9000	0.5719

**FIGURE 1  
MEDIATOR MODEL RESULTS**

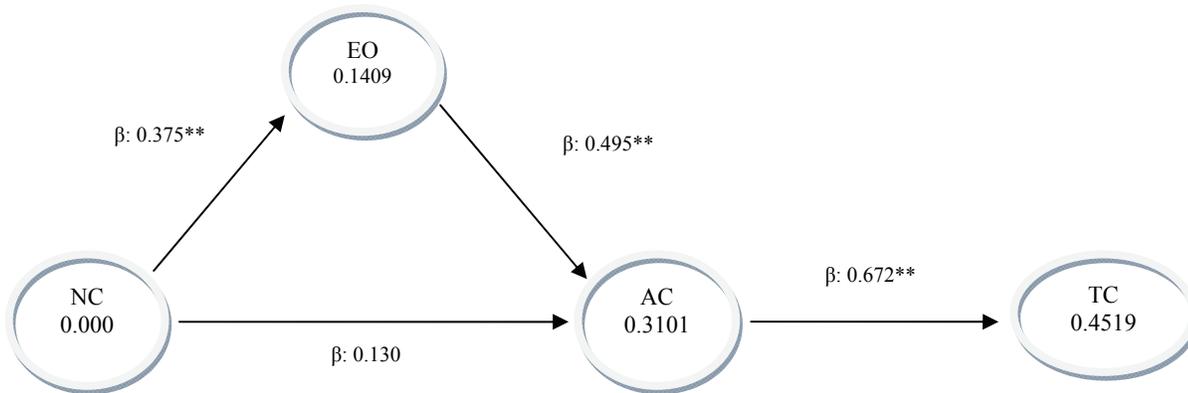


Figure 1 shows that EO acts as a mediator between NC and AC. This model confirms the assumption that entrepreneurs use the external sources of technical knowledge to foster their internal ability to address the assimilation of that knowledge in the various organizations' levels. Once the AC is addressed by the entrepreneur, the TC can be improved. Table 3 shows mediation results which have been calculated through the indirect effect generated by a particular mediator in this case EO; the statically validity of the indirect effect has been determined by using the Sobel test. The indirect effect of EO is a statistically valid effect, as the Sobel test score is a statistically significant score. The result of the model (NC<sup>x</sup>->AC<sup>y</sup>->EO<sup>z</sup>) proves the existence of a valid mediating model where EO mediates the relationship between NC and AC.

**TABLE 3  
PATH COEFFICIENTS**

	Mediation results						
	R <sup>2</sup>	B	t	Std. Error	Indirect Effect	Sobel	P
NC <sup>x</sup> → EO <sup>z</sup>	0.1409	0.375	4.1920	0.0895	0.1856250	2.93950769	0.00328734
EO <sup>z</sup> → AC <sup>y</sup>	0.3101	0.495	4.1263	0.1200			

<sup>x</sup>Independent <sup>y</sup>Dependent <sup>z</sup>Mediator

## DISCUSSION

The hypothesis that this paper tested was a mediator model itself. The model states that the mediator role played by EO on the relationship between NC and AC allows the later to have a positive impact on the improvement of TC. Based on the statistical results, this hypothesis is proven. EO mediates the relationship between NC and AC. Ellram (1991) pointed out that NC supports a firm's abilities to share information related to technology and to new product development with other firms. Among various needs firms network because of a lack of TC (Brouthers, 1995). NC is a source of technological knowledge, and firms can access knowledge and expertise from partners (Ellram, 1990; Morgan & Moncska, 1995). In this regard the paper's mediator model shows that NC is important as a source of knowledge for other capabilities. NC is the starting point in the interplay between capabilities that could improve a firm's competitiveness. To have a network is not enough; it is the ability to network that

matters (Schmitz & Gentry, 2000). Firms acquire knowledge from external sources through NC; this knowledge is guided by the firm's EO to enhance AC. This path is the prerequisite to strengthen the TC that firms already possess. In this sense NC strengthens the performance of EO within a firm. The knowledge which comes from partners can trigger EO by giving expertise and technical information that leads to innovations or improvements within the firm (Schmitz & Gentry, 2000).

Entrepreneurship research has investigated EO and its characteristics such as innovativeness, risk-taking and proactivity (Soininen & et al., 2011). EO guides firms to establish relationships with its partners, and how the knowledge taken from these relationships go through the various organizations' levels. This use of knowledge allows entrepreneurs to enhance a firm's AC. Chen et al. (2012) have pointed out the effects of EO on innovative activities and technological development within an organization. Although the confirmation of the paper's hypothesis was expected, there is no support in the literature for this mediator model attempt. In this regard this paper shed a new light on the understanding of EO's role. EO as a firm-level construct has to be analyzed from a broad perspective to show its interaction as a leading and influential factor to other capabilities. Likewise, this finding shows that the entrepreneurial vision of a firm, which starts from the entrepreneur's initiative, is the key contributor to the firm's development. In a practical way the stimulation of EO within firms can ensure that companies develop competitive advantage and strengthen the economic growth of the region and country. Strongest EO's components such as innovativeness, risk-taking and proactivity confer more opportunities to increase the firm's competitive advantage. Furthermore, EO boosts the effect of AC. AC requires not only the entrepreneur's experience and knowledge, but also the entrepreneur's perspective, to achieve effective combination of knowledge. It is the effectiveness of the assimilation, application and transformation of knowledge which shows the relevance of AC at the firm level.

This paper investigates the factors that contribute to the improvement of TC within micro and SMEs in Colombia. A firm's competitiveness depends on how well the company responds to market needs. TC is a fundamental concept for micro and SMEs which have to respond to market pressures. The findings of this research show that AC can significantly drive the improvement of TC. The process of acquiring TC requires absorptive capacity (Kim, 1999b). The main function of AC is to use knowledge effectively to raise the firm's capabilities. Murovec and Prodan confirmed the importance of AC for innovation and for the competitiveness and growth of firms (2009). AC allows firms to create value and to gain and sustain a competitive advantage through the management of external knowledge (Camison & Forés, 2010). Firms can assimilate, transform and apply knowledge and develop it in order to become more dynamic organizations in terms of responding to the changes in their contexts. This paper, however, shows that AC requires the firm to have an entrepreneurial attitude which facilitates the processes related to the management of technical knowledge. This knowledge is the basis to acquire, operate, manage and shift technology. Knowledge facilitates innovation in products and processes within firms. For this reason AC is vital to the improvement of TC. TC is focused on the specific task of applying knowledge to improve the management of technology. The skill of the firm in using that knowledge which has come from AC facilitates the use technology. In other words AC is what produces the improvement of TC. It is necessary to point out that although AC is the factor which has a direct impact on TC, the previous interaction between NC and EO is fundamental to enhancing AC. Once AC stimulates TC, the results of this relationship could be seen in the progression of products and processes upgraded. In this sense this allows the firm to compete with more differentiated products. TC effectively uses technological knowledge to build up industrial competitiveness (Lall, 1990; OECD, 1996; Kim 1999a; Schacht, 1997).

In the introduction this paper asks the following question: How can firms acquire and put knowledge to use in a practical way which can support the improvement of TC? The previous paragraphs explain how the mediator model answers this question. It is important inumerate the specific characteristics of an entrepreneur. Entrepreneurs' attitudes toward or the way assuming risks influence on the way their firm invest their critical resources in developing their offers for their market. In the Colombian context micro and SMEs are largely risk averse, yet the firms have a tendency to act proactively to beat out the competition. At the same time EO contributes to a firm's internal ability to use technical knowledge. TC

symbolizes the accumulated technological knowledge the firm employs when developing new products/services and improving existing ones (Kyleheiko & et al., 2011).

## CONCLUSION

This paper has showed which factors contribute to the improvement of TC. Having achieved this outcome firms can strengthen their competitiveness because of the obtained upgraded products and processes which can result from this improvement. The improvement of TC has been directly explained by the relationship between NC, EO and AC. EO acts as a mediator on the relationship between NC and AC. In the context of emerging economies, this research has presented the Colombian case in which due to the lack of effective support for micro and SMEs, the primary way to address the improvement of TC within micro and SMEs is by enhancing into entrepreneurial orientation. In emerging economies EO acts as the primary stimulant for capability development and improvement, while in developed countries it is primarily initiated by the national system of innovation. This paper illustrates the need in emerging countries for the consolidation not only a national innovation system but also effective promotion policies to micro and SMEs that support the entrepreneurship at the firm level. AC's significant role toward the improvement of TC establishes the fact that the knowledge held not only by the manager but also by the employees, and the internalization of the knowledge in different levels of the firm ensures the expected capability output. Even though the majority of the organizational structures in the paper's sample were not complex, the AC construct showed its relevance at the firm level, where the fact of being micro or SMEs is a positive characteristic that makes faster the decision process in terms of technical knowledge sharing within the firm. NC plays a vital role as a source of resources, information and knowledge; however, more effective governmental policies are needed to foster sectors which can impact the potential of Colombian micro and SMEs. These results show that governments in emerging economies can foster economic growth by strengthening of the entrepreneurial spirit and expanding the channels which allow micro and SMEs to obtain knowledge.

## ENDNOTES

1. "Resources can be tangible assets such as facilities and process technology, or intangible, as in the case of patents, brand name, reputation and trade secrets...A capability refers to a firm's capacity to deploy and reconfigure those resources to improve productivity and achieve strategic goals" (Ortega, 2009, p.2).
2. A literature review shows there is a consensus that t-suppliers are companies that provide equipment and/or machinery to other firms that use the equipment and/or machinery in production; moreover, t-suppliers provide knowledge-intensive services (Torres, 2010).
3. An entrepreneur is understood to be a person who generated an idea for a business which today is materialized in a firm.
4. According to the Colombian national law 590 of 2000; the definition of SMEs is based on the number of employees working at the firm, thus micro enterprises have 1-10 workers, small enterprises have 11-50 workers and medium enterprises 51-100 workers.

## REFERENCES

- Acha, V. (2000). The role of technological capabilities in determining performance: the case of the upstream petroleum industry. *The DRUID conference of industrial dynamics*. Hillerod.
- Afuah, A. (2002). Mapping technological capabilities into product markets and competitive advantage: the case of cholesterol drugs. *Strategic Management Journal*, 23, 171-179.
- Arvanitis, R. & Villavicencio, D. (1998). Introduction: Comparative Perspectives on Technological Learning. *Science Technology & Society*, 3, (1).

- Bell, M. & Pavitt, K. (1993). Technological Accumulation and Industrial Growth: Contrasts between Developed and Developing Countries. *Science Policy Research Unit*. University of Sussex, Brighton. Oxford university press.
- Bell, M. & Pavitt, K. (1995). The Development of Technological Capabilities. *Trade, Technology and International Competitiveness*, Washington, DC, the World Bank, 69-101.
- Brouthers, K.D., Brouthers, L.E. & Wilkinson, T.J. (1995). Strategic alliances: choose your partners. *Long Range Planning*, 28, (3), 18-25.
- Camison, C. & Forés, B. (2010). Knowledge Absorptive Capacity: New Insights for its Conceptualization and Measurement. *Journal of Business Research*, 63, 707-715.
- Cassen, R. & Lall, S. (1996). Lessons of East Asian Development. *Journal of the Japanese and International Economies*, 10, 326-334.
- Chen, Y-C., Li, P-C. & Evans, K.R. (2012). Effects interaction and entrepreneurial orientation on organizational performance: insights into market driven and market driving. *Industrial Marketing Management*. Doi: 10.1016/J.indmarman.2012.01.017.
- Cohen, W. & Levinthal, D. (1989). Innovation and Learning: the Two Faces of R&D," *The Economic Journal*, 99, (397), 569-596.
- Cohen, W. & Levinthal, D. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35, (1), special issue: Technology, organizations, and innovation, 128-152.
- Cook, K. & Emerson, R. (1978). Power equity and commitment in exchange networks. *American Sociological Review*, 43.
- Cortes de Castro, E. & Figueiredo, P. (2005). Does Technological Learning Pay off? Inter-firm Differences in Technological Capability-Accumulation Paths and Operational Performance Improvement. *Research Policy*, 31, 73-94.
- Covin, J. & Miles, M. (1999). Corporate entrepreneurship and the pursuit of competitive advantage. *Entrepreneurship Theory and Practice*, 23, (3), 47-65.
- Covin, J. & Slevin, D. (1989). Strategic management of small firms in hostile and benign environments. *Strategic Management Journal*, 10, (1), 75-87.
- Covin, J. & Slevin, D. (1990). New venture strategic posture, structure and performance: an industry life cycle analysis. *Journal of Business Venturing*, 5, 123-135.
- Covin, J. & Slevin, D. (1991). A conceptual model of entrepreneurship as firm behavior. *Entrepreneurship Theory and Practice*, 16, 7-25.
- Davenport, T.H. & Prusak, L. (1998). *Working knowledge: how organizations manage what they know*. Harvard Business school press, Boston, MA.

- De Obschatko, E. (1997). Articulacion productiva apartir de los Recursos Naturales. El Caso del Complejo Oleaginoso Argentino. *Working Papers ECLAC*, 74.
- Dornberger, U. & Torres, C. (2006). Kritische Faktoren für die Entwicklung von technologie-intensiven Zulieferunternehmen in Volkswirtschaften mit hoher Ausstattung an natürlichen Ressourcen. In *Kleine und mittelgroße Unternehmen im globalen Innovationswettbewerb*, Rainer Hampp Verlag, München.
- Dutrénit, G. (2004). Building Technological Capabilities in Latercomer Firms: a Review Essay. *Science Technology & Society*, 9, 209.
- Ellram, L. (1990). The supplier selection decision in strategic partnerships. *Journal of purchasing and materials management*, 26, (4), 8-14.
- Ellram, L. (1991). A managerial guideline for the development and implementation of purchasing partnerships. *International journal of purchasing and materials management*, 27, (3), 2-8.
- Ernst, D. & Kim, L. (2002). Global Production Networks Knowledge Diffusion and Local Capability Formation. *Research Policy*, 31, 1417 - 1429.
- Etemad, H. & Lee, Y. (2001). Technological capabilities and industrial concentration NICS and industrialized countries: Taiwanese SMEs versus Southern Korean chaebols. *International Journal of Entrepreneurship and Innovation Management*, 1, (3), 329-55.
- Figueiredo, P. (2002). Learning Processes Features and Technological Capability-Accumulation: Explaining Inter-Firm Differences. *Technovation*, 22, 685-698.
- Figueiredo, P. (2007). Industrial Policy Changes and Firm-Level Technological Capability Development: Evidence from Northern Brazil. *World Development*, 36, (1), 55-88.
- Giuliania, E., Pietrobelli, C. & Rabelloti, R. (2005). Upgrading in Global Value Chains; Lessons from Latin American Clusters. *World Development*, 33, (4), 549-573.
- Guifu, G. & Hongjia, M. (2009). Technological Capabilities and Firm Upgrading: an Empirical Study of High-Tech Firms. *International Conference on Information Management, Innovation Management and Industrial engineering*, Xi'an, December.
- Herniesnemi, H., Lammi, M. & Ylä-Anttila, P. (1996). *Advantage Finland: The Future of Finnish Industries*. Editor: Rouvinen, P. ETLA, SITRA, Helsinki.
- Hirschman, A. (1958). *The strategy of economic development*. New Haven. Yale. University press.
- Hobday, M. & Rush, H. (2007). Upgrading the Technological Capabilities of Foreign Transnational Subsidiaries in Developing Countries: The Case of Electronics in Thailand. *Research Policy*, 36, 1335-1356.
- Jonker, M., Romijn, H. & Szirmai, A. (2006). Technological Effort, Technological Capabilities and Economic Performance a Case Study of the Paper Manufacturing Sector in West Java. *Technovation*, 26, 121-134.
- Kim, L., Lee, J. & Lee, J. (1987). Korea's Entry into the Computer Industry and its Acquisition of Technological Capability. *Technovation*, 6, (4), 277-93.

- Kim, L. (1997). *Imitation to Innovation: The Dynamics of Korea's Technological Learning*. Boston, Massachusetts USA, Harvard Business School Press.
- Kim, L. (1999a). *Learning and innovation in economic development*. Northampton, Massachusetts USA. Edward Elgar publishing limited.
- Kim, L. (1999b). Building technological capability for industrialization: analytical frameworks and Korea's experience. *Industrial and corporate change*, 8, (1).
- Knight, G. (1997). Cross-cultural reliability and validity of a scale to measured firm entrepreneurial orientation. *Journal of Business Venturing*, 12, (3), 213-225.
- Kumar, U., Kumar, V. & De Grosbois, D. (2008). Development of Technological Capability by Cuban Hospitality Organizations. *International Journal of Hospitality Management*, 27, 12-22.
- Kyläheiko, K., Jantunen, A., Puumalainen, K., Saarenketo, S. & Tuppura, A. (2011). Innovation and internationalization of growth strategies: the role of technological capabilities and appropriability. *International business review*, 20, 508-520.
- Lall, S. (1990). Building industrial competitiveness in developing countries. *Development center, organization for economic cooperation and development*: Paris.
- Lall, S. (1992). Technological Capabilities and Industrialization. *World Development*, 20, (2), 165-186.
- Lall, S. (2000). Export Performance, Technological Upgrading and FDI Strategies in the Asian Newly Industrializing Economies: with Special Reference to Singapore. *Series Desarrollo Productivo*, 88.
- Lall, S. & Pietrobelli, C. (2002). *Failing to Compete: Technology Development and Technology Systems in Africa*. Cheltenham: Edward Elgar.
- Lee, C., Lee, K. & Pennings, J. (2001). Internal capabilities, external networks, and performance: a study on technology-based ventures. *Strategic Management Journal*, 22, 615-40.
- Leonard-Barton, D. (1995). *Wellsprings of Knowledge*. Boston, Massachusetts USA, Harvard Business School Press.
- Lumpkin, G. & Dess, D. (1996). Clarifying the Entrepreneurial Orientation Construct and Linking It to Performance. *The Academy of Management Review*, 21, (1), 135-172.
- Lumpkin, G. & Dess, G. (2001). Linking two dimensions of entrepreneurial orientation to firm performance. The moderating role of environment and industry life cycle. *Journal of Business Venturing*, 16, (5), 429-451.
- Marshall, G., Goehel, D. & Mocrief, W. (2003). Hiring for success at the buyer-seller interface. *Journal of business research*, 56, 247-255.
- Miller, D. (1983). The Correlates of Entrepreneurship in Three Types of Firms. *Management Science*, 29, (7), 770-791.

- Mohr, J. & Spekman, R. (1994). Characteristics of partnership attributes, communication behavior, and conflict resolution techniques. *Strategic management journal*, 135-152.
- Morgan, J.P. & Monczka, R.M. (1995). Alliances for new products. *Purchasing*, 12, 103-9.
- Morrison, A., Pietrobelli, C. & Rabellotti, R. (2007). Global Value Chains and Technological Capabilities: A Framework to Study Learning and Innovation in Developing Countries. Department of International Development. University of Oxford. *SLPTMD Working Paper Series*, 005.
- 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.
- Namen, J. & Slevin, D. (1993). Entrepreneurship and the concept of fit: a model and empirical tests. *Strategic Management Journal*, 14.
- Nelson, R. & Winter, S. (1982). *An evolutionary theory of economic change*. Harvard Uni. Press. Cambridge, USA.
- OECD (organization for economic cooperation and development), (1996). Industrial competitiveness. Directorate for science, technology and industry, OECD: Paris.
- Ortega, M. (2009). Competitive strategies and firm performance: technological capabilities' moderating roles. *Journal of Business Research*, 63, (12), 1273-1281.
- Panda, H. & Ramanathan, R. (1996). Technological Capability Assessment of a Firm in the Electricity Sector. *Technovation*, 16, (10), 561-588.
- Prahalad, C. K. & Hamel, G. (1990). The Core Competencies of the Corporation. *Harvard Business Review*, 68, (3), 79-91.
- Ramos, J. (2001). Complejos Productivos en Torno a los Recursos Naturales: ¿Una Estrategia Prometedora?, *ECLAC Books*, 61, Santiago de Chile, ECLAC.
- Ripollés-Melia, M., Menguzzato-Boulard, M. & Sanchez-Peinado, W. (2007). Entrepreneurial Orientation and International Commitment. *Journal of International Entrepreneurship*, 5, 65-83.
- Romijn, H. (1999). *Acquisition of Technological Capability in Small Firms in Developing Countries*. New York, USA, St. Martin's Press.
- Romijn, H. & Albaladejo, M. (2002). Determinants of Innovation Capability in Small Electronics and Software Firms in South East England. *Research Policy*, 31, 1053-1067.
- Schacht, W.H. (1997). Industrial competitiveness and technological advancement: debate over government policy. *Congressional research service*: Washington, DC.
- Schmitz, J. & Gentry, J. (2000). A network comparison of alliance motives and achievements. *Journal of business & industrial marketing*, 15, 5, 301-322.
- Schoenecker, T. & Swanson, L. (2002). Indicators of firm technological capability: validity and performance implications. *IEEE Trans Eng Manage*, 49, (1), 36-44.

Soininen, J., Martikainen, M., Puumalainen, K. & Kyläheiko, K. (2011). Entrepreneurial orientation: growth and profitability of Finnish small-and-medium-sized enterprises. *International journal of production economics*. Doi: 10.1016/J.ijpe.2011.05.029.

Teece, D., Pisano, G. & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, 18, (7), 509-533.

Torres-Fuchslocher, C. (2010). Understanding the development of technology-intensive suppliers in resource-based developing economies. *Research policy*, 39, 269-277.

Tsai, K.H. (2004). The impact of technological capability on firm performance in Taiwan's electronics industry. *The Journal of High Technology Management Research*, 15, (2), 183-95.

Vanhaverbeke, W., Cuysters, G. & Beerkens, B. (2002). Technological capability building through networking strategies within high-tech industries. Eindhoven Center for Innovation Studies (ECIS) working paper series 01.15, *Eindhoven Center for Innovation Studies (ECIS)*.

Walter, A., Aver, M. & Ritter, T. (2006). The Impact of Network Capabilities and Entrepreneurial Orientation on University Spin-off Performance. *Journal of Business Venturing*, 541-567.

Westphal, L., Kim, L. & Dahlman, C. (1985). Reflections on the Republic of Korea's Acquisition of Technological Capability, in Nathan Rosenberg and Claudio Frischtak, *International Technology Transfer: Concepts, Measures, and Comparisons*, New York; 167-221.

Wiklund, J. (1999). The sustainability of the entrepreneurial orientation-performance relationship. *Entrepreneurship Theory and Practice*, 24, (1).

Wiklund, J. & Shepherd, D. (2005). Entrepreneurial orientation and small business performance: a configurational approach. *Journal of Business venturing*, 20.

Zahra, S.A. (1993). A conceptual model of entrepreneurship as firm behavior: a critique and extension. *Entrepreneurship Theory and Practice*, 17.

Zahra, S.A., Neubaum, D.O. & Larrañeta, B. (2007). Knowledge sharing and technological capabilities: the moderating role of family involvement. *Journal of Business Research*, 60, (10), 1070-9.

Zahra, S.A. & Covin, J. (1995). Contextual influence on the corporate entrepreneurship-performance relationship: a longitudinal analysis. *Journal of Business Venturing*, 10, (1), 43-58.

Zahra, S.A., Jennings, D.F. & Kuratiko, D.F. (1999). The antecedents and consequences of firm-level entrepreneurship: the state of the field. *Entrepreneurship Theory and Practice*, 24.

Zahra, S.A. & George, G. (2002). Absorptive capacity: a review, reconceptualization and extension. *Academy of Management Review*, 27, (2), 185-203.

Web pages:

Departamento Administrativo de Ciencia, Tecnología e Innovación. Área de Normatividad. <<http://www.colciencias.gov.co/normatividad/ley-590-de-2000>>. Accessed on Jan. 26, 2011.