

# PROYECTO PHD

## The Improvement of Technological Capability in Colombia

### ABSTRACT

In this research I study the role of dynamic capabilities in the improvement of an operational capability such as Technological capability (TC). In doing so, I investigate as research object the TC impact on Technology-intensive Suppliers (TIS) located in Cali, Colombia. I argue that TC is a fundamental factor to the technological progress of developing countries. At the same time, this capability supports the structural change countries require to leave behind the dependence on natural resources. To achieve this structural change in countries such as Colombia is required more sophisticated production. Despite that TIS are mainly micro, small and medium sized firms (MSMEs), they significantly contribute to the economic development of countries. In this research was applied an interview face to face with entrepreneurs. After the data collection, statistical analysis was applied in order to examine how dynamic capabilities impact on the improvement of TC within MSMEs.

### INTRODUCTION

Technological capabilities (TC) is a complex concept, which has been developed within the business management literature. This capability is fundamental in the development of countries when these countries shift their economic structures. At the same time, TC plays an splendid role within firms; especially, those firms which operate as technology-intensive suppliers (TIS) (Cuero Acosta, Nabi, & Dornberger, 2012; Cuero Acosta, Torres, & Dornberger, 2013; Cuero Acosta, Torres, & Dornberger, 2014; Dornberger & Torres-Fuchslocher, 2006; Torres-Fuchslocher, 2006; Torres, 2014).

### MSMEs, Economic Growth and Technological Development

The role play by micro, small and medium-sized enterprises (MSMEs)<sup>1</sup> have a considerable and increasing participation within the economies of developed and developing countries during the last decades. Independently, which kind of country is analyzed, these types of firms are contributing to the strengthening of productivity (Altenburg & Eckhardt, 2006; OECD & UN-ECLAC, 2012), competitiveness and technological progress within their economies. Authors also highlight the

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<sup>1</sup> Hereafter in this research, I am going to use interchangeably the acronyms MSMEs and SMEs to refer a micro, small and medium-sized enterprises because among literature and institutions when it is described micro companies they are included without distinction in the term SMEs.

magnitude of the MSMEs impact on economic development because they are the vast majority of firms and the major driver of growth (Ayyagari, Demircug-kunt, & Maksimovic, 2013; Bartelsman, Haltiwanger, & Scarpetta, 2004; Farouk & Saleh, 2011; Ferraro, 2011; Reeg, 2013; Tambunan, 2006). In this line of thought, authors recognize MSMEs not only as backbone of the economy (Amini, 2004; Gupta, Guha, & Krishnaswami, 2013; IBRD & WB, 2013; Khalique, Isa, Nassir, & Ageel, 2011; Peters & Waterman, 1982; Radam, Abu, & Abdullah, 2008) but also as a fundamental factor for social development (Alvarez & Duran, 2009; Gupta et al., 2013). Having a look of the number of firms around the world, it can be seen that the large and the growing firms are MSMEs. To illustrate this, Kushnir, Mirmulstein, & Ramalho (2010) studied 132 economies in the world showing that there are “125 million formal MSMEs of which 89 million operate in emerging markets” (pp.2). Similarly, Stein, Goland, & Schiff, (2010) established that there are between 80 and 100 million formal MSMEs in emerging markets. The two studies corroborate the importance of the small firms in number. At the same time, Robu (2013) stated that small firms contribute between 60-70% of job creation around the world as well as the MSMEs represented the 99% of the total firms in the globe. If one have a look in the particularly situation of developing countries, the MSMEs participation within the GDP is accounted by 33% and the contribution to employment is almost 45% (Stein, Goland, & Schiff, 2010). In the specific situation of Latin America OECD & UN-ECLAC (2012) reported that as well as the global tendency small firms represent 99% of the enterprises in the region and these firms generate 67% of the employment. Undeniably, the way in which MSMEs expand can facilitate the growth of any economy.

### **Innovation in MSMEs**

The difference between the obtained improvement of industrial production, which contributes to a betterment of the socioeconomic conditions in developed countries and the Latin American countries' results, can be explained because of the differences in productivity and innovation, as well. Currently, innovation<sup>2</sup> is the main input to increase productivity by countries. In order to develop a more innovative production capacity, developing countries need to change their economic structure to incorporate the needs of MSMEs in terms of production and modernization. Therefore, the structure change that Latin American countries are demanded is related to the obtaining of economic growth through the development of more sophisticated output with the inclusion of MSMEs. This implies that

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<sup>2</sup> “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (OECD, 2005).

countries have to generate sectors where the activities are more knowledge-intensive as well as more technology-intensive (ECLAC, 2010).

Despite the relevance of innovation for the firms' performance, in the case of Latin America especially in Colombia, firms have presented many constraints to achieve innovations within their processes and products. This means that companies have to be able to develop their own capabilities to assimilate knowledge from external sources and to apply that knowledge in their processes and products. One more central aspect is that because the lack of innovations, MSMEs are behind of the levels of large firms in the topic (Katz, 2006). Katz (2006) added that firms should develop TC in order to close the gap between large firms in terms of novelty. The low level of TC explains in part why Latin America do not substantially progress (Cimoli, Porcile, & Rovira, 2010). MSMEs have to be seen as developer of TC which is a previous stage to achieve innovations (Sobanke, Adegbite, Ilori, & Egbetokun, 2014).

## **LITERATURE REVIEW**

In this literature review I present an analysis of the works which are considered central on TC literature development. Numerous studies investigating TC have been carried out on large companies or companies who are competing at the technology frontier. Several attempts have been made to understand the accumulation and the process of building up TC (Fonseca & Figueiredo, 2014; Mendes & DuBois, 2012). The evolutionary theory of economic growth has explicated how countries can manage technology in terms of use and adaptation to local conditions (Molina-Domene & Pietrobelli, 2012). Technology is needed to compete in markets, especially now that markets are globalized. In the globalization context the ability to manage technology is vital to competitiveness (Gonzalez & Da Cunha, 2012). This use of technology allows countries to answer the markets' changes in terms of technology and innovation. In the case of countries such as Colombia, "since the late 1970s literature on technology and development has emphasized the acquisition of [TC] in developing countries as a crucial determinant of successful industrialization" (Romijn H. , 1997, pp. 359). A successful industrialization requires that country's firms are competitive. To be competitive countries have to stimulate the accumulation and development of capabilities within firms. Among the various capabilities that firms can possess, TC is quite significant to achieving technological change. Although works on TC literature have paid little attention to the dynamic at the firm level of organizational capabilities, it is in this area where firms can find sources of knowledge to build their own competitiveness (Ortega, 2009).

## **Evolution of TC Concept**

The literature has examined the concept of TC as a key element of the development of technological change within countries. On the one hand the development of indigenous technology is seen as a factor in achieving economic growth. On the other hand this development can be interpreted as a requisite to achieving innovation capacity. “There is a large consensus within economic and social theories about the fact that technological change represents the engine of development and even of progress. More specifically, innovation is considered the determinant of economic growth, productivity, competitiveness, and employment” (Archibugi, Denni, & Filippetti, 2009, pp. 917). Preliminary works in the analysis of technology as a complex concept was undertaken by Stewart (1977) who pointed out the need to understand technology not only as the tenure of machinery by firms but also the development of skills and knowledge to produce by the firms’ workers. The first intent to define those skills established the definition of TC as the firm’s ability “to transform inputs into outputs” (Fransman & King, 1984, pp. 33). Authors such as Cimoli, Dosi, & Stiglitz, (2009) added their arguments to support this definition. Although this definition is simple, it focuses on the essential role that TC plays within a firm, to help the firm obtain new products. In this same line Westphal, Rhee, Kim & Amsden (1984) associated the concept of TC with production and investment, establishing a relationship between the accumulation of TC and the increase of Korea’s production capacity. Following this line of thought Westphal, Kim & Dahlman defined TC as: “The ability to make effective use of technological knowledge, it is primary attribute of human and institutional capital. It inheres not in the knowledge that is possessed but in the use of that knowledge and in the proficiency of its use in production, investment and innovation” (Westphal, Kim, & Dahlman, 1985, pp. 171). This definition takes into account more elements, such as knowledge, production, investment and innovation.

Later, the TC concept took a more elaborated definition as “the ability to make effective use of technological knowledge in efforts to assimilate, use, adapt, change, or create new technology” (Kim, Lee, & Lee, 1987, pp. 278). These authors highlighted the need to manage technological knowledge within firms through various stages such as assimilation, use and creation, both knowledge which comes from outside of the companies as well as the employees’ expertise have to be combined to benefit the firms’ technological development. The early 1980’s can be seen as the first steps in the path of the TC’s concept development where the highlights were the issue of transform knowledge into certain functional abilities. Notwithstanding, it is important to highlight that during this stage of the concept’s evolution, organizational capabilities were not take into account. It is not until the 90’s that TC concept started to have complex definitions. In this perspective a central definition in the TC

literature was written by Bell & Pavitt. These authors formulated the following definition of TC: “Technological capabilities consist of the resources needed to generate and manage technical change, including skills, knowledge and experience, and institutional structures and linkages” (Bell & Pavitt, 1993, pp. 163). Soon in the 1990’s the same celebrated authors Bell & Pavitt (1995) contribute to this body of literature incorporating into their own definition the organizational perspective. Indeed, TC is defined as “the resources needed to generate and manage technical change” (Bell & Pavitt, 1995, pp. 78). Here TC is seen as factor which can be developed and integrated to the various level of a firm. This means that TC is not only an attribute of the R&D department but also it can be a feature of the various units within a firm. Regardless, these authors barely studied the role of specific organizational capabilities in the TC’s path.

Kim expanded his own definition creating one that has been widely used in the literature: “TC refers to the ability to make effective use of technological knowledge to assimilate, use, adapt, and change existing technologies. It also enables one to create new technologies and to develop new products and processes in response to the changing economic environment” (Kim, 1997, pp. 86). The main contribution here is the incorporation of the firm’s context. It means that the development of TC is crucial to the firm’s capacity to answer the market pressures. The globalization process creates a faster changing environment for firms; for this reason firms have to have high level of TC to be innovative. At the end of the 1990’s most works were related to the definitions above. One great contributor to TC literature has been Diester Ernst who brought the concept in a narrow definition as “the great variety of knowledge and skills which firms need so that they can acquire, assimilate, use, adapt, change and create technology” (Ernst, 1998, pp. 17). One relevant aspect which can be inferred from the definitions above is that they put in a central place the use of the human resources. The daily activities done by workers have a significant impact on TC at the firm. For example, many authors pointed out the relevance of skills and experience and routines (Arvanitis & Villavicencio, 1998; Bell & Pavitt, 1993, 1995; Cassen & Lall, 1996; Cortes de Castro & Figueiredo, 2005; Dutrénit, 2004; Figueiredo, 2002b, 2007; Jonker, Romijn, & Szirmani, 2006; Kumar, Kumar, & De Grosbois, 2008; Romijn, 1999; Romijn & Albaradejo, 2002; Torres-Fuchslocher, 2010; Westphal, Kim, & Dahlman, 1985).

In the first decade of the 21<sup>st</sup> century, the concept of TC has continued its evolution. For instance, Morrison, Pietrobelli & Rabelloti defined TC as: “The 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. Capabilities are firm-specific

knowledge, made up of individual skills and experience accumulated over time” (Morrison, Pietrobelli, & Rabellotti, 2007, pp. 5). What is new here it is the acknowledgment of TC as the result of a process that takes time to have a significant accumulation and requires firms’ capabilities. Currently, TC has been associate to generation of a competitive advantage. Hobday & Rush wrote “TC can be defined as 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, pp. 1341). After I studied the literature about TC, I will use in this dissertation the definition wrote by Morrison, Pietrobelli & Rabellotti (2007) because it encompasses all the relevant internal as well as external aspects at the firm level.

### **TC Taxonomy**

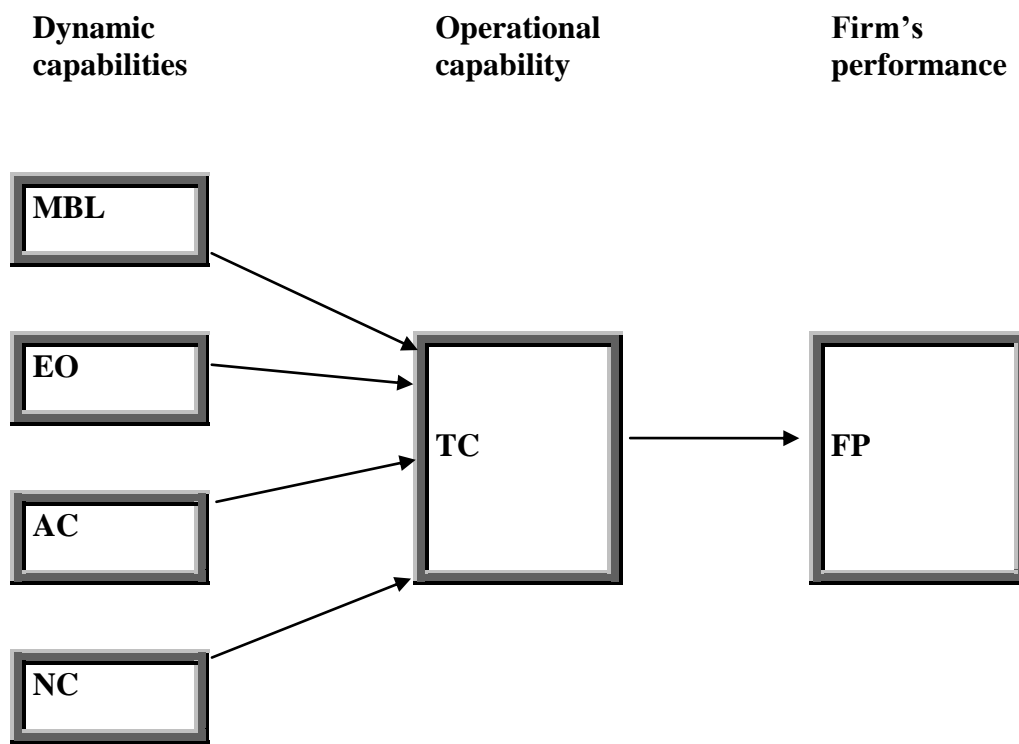
The main method to study TC has been the use of technical functions to classify the firms’ technological level (Lall, 1992; Ariffin & Figueiredo, 2003; Figueiredo, 2002a, 2002b; 2008; Rasiah, 2003, 2004, 2011). Indeed, the main TC categorization was developed by Lall (1992) based on previous works (Dahlman & Westphal, 1982; Dahlman, Ross-Larson & Westphal, 1987; Katz, 1984, 1987; Lall, 1987). Lall’s taxonomy has been extended and improved over time giving rise to subsequent models which are the fundamental works of TC literature. These works have investigated the various categories of TC. Among these derived models the most respected are those conducted by Bell & Pavitt (1993), Hobday (1995), Ariffin & Figueiredo (2003) and recently Guifu & Hongjia (2009). In this dissertation I will use the taxonomy proposed by Guifu & Hongjia (2009). These authors have a practical approach using as main categories the technological acquiring, technological operating and technological shifting capability. This classification is narrower but at the same time facilitates the analysis of the process of improvement of TC within a firm. Technological acquiring capability refers to capabilities to acquire new knowledge through formal and informal channels. Technological operating capability refers to capabilities to operate, use and sustain production equipment and facilitates. The technological shifting capability refers to capabilities to improve greatly on products and processes depending on firm’s own strength and adjust the current product and process parameters according to changing market demands (Guifu & Hongjia, 2009).

### **Main Gaps in TC Literature**

After reviewing the TC literature I found interesting gaps which needed to be fulfilled. First, TC concept has not yet been applied in the perspective of MSMEs in developing countries. Second, TC has mostly been analyzed as accumulation or building up process, while the analysis of the improvement of

TC has not yet been examined. Third, TC requires to be improved to perform in a more competitive way the daily activities. In doing so, it is necessary to have a better understanding of how dynamic capabilities contribute to the improvement of TC. Fourth, as TC is a vital capability in the performance of TIS and TIS are quite important for the economic development of developing countries, it is interesting for me to have a clear picture about the possibilities of these kinds of firms in terms of the improvement of their performance. To fulfill these gaps in the literature I designed my research to explore the relationships between dynamic capabilities and TC. I present the rationalization of my research design as following.

**Figure 1** Analytical Framework



## **METHODOLOGY**

I propose the exploratory analysis of the relationships between some dynamic capabilities. Specifically, I here summarize the constructs MBL, EO, AC and NC and TC. I measure these constructs with a Likert scale from 1 to 7. In the following table I present the operationalization of the constructs.

Table 1 Operationalization of the Constructs

Constructs	Operational definition	Components	Number of indicators	Comparative measurement of own in respects of the market leader
Entrepreneurial Orientation (EO)	Firm's behavior demonstrating proactiveness, risk taking propensity, innovativeness and competitive aggressiveness. (Ripolles, Menguzzato, & Sanchez, 2007; Miller, 1983; Lumpkin & Dess, 1996)	Innovation (INNO) Proactiveness and Competitive aggressiveness (PCA) Risk taking (RISKT)	09	<b>1-7 point Likert scale:</b> <i>1= Totally disagree.</i> <i>2= Disagree.</i> <i>3= Partially disagree.</i> <i>4= Indifferent.</i> <i>5= Partially agree.</i> <i>6= Agree.</i> <i>7= Totally agree.</i>
Absorptive capacity (AC)	Firm's ability to learn from external knowledge through processes of knowledge identification, assimilation, and exploitation. (Cohen & Levinthal, 1989; Camison & Forés, 2010)	Assimilation (ASSIM) Transformation (TRANM) Application (APLIC)	11	
Networking capability (NC)	Ability to develop relationship with, coordinate the interaction with and gather knowledge about the partners and agents outside the firm. (Walter, Auer, & Ritter, 2006)	Coordination (COORD) Relational skills (RELS) Partner knowledge (PAKN)	09	
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). Technology operational capability (TOC). Technology shifting capability (TSC)	10	

### Data Collection

MSMEs, those that are 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. The Cali Chamber of Commerce contained a listing of 280 such firms, of which 114 were operating. Primarily 114 firms were contacted during the period of September – December 2010 with an invitation to fill-in a questionnaire designed for this research, 85 answered questionnaires came back. Five questionnaires were incomplete, and 80 questionnaires were retained finally which made the sample size 80, which represents 70% of the companies. All of the 80 companies are machinery manufacturers. The sample is made up with 59 micro enterprises, 20 small enterprises, and 1 medium enterprise<sup>3</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. Both descriptive and inferential statistics have been applied for analyzing the collected data. Bivariate correlation, linear multiple regression and mediation model have been applied to draw inference from the data. First, after the collection of the data, descriptive analysis of the constructs was applied. Then, correlation analysis

<sup>3</sup> 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.



was applied to find out the relation between constructs. Also, the linear multiple regressions showed that the constructs have strong relation amongst themselves.

**RESULTS**

In this section I will present the statistical results of the exploratory study that I conducted in Cali, Colombia. These results show how TIS in Cali can use their own abilities to pursue the improvement of TC.

**Reliability**

It is necessary to evaluate the internal consistency of the constructs that the survey is examining. In doing so, I use the common criterion which is the Cronbach’s Alpha. This criterion illustrates the reliability between the items which form the constructs under study (Hair, Hult, Ringle, & Sarstedt, 2014). In Table 2 I show the statistics results for the reliability of the constructs.

Table 1 Constructs Reliability

Constructs	Constructs Reliability Statistics	
	Cronbach’s Alpha	Total items
MBL	0,89	8
EO	0,86	9
AC	0,80	11
NC	0,940	9
TC	0,79	10
FP	0,79	11

As a rule, the literature states that reliability values should be acceptable when they range from 0, 60 to 0, 70 within exploratory research (Nunally and Bernstein, 1994; Hair, J., Anderson, R., Tatham, R., & Black, W, 1998). The Cronbach’s Alpha values satisfactory passed the criteria of 0.60 for each of the constructs

**Correlations Analysis**

I investigated how MBL, EO, AC and NC can have an impact on the improvement of TC at the firm level. In doing so, I studied whether there exists any relationship between the capabilities already

mentioned and TC. I use correlation analysis to find the possible relationships. Table 3 presents the correlations results.

Table 3 Correlation Matrix

		MBL	EO	AC	NC	TC
MBL	Pearson Correlation	1				
	Sig. (2-tailed)					
EO	Pearson Correlation	,563**	1			
	Sig. (2-tailed)	,000				
AC	Pearson Correlation	,471**	,444**	1		
	Sig. (2-tailed)	,000	,000			
NC	Pearson Correlation	,361**	,309**	,266*	1	
	Sig. (2-tailed)	,001	,005	,017		
TC	Pearson Correlation	,422**	,520**	,573**	,353**	1
	Sig. (2-tailed)	,000	,000	,000	,001	

\*\* . Correlation is significant at the 0.01 level (2-tailed).  
 \* . Correlation is significant at the 0.05 level (2-tailed).

In Table 3 it can be seen that the correlation coefficients and the significance of the coefficients. Correlation explains if there exist relationships between variables. The coefficient value represents the magnitude of the relationship. Coefficient values can range from -1.00 to +1.00. In my research I found that the relationships of the variables under study and TC have acceptable coefficient values as well as these values are significant. The matrix correlations show that the EO and AC present the strongest relationship with the improvement of TC according to their coefficient values of 0,520\*\* and 0,573\*\* respectively. These relationships provide evidence of the role of entrepreneurs’ vision on the direction of firms’ technological development. Likewise, the processing of knowledge and its integration into the various firms’ process plays a strong role in the improvement of TC. In Table 5.10 it can be observed that the independent variables MBL, EO, AC and NC have internal correlations between each other. This suggests that it could be a multicollinearity problem in the measurement of the constructs. To verify this problem and to understand the strength of the relationships between the independent variables and the depend variable I ran a regression analysis as well as a collinearity test.

### Multivariate linear regression analysis

Table 4 provides the summary of the regressions’ statistical results. The  $R^2$  has a value of 0,438 which means that the variables used to explain the improvement of TC are doing this job. Additionally, the value F (14.614) is significant at the level of 99%. The confidence of the model is acceptable. At the same time Table 33 presents Beta values for the independent variables. I highlight those variables such as EO and AC that according to the statistical results have a more notable impact on the dependent variable and their relationships with the dependent variable is significant. This provides evidence that the orientation that entrepreneurs give for firms and the internal ability of knowledge’ management is

fundamental within MSMEs to progress in the use of technology through the improvement of TC. MBL and NC did not show significant relationship with TC. The coefficient values were weak.

Table 4 Results Summary of Multiple Regression Analysis

Dependent Variable	Independent Variables	R <sup>2</sup>	F (sig)	β	t (sig)
TC		0.438	14.614 (0.000)**		
	MBL			0.019	0.173 (0.863)
	EO			0.286	2.626 (0.010)*
	AC			0.397	3.903 (0.000)**
	NC			0.153	1.623 (0.109)

\* Significant at the 5% level  
 \*\* Significant at the 1% level

As the correlation matrix in Table 3 suggests that could be a multicollianerity problem between the internal relationships of independent variables, I applied a collinearity test to the regression model. The results for the collianerity test are shown in Table 5.

Table 5 Collinearity Test

Collinearity statistics		
Independent variables	Tolerance	VIF
MBL	0,596	1,677
EO	0,633	1,580
AC	0,726	1,378
NC	0,847	1,181

I present the values for tolerance and VIF in Table 5. As a rule of thumb is established, the values of the tolerance have to be higher than 0,20 to demonstrate independence between variables. Likewise, the rule for the values of VIF express that value over 10, demonstrate a collinearity problem between the predictor variables. According to these rules the range of correlation between independent variables does not create enough “noise” that could affect the analysis of the impact of each variable on TC. It is also clear that the relationship that I explore here is between those variables that are independent and TC which is dependent. In this sense whether there is a correlation between the independent variables or not, there is no affect on my analysis because the direction of my analysis in horizontal and no vertical.

### The impact of TC on FP

The improvement of TC has to have an effect in the FP. The construct FP was used to identify what is the impact of TC in the TIS’ performance. FP measure the perception of entrepreneurs about the ability to make upgrading in their products and processes. Unfortunately, entrepreneurs did not want to give specific information about number of customers, sales, turnover and markets, however, they could

express how much they perceive that TC contribute to increases the abilities as well as the financing outcome. In Table 6 I present the regression analysis for the relationship between FP as dependent variable and TC as independent variable.

Table 6 Regression Analysis between TC and FP

Dependent Variable	Independent Variable	R <sup>2</sup>	F (sig)	β	t (sig)
FP		0.275	29.541 (0.000)**		
	TC			0.524	5.435 (0.000)**

\*\* Significant at the 1% level

As it can be observed the impact of TC in the FP is strong enough to point out that entrepreneurs perceive the improvement of TC as a characteristic which support the performance of the firms. It is not just the financing issue which matters for TIS' managers; it is the generation of abilities which contribute to innovative within firms which really these firms search.

## DISCUSSION AND CONCLUSIONS

### The Interplay of Capabilities within MSMEs

In this section I will use interchangeably the terms TIS and MSMEs because the research's sample is constituted by TIS which are essentially MSMEs. Most of the literature which tries to capture those firms outside of the large-sized category is focused on small and medium-sized firms. Nevertheless, the micro-sized firms are outside of the scope of small-sized firm's literature. Capturing the organizational composition within a micro-sized firm is quite a challenge because many functional tasks are normally concentrated either in few people or in one person. In my sample entrepreneurs were people who, despite not having a high level of formal education, can identify the various firm's functional tasks as well as comprehend the formulation of adaptation or innovation for product and processes. This means that although many process conducted by TIS did not present a complex systematization; the entrepreneurs understand what was the objective of a particular process and its main outcome. I take the example of MBL, this constructs in the statistical results show neither strong correlation nor high significant regression with the improvement of TC. Notwithstanding, interviewees claimed that this construct is vital for their abilities to improve products and processes. The low scores in the results are associated with the managers' weakness to process the information which comes from customers and competitor in a systematic way. These findings demonstrate that despite their small organizational size, TIS are able to behave in a way that a large companies do. Competitive and innovative behavior are not

related to size; in my research the performance in terms of competitiveness and innovations is more related to the vision and direction that entrepreneurs draw for their firms.

### **The Entrepreneurs' Combination Use of Experience and Knowledge**

The interviewed entrepreneurs have experience from multinational or large companies. They learned in those kind of firms design, use of materials, establishment of process and other activities concerned to the TIS' performance. In fact most of the interviewees expressly start up their business in order to bring local solutions to those large firms that sometimes need to import spare part. Most of the companies are mature, which shows that entrepreneurs have not looked for growth in their business. This situation is explained by the fact that if a business grows, the entrepreneur has to delegate functions and to give decision power to new members of the firm. Entrepreneurs said that they do not want to lose control of the whole activities or process within their firms. This characteristic complements the findings related to MBL. Entrepreneurs do intentionally not systematize all the process within the firms, trying to have the control of the technical knowledge which facilitates innovations. Another relevant aspect found in this research is the ability of entrepreneurs to communicate their vision and spirit to the members of their firms. EO was found as one of the capabilities which have strong as well as significant relationship with the improvement of TC.

### **AC as Dynamic Capability**

AC is the capability under studied which more high statistical results. AC as dynamic capabilities contributes to generate a mix between external knowledge and internal knowledge. This brings into firms the necessary dynamism to response to the markets changes and tendencies. Taking knowledge and applying it in products and processes makes micro firms competitive and productive. I found that TIS which require daily assimilation of knowledge and its application can identify the mechanisms to make the use of knowledge effective. AC contributes to facilitate the TIS' articulation of knowledge in ways that create advantage to compete. If markets are dynamic and firms can follow that dynamism, it means that firms' capabilities have been applying effectively.

### **Network Capability**

Networks were seen as dangerous when the contracts are not clear and the information has not legal protection. NC was highly affected by the Colombian's corruption situation. Although NC contribute to the impact of AC on the improvement of TC (Cuero, Nabi, & Dornberger, 2012), its relationship with TC was not significant in my research. Although theoretically and statistically NC has reliability, an

issue such as the impact of corruption on the way of doing business (WEF, 2012), it is a factor which has to be considered within future research.

### **The level of TC**

I applied the Guifu & Hoijna (2009) derivation of the Lall's model because it is more suitable to use in MSMEs. In this research I measure TC in three categories acquiring, operating and shifting. According to the statistical resources, TIS are located in the category of shifting. The interpretations of these findings are again related with the context in which the firms have to perform. After the world crisis of 2008-2009 entrepreneurs limited their financing resources to invest in the acquisition the new technology of the activities related. The TIS' low score in this category did not represent that the previous expertise developed to perform the operating and shifting categories of TC were affected. By way of contrast, these two other categories were strengthened to continue within the markets. The fact that TIS perceive themselves as firms able to change their products and their own processes is an example of how these MSMEs are able to apply functional tasks as the large companies do. The shifting category is the fundamental capability to permanently compete in markets against competitors. Adaptation, innovations and upgrading are demanded daily in the city of Cali for all kind of companies. Companies look for quick solutions to continue their productions without stops; TIS use all their past experience, expertise and knowledge to be flexible in their production to answer the markets need. To produce a specific solutions in short time and with high quality make these companies fundamental for the productivity of the Valle del Cauca region. TC shows its forceful role for FP. TC achieves the application of knowledge into product and processes upgrading. MSMEs start their path to innovations with simple upgrading and adaptations of products.

### **Conclusions**

In this research I investigate the role of dynamic capabilities in the improvement of TC within MSMEs in the case of Colombia. I use a new approach to capture not only the degree of TC at the firm level but also the sources of knowledge which make better TC. Although in the capabilities literature MSMEs have barely examined, I argued that this kind of firm behaves in a similar way as large companies when they seek to innovative. The micro and small size give opportunities for entrepreneurs direct and use knowledge in functional tasks which are part of the operational activities. The main conclusion of this research is that the improvement of TC is strongly explained by EO and AC. As I already explain in this paragraph entrepreneurs' attitude is fundamental to the management of knowledge within firms. At

the same time, for TIS which have constantly response to new technical customers' requirements, AC is fundamental to obtain the enough knowledge combination which will configure TC.

TIS within the context of Colombia confront various constrains such as corruption, weak institutional support, limited access to network, lack of articulation with universities and research centers to name few examples. Even though these constrains are quite decisive for the firms' development and performance, TIS obtain upgrading in their products and processes. This demonstrates that for TIS the use of knowledge through TC is more crucial for their performance than the environments.

As third conclusion I point out the positive relationship between dynamic capabilities such as EO and AC with TC. As first attempt to study this relationship this research contribute to the TC literature bring an approach which is focus on the internal abilities of firms and their output. Dynamic capabilities have been tested according to their functional tasks and their impact on operative capabilities; however, their impact on TC has not tested before. Dynamic capabilities are a body of literature which can be very useful in the context of developing countries; moreover, dynamic capabilities foster the development of TIS showing that this concept is not exclusive for large companies. MSMEs can generate the enough dynamism to maintain their positions in markets.

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