

SMEs' innovation capacity assessment: a dedicated analysis of SMEs' innovation performance determinant factors

Abstract: This study explores innovation capacity in the specific context of small and medium-sized enterprises (SMEs). Innovation capacity is particularly difficult to define in SMEs because most of their innovative activities are informal and merge into overall firm activities. The objective is to test the central dimensions of innovation capacity to propose insights for assessing the innovation capacity of SMEs. Our nine-dimension framework is built on theoretical insights from the entrepreneurship and innovation literature and is tested through a quantitative survey administered to a first sample of 213 SMEs. Those preliminary research will be completed with a second sample of 320 SMEs. Our preliminary findings discuss the nine critical dimensions of the innovation capacity of SMEs that have been previously emphasized in the literature; six dimensions appear to be significant in our model, whereas three other dimensions are not significant. These findings allow us to propose a new framework for analyzing the innovation capacity of SMEs that is based on SME specificities. We plan a second row of analysis based on the second sample. We would perform a factor analysis to discuss our 9 dimensions emerging from literature and propose a new model of SMEs innovation capacity

Key Words : Innovation capacity, SMEs, Innovation performance

1. INTRODUCTION

Small and medium-sized enterprises (SMEs) are an essential part of economic growth according to their number and presence in economic environments (Bruque and Moyano, 2007; Zeng et al., 2010) and their contribution to innovation activity (Akman and Cengiz, 2008). This sector faces considerable challenges regarding its innovation activities because the globalization of markets, economic changes, rapid product life cycles, and technological developments continuously increase competition (Utterback, 1994). In this context, innovation and all of its aspects and activities appear to be a major issue for firm survival and business performance in a changing and dynamic competitive environment (Adams, Bessant and Phelps, 2006; Schumpeter, 1934; Porter, 1991). In these environments, companies that have an efficient innovation approach that generates outputs perform better than other companies (Hoffman, Parejo, Bessant and Perren, 1998; Porter, 2001; Roper et al., 2002; Baldwin and Gellatly, 2003). Thus, innovation appears as a key factor of SMEs' growth and development (Bruque and Moyano, 2007; Terziovcki, 2010). and the innovation practice of SMEs plays an important role in overall growth and technological progress (Bruque and Moyano, 2007). However, how innovation can become a factor for SME performance and the levers that foster the innovation performance of SMEs remain unclear.

Few studies have investigated the innovation capacity of SMEs as a factor of their innovation and overall performance (Forsman, 2011). Innovation management assessment is one field of research that focuses on the factors that may lead to innovation performance. The dedicated literature encompasses three complementary dimensions of innovation assessment (Adams et al., 2006; Boly et al., 2014). First, the assessment of innovation inputs represents the innovation investments of the firm. Mostly considered the R&D expenditures and available workforce, this dimension represents the inputs of the innovation process, namely the resources that will be used by the process to produce innovation (Boly et al., 2014). The R&D intensity, sized with workforce and financial investments dedicated to innovation are used as the evaluation metrics (Hagedoorn and Cloudt, 2003). The financial inputs or hired workforce that are used to measure the R&D effort cannot be used to measure the R&D results because they fail to provide and integrate the qualitative data. Furthermore, the final results of R&D efforts are certainly influenced by many other factors (Boly et al, 2014; Pantzalis and Park, 2009). Therefore, innovation inputs appear to be limited in explaining and assessing overall innovation activity because of its focus on quantitative and descriptive data concerning investments, and they fails to provide insights on activities, processes and results. The second assessment dimension is

innovation outputs, which are the innovations that are produced by a firm. The measurement protocol for these outputs is very controversial, and researchers tend to measure innovation performance with different items. The most used variables are the overall amount of innovation that is produced, specifically the patents and percentage of sales revenue due to innovation (Adams et al., 2006; Boly et al., 2014; Hagedoorn and Cloudt, 2003). These indicators are useful to determine if firms perform their innovation activities but fail to provide information on how firms perform. Therefore, inputs and outputs are two assessment criteria that are only useful to determine whether a firm is performing and active based on quantitative indicators, but they do not describe how it performs and how it can improve. A third assessment dimension, based on firm's innovation capacity approach, includes assessment methods that are based on activities involving the innovation process that are described as the central part of the innovation management assessment (Adams et al., 2006; Boly et al., 2014). Innovation capabilities allow a firm to develop and coordinate an innovation process and use innovation inputs to produce innovation outputs (Adams et al., 2006; Boly et al., 2014; Yam, Guan, Pun, and Tang, 2004). Our studies focus on this central part of innovation assessment and investigate how SMEs' specificities may influence it. Despite a clear correlation between innovation and performance, the factors that can enhance innovation remain unclear and need further investigation (Forsmann, 2011). This need appears, particularly in the field of SMEs, where innovation-increasing factors remain ambiguous (De jong and Marsilli, 2006) and where the literature fails to provide a sufficient empirical exploration of the concept and its foundations (Forsman, 2011; Mansury and Love, 2008). Therefore, SMEs' innovation capacity is a valuable concept for SMEs because it may be a direct source of innovation performance and may thus be a performance accelerator of SMEs. The aim of this research is to fill the gap concerning the assessment of the innovation capacity of SMEs by examining dedicated criteria of SMEs and measuring their influence on SME innovation performance. For this purpose, we use a quantitative method and linear regression analysis to fulfill the following objectives:

- To identify the key factors of the innovation capacity of SMEs
- To explore the relationships between SMEs' innovation capacity factors and SMEs' innovation performance; and
- To provide some recommendations to improve the innovation performance of SMEs.

Our first findings confirm that six dimensions are significant in an SME innovation capacity model assessment and that three dimensions are not significant. These results have a determinative impact on research and practitioners. From an academic perspective, these results support SME specificities theory and innovation theory by analyzing the impact of SMEs'

specificities on their innovation performance factors and by providing an assessment model that is dedicated to SME characteristics. From a managerial perspective, these results provide new insight for managers and practitioners to better understand the innovation issues of small firms. By providing a new understanding of the critical activities that allow innovation performance, we provide insights to better plan and manage a key factor of SME survival and development, namely innovation.

2. SMES' INNOVATION CAPACITY

Innovation capacity is defined as a firm's continuous improvement of its capabilities and resources to explore and exploit the opportunities of new product development to meet market expectations (Boly et al., 2014; Forsman, 2011; Szetto, 2000). Innovation capacity represents a firm's ability to innovate continuously ahead of its competitors (Qian and Li, 2006). These capabilities should enable a firm to rapidly enter a new market, ascend to a new level of quality earlier than its competitors or force a firm to imitate and improve product quality faster than its competitors to gain a competitive advantage (Qian and Li, 2006). Innovation capacity encompasses various factors that allow firms to remain innovative in the long run. Capabilities should be distinguished from resources (Forsman, 2011). Resources represent a set of available factors that are owned by firms, whereas capabilities represent a firm's ability to deploy these resources according to its processes, routines and all the firm's activities that are embedded in this process (Amit and Schoemaker, 1993). The resource perspective explains a firm's ability to innovate from a static perspective based on its present assets. The capability perspective may explain the implementation and evolution of these assets. "Continuous improvement" is a core dimension of innovation capacity (Szetto, 2001) and refers to the continuous improvement of a firm's set of resources and capabilities to remain innovative and maintain the viability of the innovation process. Thus, innovation capacity comprises crucial dimensions that are known as innovation capabilities (Forsman, 2011). Dynamic capabilities represent an essential part of innovation capacity because they help maintain, improve and reconfigure a firm's set of resources and capabilities in dynamic environments (Boly et al., 2014; Eisenhardt and Martin, 2000; Forsman, 2011; Teece et al., 1997; Teece, 2007; Zollo and Winter, 2002). This constant adaptation, evolution and reevaluation represent a major issue for the firms that evolve in innovative and competitive markets, which implies a volatile environment that is caused by market velocity and uncertainty (O'Connor, 2008). Therefore, innovation capacity can be theoretically presented as a firm's set of resources, capabilities and dynamic capabilities that are dedicated to the innovation process. It raises the question of how to more deeply understand

the innovation capabilities. Are innovation capacity dimensions specific to different contexts, or can these dimensions be improved on from a generic perspective?

In the literature, this question is controversial (Oberg and Alexander, 2014). For some scholars, innovation capacity and innovation capabilities can be analyzed generically using a set of best practices that are relevant to all firms (Lawson and Samson, 2001). For other scholars, different combinations of capabilities that depend on the context are required to produce effective innovation (Tidd, 2001). At the product level, the innovation type or the innovation target influences the need for a specific set of resources and capabilities (O'connor, 2008; Tidd, 2001; Garcia and Calantone, 2001). At the firm level, industry and environmental characteristics influence the resources and capabilities that are necessary for innovation (Damanpour, 1991; Persaud, 2005). Thus, a combination of significant contingencies may explain the various configurations of firms' innovation practices (Tidd, 2001). However, the nature and extent of the innovation capabilities that are combined based on different contexts remain insufficiently understood. Even if innovation activities appear to be a source of performance for SMEs, the reasons for this influence remain unclear (Baldwin and Gelatly, 2003; Gronum et al., 2012). Further investigation is necessary to understand the combination of these capabilities in specific contexts (Oberg et al., 2014). Therefore, empirical explorations of the critical factors that influence SME innovation are required (Gronum et al., 2012).

3. SME SPECIFICITIES AND THEIR IMPACT ON INNOVATION CAPACITY

Several scholars have considered SME specificities as a determinant context factor (Gronum, 2012; Keizer et al., 2001; Motwani et al., 1999). As emphasized by Man and colleagues (2002). *“A small firm is not a scaled-down version of larger firms. Larger and smaller firms differ from each other in terms of their organizational structures, responses to the environment, managerial styles and, more importantly, the ways in which they compete with other firms”*. The dominant paradigm of SME specificities clearly presents a need to investigate SMEs according to the specific characteristics and behaviors (Julien 1993; Volery and Mazzarol, 2015) that affect their innovation practices (Gronum et al., 2012; Motwani et al., 1999). Thus, SMEs' innovation capacity should be analyzed and should unambiguously consider SME specificities and characteristics (Damanpour and Wischnevsky, 2006; Motwani et al., 1999; Salerno et al., 2014; Terziowcki, 2010).

Some authors consider SME specificities to be strengths for innovation that allow them to perform better than large companies (Martinez-Ros, 2008; Lee and Chen, 2009). while other

authors consider these specificities to be a curb on SMEs' innovation activity (Camison-Zornoza et al., 2004; Hitt et al., 1990). Moreover, studies that have focused on innovation emphasize the need to consider SME specificities when analyzing their innovation processes (Gronum, 2012; Keizer et al., 2001; Motwani et al., 1999).

According to these authors, SME specificities should be considered when SMEs' innovation capacity is explored (Motwani, 1999; Terzirovski, 2010). Building on the literature concerning SME specificities, we have identified three SME characteristics that could influence their innovation capacity, namely the scarcity of resources, the leading role of the owner/entrepreneur and SMEs' informality and flexibility.

First, unlike large companies, SMEs have scarce resources. This lack of resources influences their common activities (Julien and Carrier, 2002; Torres 1998). Specifically their innovation activities (Hausman, 2005; Hewitt-Dundas, 2006; Guijaro, 2009). The need for resources is not the same for all SMEs. This need may vary depending on the firm and its environment (Hadjimanolis, 2000; Julien, 2000; Guijaro et al., 2009; Rothwell, 1989). SMEs constantly seek the available human, financial and technological resources to achieve their innovations. These essential resources can be developed internally or accessed externally. SMEs can find alternatives by combining internal resources to create new resources (Love et al., 2009; Mohannak, 2007; Helfat and Peteraf, 2003). To accomplish this resource creation, SMEs must organize and optimize their internal processes, such as project management and knowledge management; however, this optimization is very challenging for SMEs (Wolf and Prett, 2006; Motawani et al., 1999). Another option involves accessing the required resources externally by using partnerships and inter-organizational collaborations (Gronum et al., 2012; Lasagni, 2012).

Second, innovation activities are strongly influenced by the leader of the SME, i.e., either the owner or top managers (Garcia and Calantone, 2002; Julien and Carrier, 2002; Guijaro et al., 2009). The leader is perceived as the main driver of innovation activities, and innovation activities depend on the its vision (O'Regan et al., 2005; Teirlinck and Spithoven, 2013). Its characteristics tend to shape the firm (Hyvarinen, 1990; Lefebvre et al., 1997). Two characteristics seem to have a significant impact on SMEs' innovation activities. One characteristic comprises the personal experiences, knowledge, competencies and abilities of the leader. The previous experiences and academic background of the entrepreneur can influence an SME's innovation activities (Birchall et al., 1997). The other characteristic that has a significant impact on SMEs' innovation activities includes the personality and behavior of the leader, which also impacts the SMEs' innovation activities, particularly regarding the will to

innovate (Miller and Toulouse, 1986; Lefebvre et al., 1997). For instance, some leader are not willing to take risks, and they limit their firm's innovation (Hausman, 2005; Rothwell and Zegveld, 1982). Some leader implement proactive and collaborative management programs that encourage innovation and change (Kickul and Gundry, 2002). whereas others prefer to implement aggressive or protective management programs that limit innovation (Lefebvre et al., 1997; Thom, 1990).

Third, SMEs have been shown to compensate for their lack of resources with a high level of flexibility (Qian and Li, 2003; Wolff and Prett, 2006). SMEs are simple organizations with little hierarchy and where power is centralized. Because of this simple organizational structure, SMEs can easily integrate market needs and technological changes (Rothwell, 1989). When responding rapidly to environmental changes, this simple structure is also better adapted than the complex structures of large companies, where it is time-consuming and costly to implement organizational or strategic changes (Julien and Carrier, 2002; Lee and Chen, 2009; Qian and Li, 2003; Mazzarol and Reboud 2009; Tidd, 2001). The organizational structure of SMEs is also informal and flexible, which allows them to respond rapidly to any change in the environment (Qian and Li, 2003; Wolff and Prett, 2006). Informal interactions among members accelerate communication and enhance collaboration and thus increase creativity (Julien and Carrier, 2002; Qian and Li, 2003). However, the simple, informal and flexible structure of SMEs can also limit innovation activities. Because SMEs do not have processes or methods to properly assess the costs of innovation projects or the time to market, managing innovation becomes difficult (Hadjimanolis, 1999, 2000). Thus, innovation activities can be less efficient in SMEs than in large companies.

These specificities justify the need to investigate SMEs' innovation activities by considering their specificities (Audretsch and Lehmann, 2005; Rosenbuch et al, 2011). Thus, the innovation capacity of SMEs should be analyzed and unambiguously based on SME specificities and characteristics (Damanpour and Daniel Wischnevsky, 2006; Motwani et al., 1999; Salerno et al., 2014; Terziovcki, 2010). Because SMEs' innovation capacity is not easy to define, very few studies have focused on it (Forsman, 2011). The reason for these difficulties is because SMEs recognize their innovation activity as not specifically dedicated to innovation and that only one-third of them have a deliberate innovation strategy (De Jong and Marsili, 2006). For most SMEs, innovation activities refer to the common activities that are used to produce innovations. Because the boundaries of innovation are vague, innovation capacities are difficult to identify and extract in terms of overall SME activities (De jong and Marsilli, 2006). Innovation capacity

encompasses multiple qualitative and quantitative dimensions that must be integrated into an assessment model to be relevant and effective (Boly, 2014; Guan and al, 2006; Wang and al., 2008). Therefore, empirical explorations of the critical factors of SMEs' innovation and innovation performance are necessary (Gronum, 2012). and understanding the impact of SME specificities on these factors is determinative in proposing a dedicated assessment model.

4. DEVELOPMENT OF A RESEARCH MODEL

A review of the literature that explores the factors of SMEs' innovation capacity reveals many articles and emphasizes the lack of consensus in the definition of SMEs' innovation capacity. These differences are clearly illustrated by the dedicated literature and research results in which diverse models coexist to represent SMEs' innovation capacity (Olsson et al., 2010; Vicente and Abrantes, 2015). Several factors can explain this diversity. First, only one-third of SMEs have a deliberate innovation strategy (De Jong and Marsili, 2006). For most SMEs, innovation activities refer to the common activities that are used to produce innovations. Because the boundaries of innovation are vague, the innovation capacity dimensions are difficult to identify in terms of overall SME activities (De Jong and Marsilli, 2006). Because SMEs' innovation capacity is not easy to define, few studies have focused on precisely describing its roots (Forsman, 2011). Second, the results that have been obtained in previous studies on SMEs' innovation capacity can be questioned because they have been obtained without considering SMEs' specific characteristics. Most of the previous studies were not specifically dedicated to SMEs and did not build on their specific context and characteristics. The models that are used are built on a literature review rather than only being based on the SME context. Therefore, the relevance of the models that are used in the literature can be questioned, and these models can be challenged in studies that involve the consideration of the specific context of SMEs (Pierre and Fernandez, 2018). Third, we can question the possibility of building a generic model for SMEs' innovation capacity. The research results on the need to integrate SMEs' heterogeneity, which is induced by factors such as size, age, sector, and industry differences, threatens SME innovation and remains contested by ambivalent results. The need to build a diversified framework that depends on SMEs' heterogeneity is still not validated by the literature on SME innovation (Forsman, 2011; Marchesnay, 2014 ; Saunila, 2014; Wolff and Pett, 2006). Although the SME heterogeneity approach has been defended by some scholars (Torres and Julien, 2005; Volery and Mazarol, 2015). No consensus exists on which heterogeneity factors directly influence innovation capacity (Forsman, 2011; Marchesnay, 2014; Saunila, 2014;

Wolff and Pett, 2006). For other scholars, this debate is minor, and they encourage future research to focus on the dominant characteristics that are shared by innovative firms (Lawson and Samson, 2001; Tidd, 2014). Further research is needed to propose a global framework to assess the innovation capacity of SMEs.

By building on journal publications that comply with acceptable standards of methodological rigor (Flynn et al, 2004; Terziiovcki, 2010). We reduced this literature to only the relevant articles that allow us to propose by the aggregation of similar factors (titles and description) a first comprehensive view of SMEs' innovation capacity dimensions. We propose 9 dimensions that are generally discussed as the factors characterizing SME innovation performance. The next sections illustrate and discuss these dimensions' impact on SME innovation performance and present the variables and hypothesis of our research framework.

4.1 Independent variables

4.1.1 Network integration

Because SMEs lack resources, network integration becomes an important factor of innovation capacity. Networks enable SMEs to access resources and to divide the risks and costs (Gronum et al., 2012; O'regan et al., 2005; Lasagni, 2012; Pittaway et al., 2004). Network integration capacity follows three steps. SMEs need the capacity to detect potential networks, to create and maintain collaborative relationships and to exploit the elements that are provided by network relationships (Forsman, 2011, Freel, 2003). The ability to collaborate with both public and private partners is another source of SMEs' innovation capacity (Gronum et al., 2012; Keizer et al, 2001; Lasagni, 2012). An SME's ability to detect and integrate useful partnerships may have a strong effect on the SME's innovation performance because SMEs naturally tend to lack the resources required to innovate. Therefore,

H1: SMEs' networking capabilities have a significant effect on SMEs' innovation performance and must be integrated into an innovation capacity assessment model.

4.1.2 User and customer integration

Users and customers are considered important sources of innovation performance. They bring direct knowledge to the firm (Apiah-adu et al., 1998; Gronum, 2012; Von hippel, 2005). Integrating customers and users in the innovation process provides new ideas and insights to better understand users' needs. This integration allows a firm to ensure that it is responding to market needs and to therefore avoid potential loss due to market failure. This approach must be completed by the detection of non-typical and potentially future users and customers to ensure the openness of the firm and its innovation capacity (Danneels, 2002). However, customers'

integration may also be expensive in terms of time and cost to efficiently use the information that has been gathered (Von Hippel, 2005). Such integration may be beneficial to SMEs' innovation activities through the following: (1) to save resources by avoiding loss and (2) to access competitive advantages faster. Therefore,

H2: SMEs' ability to integrate customers in their innovation process has a significant effect on SMEs' innovation performance and must be integrated into an innovation capacity assessment model.

4.1.3 Institutional support

At the institutional level, the innovation system in which SMEs are embedded provides resources and knowledge through public policy to directly or indirectly encourage firms to innovate at a product or process level (Patel and Pavitt 1994; Smallbone et al., 2003). Public institutions can provide financial or technical support for innovation in SMEs (Kaufman and Todtling, 2002) that is useful to enhance innovation and create jobs (Hewitt-Dundas, 2006). The ability to detect and use these supports is considered an innovation capacity and a factor of innovation performance for SMEs (Keizer et al. 2001). However, to use it efficiently, this capacity requires human resources that have a deep knowledge of the national supports to ensure that a firm can fit the institutional prerequisites and to avoid the bureaucratic burden that may be a barrier to innovation (Henrekson and Johansson, 1999). These capacities that are linked to SMEs' resource scarcity tend to foster innovation activity if correctly harnessed. Therefore,

H3: SMEs' ability to integrate institutional support has a significant effect on SMEs' innovation performance and must be integrated into an innovation capacity assessment model.

4.1.4 Innovation strategy and planning

Innovation strategy refers to the innovative position that is designed by a firm that depends on its competitive environment (Dyer and Song, 1998), resources and competencies (Helfat and Peteraf, 2003; Leonard-Barton, 1993; Prahalad and Hamel, 1990; Ramanujam and Mensch, 1985; Tidd et al., 2013; Teece et al., 1997, 2007). The innovation strategy should fit the business strategy of a firm (Sundbo 1997). The innovation strategy should support a firm's competitiveness in its environment (Leonard Barton, 1993; Teece et al., 1997, 2007; Tidd et al., 2013). SMEs with a formal strategic design seem to achieve better results (Rothwell and Dodgson 1991; Terziovski 2010). Despite the SMEs' characteristic of informality, strategy planning appears to have a positive effect on SMEs' innovation performance. Therefore,

H4: SMEs' ability to formalize an effective innovation strategy has a significant effect on SMEs' innovation performance and must be integrated into an innovation capacity assessment model.

4.1.5 Corporate conditions for innovation

The impact of an SME's structure on innovation is controversial. The core debate concerns the degree of formalization of the organizational structure of SMEs that encourages innovation (Terziovski, 2010). An organization should be flexible to adapt to the environment, to liberate creativity, and to explore and promote internal collaboration (Amabile et al, 1996; Chesbrough, 2003; Damanpour, 1991; Teece et al, 1997, 2007). Simultaneously, an organization should be structured to improve its innovation process, operation and efficiency (Lawson and Samson 2001, Moore and tushman1982, Tidd et al., 2013). To address both constraints, a solution may involve the promotion of a hybrid organization in terms of structure and creativity (Christensen, 1997; Bessant, Lamming, Noke, and Phillips, 2005; Eisenhardt and Martin, 2000 Van de Ven et al., 1999). Corporate culture is assessed by the "corporate conditions for innovation" (Rothwell, 1992). Therefore,

H5: SMEs' ability to balance between structure and creativity in their organizational culture and structure has a significant effect on SMEs' innovation performance and must be integrated into an innovation capacity assessment model.

4.1.6 Innovation process management

Innovation process management enables SMEs to produce innovation using scarce resources and capabilities (Boly et al, 2014; Forsman, 2011). This dynamic concatenation of activities is organized in the three basic steps of finding ideas, developing concepts and implementing them (Salerno 2014, Tidd et al 2013, Van de Ven, 1999). Among these activities, we can distinguish the internal management of available resources and competencies (Afuah 2002), the marketing capacity of detection, analysis and promotion (Adams et al, 2006; Chakravorti, 2004; Day, 1994 Verhaeghe and kfir 2002), R & D (Deeds 1991 Yam 2004), production (Chiesa et al., 1997; Yam, 2004) and sales (Avlonitis et al, 2001; Song and Parry 1996). All of these activities depend on managerial capabilities such as project management, project portfolios, internal communication capabilities or decision-making capabilities (Cooper et al, 1999; Chen and Guan, 2011; Tidd et al 2013). Despite SMEs' usual informality concerning the innovation process, these practices tend to foster their outcome productivity and avoid a loss of resources (Freel, 2000). Therefore,

H6: SMEs' innovation process management capabilities have a significant effect on SMEs' innovation performance and must be integrated into an innovation capacity assessment model.

4.1.7 Learning process

SMEs' learning process and knowledge management activities (KM) play a key role in innovation management (Adams et al., 2006; Darroch, 2005). Several sources of knowledge have been identified in the literature (Keskin 2006, Lee and Tsai 2005; Nonaka, 1991). The detection and the integration of external knowledge increase the knowledge capital of a firm (Darroch, 2005). R&D investments, subcontracting and the integration of networks allow the renewal of internal knowledge (Fu et al., 2012, Ferreira et al., 2015). Regardless of the source of knowledge, absorption capacity is essential to create a knowledge-based competitive advantage (Cohen and Levinthal, 1990, Tsai 2001). These capabilities may increase and update a firm's resources and capabilities to stay performing. Absorption capacity plays an important role in firms where resource scarcity may reduce the dedicated investments to acquire resources and capabilities. Therefore,

H7: SMEs' learning capabilities have a significant effect on SMEs' innovation performance and must be integrated into an innovation capacity assessment model.

4.1.8 Access to cash flow

Because SMEs tend to be generally restricted by scarce financial resources, the financing of innovation activity can be difficult and can challenge owners/managers in their innovation strategy to propose commercial activities and generate incomes that finance their ambitions (Freel, 2000). Innovation capacity appears to be directly linked to a firm's capacity to generate revenue. First, SMEs that provide good financial results tend to be more favorably inclined toward the risk acceptance of innovation and more inclined to invest in these activities (Souitaris, 2001). Second, good financial results are linked to a firm's attractiveness and help convince investors, such as venture capitalists (VCs) to invest in their innovation activity. Good financial results also help firms convince partners and start new R&D partnerships or commercial partnerships (Pierre and Fernandez, 2017). Finally, debt financing and a lack of liquidity are perceived as having a negative effect on SMEs' innovation activity that leads to the necessity of finding other financial resources (Giudici and Paleari, 2000; Freel, 2000; Madrid-Guijaro, 2009). Financial constraints may urge small firms to innovate, but if they persist, they may have a negative impact on innovation activities (Xuemei et al, 2013; Hewitt-Dundass, 2006). Therefore,

H8: SMEs' ability to build profitable business models has a significant effect on SMEs' innovation performance and must be integrated into an innovation capacity assessment model.

4.1.9 IP strategy

In the field of SMEs, intellectual property (IP) strategy is expressed as an important part of innovation strategy for reasons that differ from that of large companies (Holgersson et al., 2013). The first reason is linked to market positioning and attractiveness. SMEs use patents to promote their knowledge and technology, which are used to attract customers in the first instance (Holgersson et al., 2013). Patents are also mainly used to attract investors, VCs and banking partners by offering tangible proof of a firm's innovativeness and allowing them to secure a potential return on their investment (Hsu and Ziedonis, 2008; Haeussler et al., 2009; ; Lemley, 2000; Rassenfosse, 2012). The second reason that IP strategy is important to SMEs is criticized but is based on the desire of firms to protect and secure their assets and past investments (Opekun, 2006). This position is criticized in terms of the monitoring, enforcing and defense costs after patent publication that may limit the interest of firms to patent (Harabi, 1995; Kingston, 2004; Lanjouw and Schankerman, 2004; Levin et al., 1987). IP strategy may therefore appear as an important orientation of SMEs' innovation performance even if the costs of protection may be high for SMEs and may reduce, in certain cases, the interests of the IP strategy. Therefore,

H9: SMEs' ability to build an IP strategy that is adapted to their situation has a significant effect on SMEs' innovation performance and must be integrated in an innovation capacity assessment model.

4.2 Dependant variable

4.2.1 Innovation performance

Many models coexist in the literature to characterize firm's innovation performance from technical performance to market/profitability performance using different indexes, ratios and criteria depending on the type of innovation, product or process (Cooper and Kleinschmidt, 1995; Cordero, 1990; Kirner et al, 2008; Laursen and Salter, 2006; Prajogo and Ahmed, 2006; Saunilla, 2014). For this study, we use the total percentage of sales due to innovation outputs (Laursen and Salter, 2006) as the measure of innovation performance.

4.3 Control variables

According to our research subject and our sample, we introduce one control variable to secure our regression model. According to dedicated literature, Size of SMEs is perceived as an important context factor that may induce a high impact on innovation capacity factors and their influence on SMEs innovation performance (De jong and Marsili, 2006; Phelps et al., 2007;

Wolff and Prett, 2006). We therefore integrate firm’s size thru their total amount of employee as a control variable in our model.

5. METHOD

The main objectives of this research are first to test the validity of selected SMEs’ innovation capacity based on a construct that is built from the literature review. The second objective is to measure the essential part of SMEs’ innovation capacity that could explain the innovation performance of SMEs. The third objective is to test and measure the impact of innovation capacity factors on innovation performance.

We proceed to a statistical test and use multicollinearity to test our innovation construct by analyzing the multicollinearity among the variables of innovation capacity. We then propose multiple linear regressions to propose a critical analysis of SMEs’ innovation capacity factors by providing their impact factors on SMEs’ innovation performance. Therefore, as expressed by Figure 1, we built a research framework based on 9 variables that illustrate the SME’ innovation capacity construct and may explain the innovation performance of firms. To articulate the relationships that were captured in the research framework, 9 hypotheses were developed because each illustrated dimension of SME innovation capacity explain and have a positive effect on SME innovation performance, as expressed by Figure 1.

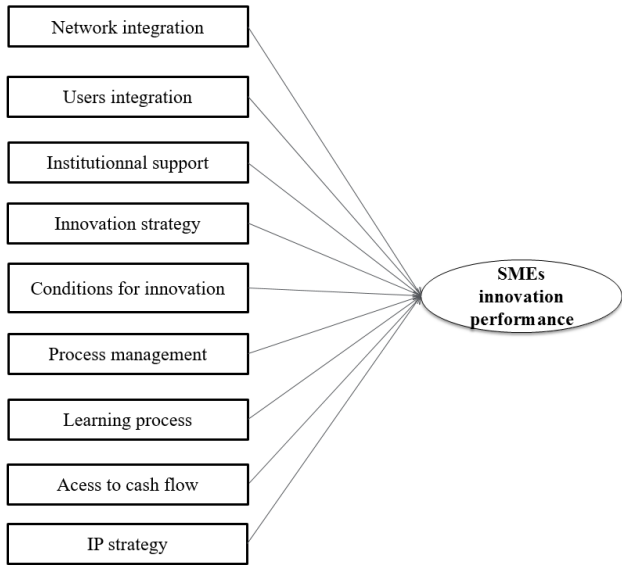


Figure 1 : Research framework

5.1 Data

The data are collected directly by a research team that uses a survey technique and questionnaire because they allow the gathering of a large amount of data and the collection of accurate information (Beregheh et al, 2012; Saunders et al, 2003). Surveys are a suitable method for collecting data and have been used in previous innovation-dedicated studies (Baregheh et al, 2012). We directly contact innovative SMEs by conducting a three-stage solicitation. We start by sending a first mailing that presents the survey, aim of the study, research team and potential gain for participants. The survey was sent to 700 qualified firm's through a database that was provided by our partner Deloitte-In Extenso Innovation Croissance and the association of "les lauréats de l'innovation", an association that regroups the laureates of the French Ministry of Research's innovation competition "Ilab".

In addition, we propose strict inclusion and exclusion criteria for our survey. As recommended by a European Commission recommendation of 6 May 2003 and the OECD's SMEs definition (2005). the SMEs that participated in this survey have strictly under 250 employed persons and under 50 million in annual turnover. A full description of the data set and sample is provided in Table 1. The industry sector and size classifications are conducted according to our partners' classification scheme. Our partner checked for response bias by conducting interviews with 10 non-respondent firms, which revealed no response bias in the sample. We collected 213 usable answers only from top management profiles for this first session of analysis. We will proceed to another test based on our second sample of 320 firms.

Information	Details	Number of enterprises	% of enterprises
	Total	213	
Industry	Digital and IT	64	30%
	Life science and biotechnologies	74	33%
	Chemistry and environment	23	11%
	Materials, mechanics and industrial processes	32	16%
	Electronics and signal processing	19	10%
	Total	213	
Annual Turnover (Mil €)	< 1	178	83%
	1 – 5	14	6%
	5 – 15	12	5.6%
	15 – 30	6	3%
	30 – 50	3	1.4%
	Total	213	
Innovation type	Product	145	68%
	Process	18	8.4%
	Uses	50	23.6%

Table 1: Sample description

5.2 Data validity and analysis

We first check the reliability and viability of our construct by processing content validity and structural validity as recommended (Kaynak and Hartley, 2006; Terziiovcki, 2010). Content

validity is found because we selected items for the theoretical model after we reviewed the existing literature. We then analyzed the standard of reliability using the Cronbach alpha's test to ensure the reliability of the survey instruments with coefficients above $\alpha = 0.6$, as recommended by Hair et al.,(1995;2010) and proposed on innovation capacity dedicated research (De jong and Marsili, 2006 ; Forsmann, 2011).

Multiple regressions are conducted with a full integration method. We then proceed to conduct several tests (Carricano et al, 2008). Table 3 indicates that the regression model is statistically significant regarding the variance analysis with F value = 4.108 and $p = 0.003$. As a preliminary step, we check the multicollinearity of the independent variables using a bivariate correlation and removing the variables with an intercorrelation coefficient above $r = 0.9$ (Hair et al., 2006). The results show that all VIF statistics are far below 10 (and close to 1.0) which indicates that multicollinearity is not a concern when the independent variables are in the same equation. The Durbin-Watson (DW) value is then used to test whether the residuals are mutually independent. The obtained result (DW = 2.042) shows that there is no autocorrelation. We finally test criterion validity by examining multiple R coefficients and R^2 , and a coefficient of 0.662 suggests that the model is acceptable and explains 66% of the variance in the SMEs' innovation performance. We use the standardized Beta to analyze the respective contributions of each independent variable to the dependent variable. We then conduct a T test to measure the impact of each variable and its respective significance. As used in innovation capacity articles, a p value is significant at the $p < 0.1$ level (Martinez roman et al., 2011). Table 3 shows the multiple regression model results, and all results are summarized in Figure 2.

Multiple R				0.814
R square				0.663
Adjusted R square				0.502
Standard error				0.270
F				4.130
F sig.				0.003
Durbin-Watson				2.035
	Variables	Beta	T	Sig T
	V1: Network integration	-0.064	-0.395	0.697
	V2: Users integration	0.211	1.832	0.081
	V3: Institutional support	0.179	2.864	0.009
	V4: Innovation strategy	0.417	2.375	0.027
	V5: Conditions for innovation	0.260	1.861	0.077
	V6: Process management	-0.108	-0.735	0.470
	V7: Learning process	-0.393	-1.929	0.067

V8: Access to cash flow	0.015	2.414	0.025	1.321
V9: IP strategy	-0.123	-1.016	0.321	1.949
Control Variable : total number of employee	0.002	0.399	0.694	2.061

Table 2: Model summary and regression coefficients

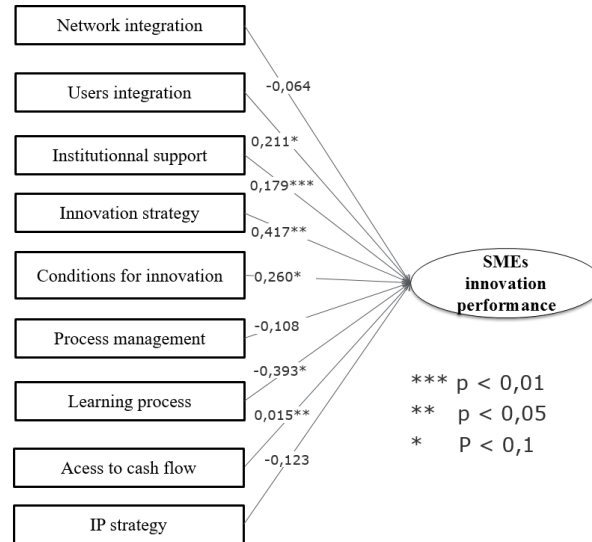


Figure 2: Results of the regression analysis

6. RESULTS AND DISCUSSION

This paper explores models that assess SMEs' innovation capacity. Because only one-third of SMEs have a recognized formal strategy that is dedicated to innovation, the detection and extraction of the innovation capacities of SMEs proves difficult (De Jong and Marsili, 2006). As previously noted, SMEs' innovation capacity deserves more investigation regarding its consistency (De Jong and Marsilli, 2006 ; Forsmann, 2011). Our research aimed to build a comprehensive framework to assess SMEs' innovation capacity with dimensions that are particularly fitted to SMEs. Those first results will be completed on our second test session based on our second sample of 320 firms. We would proceed to a factor analysis in order to test our construct of innovation capacity and to compare results with our first aggregation based on literature review.

6.1 Contribution to SMEs' innovation capacity assessment

Our findings extend the existing knowledge on the assessment of the innovation capacity of SMEs and discuss the existing results. A firm's ability to integrate networks into its innovation process tends to be presented as a central factor of its innovation capacity. The literature tends

to present SMEs as highly dependent on networks due to their natural lack of resources. Their ability to detect, integrate and maintain network relationships is perceived as central (Gronum et al., 2012; O'regan et al., 2005; Lasagni, 2012; Pittaway et al., 2004). Surprisingly, the results observed in this study showed that network integration (V1) exhibits an insignificant relationship in our regression ($p > 0.05$; Sig T = 0.697). which rejects H1. These results may be explained by the difficulties that were expressed by SMEs in implementing such relationships and the costs that are incurred to detect, efficiently use and maintain positive and profitable relationships. As expressed by litterature, network integration is correlated with the learning process and the IP management strategy, which are perceived as difficult to manage by the SME-dedicated literature (Harabi, 1995; Kingston, 2004). Therefore, a high integration of networks may be too expansive regarding the financial and human costs to be positively linked to SMEs' innovation performance. SMEs lack of resources may tend to limit a positive balance of network integration.

User integration is expressed in the literature as a lever to SMEs' innovation performance because it may not only provide new ideas and insights to better understand user needs but also allow a firm to ensure that it is responding to market needs and meeting them. This approach tends to foster market access and limit loss due to market failure (Apiah-adu et al., 1998; Gronum, 2012; Von hippel, 2005). However, such an approach is also discussed regarding its costs in terms of time and money to efficiently use the gathered information (Von hippel, 2005). Our results confirm these observations. User integration (V2) demonstrated a significant and positive relationship ($\beta = 0.211$; T = 1.832 and Sig T = 0.081) with innovation performance. Therefore, H2 is confirmed. These results tend to confirm that users may be important actors of SMEs' innovation because they permit faster market access by adjusting the market fit and creating the first commercial relationships because of their primer integration. This integration also benefits innovation performance regarding users' impact on the ideation and creativity phases in the process.

Institutional support is expressed as an important lever of the innovation capacity of SMEs. The ability to detect and use these supports is considered an innovation capacity and a factor of SMEs' innovation performance (Keizer et al., 2001). However, dedicated competencies are needed to fully integrate such supports. Our results provide a clear vision of the positive impact of institutional support on SMEs' innovation performance. Institutional support (V3) demonstrated a significant and positive relationship ($\beta = 0.179$; T = 2.864 and Sig T = 0.009) with innovation performance, confirming H3. Financial, operational and technical supports

appear to be central in encouraging SMEs' innovation capacity due to the lack of resources of SMEs. This support is positively related to performance despite the literature's description of the limit that is induced by the needed expertise inside the firm (Henrekson and Johansson, 1999).

In this study, innovation strategy (V4) demonstrated a significant and positive relationship ($\beta = 0.417$; $T = 2.375$ and $\text{Sig } T = 0.027$) with innovation performance. Therefore, H4 is confirmed. This finding confirms the literature's perception of the beneficial impact of innovation strategy (Rothwell and Dodgson 1991; Terziovski 2010). Despite their natural flexibility and informality strength, SMEs' ability to construct and plan their innovation strategy into mid- and long-term objectives and a roadmap appears to favor innovation performance. Therefore, strategy planning may not be linked to flexibility loss and may not limit SMEs' ability to confront particularly uncertain environments.

Conditions for innovation (V5) demonstrated a significant and positive relationship ($\beta = 0.260$; $T = 1.861$ and $\text{Sig } T = 0.077$) with innovation performance. Therefore, H5 is confirmed. These results are consistent with the common literature on innovation that expresses the need to create a positive environment to foster innovation performance (Lawson and Samson 2001; Terziovski, 2010). A firm's ability to integrate employee environmental needs into its management process tends to encourage innovation and secure employees' involvement in the process. Our results also confirm that these environmental considerations do not have a negative impact on SMEs' ability to propose efficient processes and to ensure their ability to produce innovation outputs. Despite SMEs' natural informality that is expressed in the literature, our results tend to prove that SMEs have a particular interest in creating favorable environments, and our results propose structured reasoning on how to improve them.

This study's regression analyses did not find a significant relationship between innovation process management and innovation performance. Process management (V6) demonstrated an insignificant relationship ($\beta = -0.108$; $T = -0.735$ and $\text{Sig } T = 0.470$) with innovation performance. Therefore, H6 is rejected. This finding is very surprising regarding the literature, where innovation process management is perceived as a solid enabler in producing innovation by using scarce resources and capabilities (Boly, 2014; Forsman, 2011). These results may be explained by SMEs' natural lack of formalization in their management process and their constant need to quickly reach the market that may limit the time that is invested in the project management process. Another option that may explain these results is the relatively small

amount of innovation projects at SMEs. A limited number of projects induces a limited need for portfolio management that could limit the impact of assessing each project to perform.

Learning process (V7) demonstrated a significant and negative relationship ($\beta = -0.393$; $T = -1.929$ and $\text{Sig } T = 0.067$) with innovation performance. Therefore, H7 is partially confirmed. These results are interesting considering the existing literature, where learning process and knowledge management activities (KM) play a key role in innovation management (Adams et al, 2006; Darroch, 2005). The detection and integration of external knowledge are supposed to increase the knowledge capital of a firm (Darroch, 2005). The literature indicates the need to manage and secure knowledge integration through managerial processes, human resource training and contract terms. These results may emphasize the negative impact of the knowledge management processes inside SMEs. The high care of knowledge integration through processes may disturb the global innovation process by using and wasting resources and time that would benefit other dimensions of SMEs' innovation capacity.

According to the dedicated literature, firms' ability to propose efficient commercial activities that generate income to finance their ambitions (Freel, 2000) is important to foster and sustain innovation. SMEs that provide good financial results tend to be more favorably inclined toward the risk acceptance of innovation and more inclined to invest in such activities (Souitaris, 2001). Although financial constraints encourage small firms to innovate, if they persist, financial constraints may have a negative impact on innovation activities (Xuemei et Al, 2013; Hewitt-Dundass, 2006). In our study, access to cash flow (V8) demonstrated a significant and positive relationship ($\beta = 0.015$; $T = 2.414$ and $\text{Sig } T = 0.025$) with innovation performance. This observation is consistent with the existing literature; therefore, H8 is confirmed. SMEs' ability to generate revenue with their activity is positively linked to their innovation capacity and therefore must be integrated into SMEs' innovation capacity assessment.

Despite consistent criticism mainly concerning the monitoring, enforcing and defense costs after patent publication that may limit firms' interest in patents and monitoring the firms' IP strategy (Harabi, 1995; Kingston, 2004 Lanjouw and Schankerman, 2004), literature tends to propose the positive impacts of IP strategy. IP may be attractive to secure the innovation value and valorization of SMEs, specifically to attract customers (Holgerson et al., 2013) as well as investors and partners, by offering tangible proof of a firm's innovativeness and allowing investors to secure a potential return on their investment (Lemley, 2000; Hsu and Ziedonis, 2008; Haeussler et al., 2009; Rassenfosse, 2012). In our study, IP strategy (V9) demonstrated

an insignificant and negative relationship ($\beta = -0.123$; $T = -1.016$ and $\text{Sig } T = 0.321$) with innovation performance. Therefore, H9 is rejected. These results are consistent with the studies that have determined the relative impact of IP. These results may be explained by the induced costs but are mainly explained by the lack of security that is offered by an IP strategy. Even if it is protected, IP does not guarantee the full protection of SMEs' innovation outputs. Second, IP interest may be highly relative to a firm's sector. Therefore, IP strategy is not a central factor in explaining and analyzing SMEs' innovation capacity.

6.2 Managerial implications

Our results allow us to formulate some recommendations to managers who are involved in innovation activities at SMEs. The objective is to reduce the failure rate observed in SME innovation. As noted by Terzirovski (2010). The new business failure rate is close to 20% within two years and is nearly 60% within six years in most developed countries. Numerous explanations can be provided with an understanding of the levers of value creation and value destruction in the first years of an SME's existence, but the reduction of the failure rate remains central. In this initial period, SMEs necessarily destroy value because they are embedded in an expansive, voracious and time-consuming process regarding several aspects of their growth, such as R&D, business development and internal structuration. To limit this value destruction, SMEs should initiate value creation processes. SMEs should also focus on key levers to accelerate their innovation performance.

First, our findings invite SME managers to consider the integration of different dimensions of the innovation capacity of their company to optimize innovation activity and to increase innovation performance. Our findings can be considered best practices that are based on an unprecedented benchmark concerning how to perform regarding innovation activity. These insights are usually not available because firms generally do not communicate their key success factors. Second, our findings invite SME managers to organize innovation activities to maximize their innovation performance. Many SMEs tend to consider innovation activity as being based on technical or scientific knowledge, and they neglect other aspects of innovation capacity. More attention should be paid to managerial practices.

7. CONCLUSION

The aim of this study was to explore the dimensions of SMEs' innovation capacity that must be integrated into a dedicated assessment model. Based on a quantitative survey and regression analysis, we questioned the participants regarding ten dimensions of SMEs' innovation capacity. Six dimensions are significant and therefore must be integrated into our model, and four dimensions appeared to be irrelevant in explaining SMEs' innovation performance. Our findings provide new insights into SMEs' innovation capacity. Because most SMEs do not have resources that are dedicated to innovation, the concept of innovation capacity is usually difficult to investigate. Therefore, our research offers an interesting perspective from which to study the innovation activities at SMEs.

However, our approach suffers from limitations that offer good opportunities for future research. First, our research is based on a global SME context, with no differentiation regarding activity sectors, and provides results that may be aggregated and diversified in different contexts. Future studies could focus on diversified contexts such as different industries or more or less innovation. Discussing the influence that innovation output has on innovation capacity in terms of type (i.e., product, process, etc.) and degree (i.e., incremental or radical) would also be interesting.

Second, our study is based on a static perspective of innovation capacity. Because SMEs evolve rapidly, a longitudinal analysis of SMEs' innovation capacity would be appropriate. This analysis may provide insights into the evolution of innovation capacity and its impact on innovation performance.

Third, our analysis is focused on a linear regression model based on literature review aggregation. We could integrate a different perspective by performing a factor analysis based on multiple items in order to statistically build our model of innovation capacity. This is what we would propose in our second analysis based on our second sample of 320 firms

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