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External knowledge sources, green innovation and performance

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ABSTRACT

Theoretically speaking knowledge sharing seems relevant for innovations in general. Yet, there is no adequate understanding of how knowledge sharing can develop green innovation in SMEs. This paper focuses on how internal and external knowledge sharing intercede green innovation and ponders on how it affects the organization performance. First, the empirical results show that all types of external knowledge don't convey the same green innovative outputs. Second, they reveal that the success of the innovation process is strongly impacted by the access to knowledge sources but above all by the combination of internal and external knowledge in each phase of the green innovation process. The success of green innovations unveils the organizational absorptive capacity of external knowledge and their transformation into internal skills. Eventually, the risks associated with knowledge transfer can hinder the positive relationship between green innovation and the firms' performance. It also leads to the financial failure of green innovations.

1. Introduction

The green innovation theme has recently received an increasing attention in academic and political circles with the implementation of corrective policies in a lot of countries in the last years to diminish or palliate environmental damages (Boons and Lüdeke-Freund, 2013). Innovation comprises any new practice added to the organizations, including equipment, products, processes, policies and projects. Technical innovation pertains to products, services and production technologies; it is related to the basic activities and is concerned with either product or process (Damanpour, 1991; Kimberly and Evanisko, 1981). According to academic literature, green innovations are a subset of general innovations (Wagner, 2008) and share many characteristics with them. There are three major dimensions within the notion of green innovation: process, product, and organization. Concerning the first two, the aim is to combine environmental goals with "*process innovation* (*productive efficiency*) *and product innovations* (*product quality*)" (Triguero et al., 2013). There exist complementarities between the three terms, as they each concern resources: their nature, how they are collected, used and managed.

Several researchers have suggested a number of factors influencing the adoption of innovations. Kimberly and Evanisko (1981) indicate that organizational and contextual factors can influence the adoption of innovations. The determinants of this influence include perceived innovation characteristics, adopter's organizational characteristics and environmental influences. The availability and quality of internal resources and external knowledge, the knowledge transfer activities, and the political and legal environment are relevant for the adoption of technical innovations (Scupola, 2003). In general, the adoption of technical innovations is affected by technological, organizational and external environmental context (Tornatzky et al., 1990). Regarding organizational green innovation, some authors stated that green innovation "*involves the implementation of several management activities aimed at reducing environmental impact*" (Triguero et al., 2013).

Some quantitative empirical studies show that involving a large number of external knowledge sources in innovation is a promising alternative for large companies (Lakhani et al., 2012; Laursen and Salter, 2006). Researchers also emphasize the importance of absorptive capacity that allows firms absorb, identify and implement external knowledge. In that sense, they highlight that external knowledge does not replace internal knowledge. Although they agree that SMEs play a growing role in innovation, their studies lack a main point regarding how the SME are excluded from the mainstream discussion on green innovation (Cohen and Levinthal, 1989; Chesbrough, Vanhaverbeke, and West, 2006; Dahlander and Gann, 2010).

While the world has been accustomed to developing in a production-based economy, according to Drucker (1993) this statement has no longer been true since several decades. Indeed, according to the author, economic actors now evolve in a knowledge-based economy, where knowledge-workers and knowledge-work are fundamental elements of this new economy. A firm's capacity to create and apply new knowledge is vital for firms to maintain their competitive advantage (Anand et al.,

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2007). Indeed, in a chaotic environment, a firm's capability regarding competitiveness and efficiency strongly relies on its ability to capitalize and extract value from knowledge creation, whether it is of organizational, scientific, or technological nature (Lemon and Sahota, 2003).

Even though there is a significant body of research that has investigated knowledge sharing aspects, it misses an accepted definition for knowledge sharing. For example, Nonaka (1991) and Rowley (2000) broadly define knowledge management as a process through which useful information is identified and collected from different sources. These authors distinguish several processes: the process of knowledge acquisition that enables employees to retrieve and processing organizational related knowledge; the process of organizing knowledge that invents and applies knowledge properly; the process of leveraging and circulating knowledge through all organizational levels, and the process of storing and sharing knowledge in organizational databases to build an organizational memory.

Although the relationships between knowledge sharing and various aspects of innovation have been empirically examined in details, few researches consider the specific effects the external and internal knowledge sharing practices have on innovation process, especially for green innovations (Noailly and Ryfisch, 2015; Lee et al., 2010; Brockman and Morgan, 2006; Hall and Andriani, 2003).

This paper focuses on how internal and external knowledge sharing fosters green innovation and on its effects on the organization performance. Theory argues that knowledge sharing is relevant for other innovations (Calantone et al., 2002; Linder et al., 2003). However, considering the increasing relevance of green innovation, there is a lack of understanding of how knowledge sharing can foster green innovation in SMEs. There is only little insight to how internal and external knowledge sharing might be developed in order to enhance an organizational capacity in green innovations. In this paper, we aim to bridge this gap dealing with this problematic issue: How can French SMEs benefit from the combination of internal and external knowledge sharing to enhance green innovations?

The remainder of this paper is structured as follows. Section 2 defines green innovation, highlights its main peculiarities and discusses knowledge sharing dimensions and its effects on green innovation processes. Section 3 presents the research methodology. In Section 4, the main results are described and findings are discussed. Section 5 concludes and offers limitations and further research directions.

2. Theoretical background

2.1. Green innovation

2.1.1. Definition

As a phenomenon, green innovation is hardly defined in a clear way as it resembles some concepts in the literature that are not empirically measured (Arundel et al., 2006). As the various research studies do not agree on a common definition, defining green innovation is not a simple task. Referring to the literature, it should be noted that several terms have been used to describe green innovation: “Green innovation”, “Ecological innovation”, “Environmental innovation” and “Sustainable innovation” (Boons and Lüdeke-Freund, 2013; Carrillo-Hermosilla et al., 2010; Hall, 2006). Throughout the literature review, researchers use these several terms interchangeably. According to researchers, it is necessary to highlight that the first three of these terms embrace ecological and environmental dimensions, while the sustainable innovation addresses a broader concept and embraces an additional social dimension (Charter and Clark, 2007; Schiederig et al., 2012).

In the Eco-Innovation Observatory (2013), eco-innovation is defined as the “*introduction of any new or significantly improved product* (*good or service*), *process*, *organizational change or marketing solution that reduces the use of natural resources* (*including materials*, *energy*, *water and land*) *and decreases the release of harmful substances across the whole life-cycle*”.

Kemp and Pearson (2008) delivered a definition which incorporates several aspects of the innovation process. According to them, environmental innovation can be defined as “*The production*, *assimilation or exploitation of a product*, *production process*, *service or management or business method that is novel to the organization* (*developing or adopting it*) *and which results*, *throughout its life cycle*, *in a reduction of environmental risk*, *pollution and other negative impacts of resources use* (*including energy use*) *compared to relevant alternatives*”.

Generally speaking, green innovation comes from traditional market constraints such as customer demands or product life cycles, but also societal and environmental pressures and/or opportunities (Hall and Mairesse, 1995). Accordingly, green innovation must create value for all the stakeholders involved in its adoption. The value associated with the new product or process must make a clearly defined contribution in the environmental and/or social field so that it can be described as eco-innovative (Ryszko, 2016). The green innovations are conditioned by both the technological possibilities of the firm and its ability to appropriate the benefits of innovative activities (Horbach, 2008). Although these terms share the same content to a certain extent (Schiederig et al., 2012), the term green innovation as an environmental innovation aims to improve both environmental and economic performance (Ekins, 2010). In a more comprehensive sense, green innovations can be defined as the measures of relevant actors in the development, application, or introduction of new ideas, as well as the behaviors, products and processes that contribute to a reduction of environmental burdens or to achieve ecologically specified sustainability targets (Rennings and Zwick, 2002). However, most green innovation definitions refer to products, processes or management practices aimed to reduce the environmental impacts (Kemp and Arundel, 1998; Rennings and Zwick, 2002; Kemp and Pearson, 2008). According to these researchers, it seems that green innovations are those which primarily affect the design of the product and are aimed at reducing the product's environmental impact throughout production, use and disposal at the end of the product's life. To measure the prevalence of green innovation, large-scale innovation surveys such as the Community Innovation Survey (CIS) seem very useful. It defines nine types of green innovations and classifies them in two categories. Six types of green innovations refer to environmental benefits deriving from the production of goods or services: reduced material use per unit of output; reduced energy use per unit of output; reduced CO2 footprint (total CO2 production); replaced materials with less polluting or hazardous substitutes; reduced soil, water, noise, or air pollution and recycled waste, water, or materials. The other three innovations are related to the benefits deriving from the after-sales use of a good or service: reduced energy use; reduced air, water, soil or noise pollution; improved recycling of product after use. Because of this additional environmental dimension, green innovations are generally perceived to be more complex than other innovations. Given their limited resources, this complexity can be a constraint for SMEs compared to large size companies (Oltra and Saint Jean, 2009). Similarly, De Marchi (2012) emphasized that this type of innovation is more complex and more costly for SMEs and argued the importance of R & D cooperation in their development.

2.1.2. Double externality

The diversity of green innovations is very wide (Carrillo-Hermosilla et al., 2010). Some are certainly systemic, complex and radical, but many are rather incremental. As any other innovation, green innovation has to contribute to the general objectives of the firm, including cost reductions and/or revenue increase. The specificity of green innovation is its “double externality” (Rennings and Zwick, 2002). Indeed, an eco-innovation generates not only a positive externality of knowledge (produced by any standard innovation), but also a positive external environmental effect. This environmental spillover implies a reinforcement of the uncertain character of the process of adopting innovations (Jaffe et al., 2005; Rennings and Zwick, 2002; Faucheux and Froger, 1995) and reinforces the interaction between firms and the