Understanding the use of patent data along the innovation process

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Abstract :

While research has paid attention to open innovation, we have witnessed a strong emphasis on the question of how firms can learn from patents and knowledge generated outside their organizational boundaries. In this article, we examine the way patents can be used as an input into the innovation process. To better comprehend the use of patents in this process, we focus through the lens of a leading global automotive company, which offer a particularly suitable context for such an investigation. Based on a case study, we show, step by step, how to integrate external patents throughout the different stages of the open innovation process. We then highlight specific policy implications that suggest a more holistic approach for firms intending to encourage the use of external patents. We conclude by outlining limitations of our work and proposing potential future research opportunities.

Keywords: patents, absorptive capacity, open innovation, outside-in process, automotive industry.

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INTRODUCTION

Innovation theorists have long acknowledged that patents are linked to the innovation process (Chesbrough, 2003; Corbel & al., 2007; Vanhaverbeck & al., 2008; Mbongui-Kialo, 2013). However, this insight has rarely been extended to understand the way firms integrate patents within their organization and how they use them to increase their innovative potential (Chesbrough, 2003). To extend the theory on patents, it is therefore important to focus on the use of patents as an input in the open innovation (OI) process. In the past few years, patents were viewed mainly as the province of the legal department ; today, however, they are being considered as an integral part of corporate strategy (Rivette & Kline, 2000 ; Mbongui-Kialo, 2013 ; Senarathne & Wei, 2018 ; Masayuki, 2019 ; Mezzanotti & Simcoe, 2019). They gained a strategic importance that exceeded their traditional role of appropriating direct returns from R&D (Corbel, 2006; Blind & al., 2009) and appear increasingly as a multifaceted strategic tool (Corbel, 2006; Blind & al., 2009; Kim & al., 2016; Rudy & Black, 2018; Suh & Jeon, 2018; Masayuki, 2019; Mezzanotti & Simcoe, 2019). Huston & Sakkab (2006) reported that P&G, after moving to an open-innovation model, was able to achieve “sustained and steady top-line growth,” with 35% of its new products having elements that originated from external patents and other external resources. According to Valverdea & al. (2014), some solutions to industrial problems can be found by looking for knowledge using different information sources such as patent databases, journals, etc. Patents are a large source of free technical knowledge that describe, explain and reveal current technologies used and, provide solutions to problems. Despite this informational dimension of patents that can accelerate internal innovation (Chesbrough & al., 2006), survey evidence suggests that firms do not place much value on the disclosed information (Cohen & al. 2002). We contribute to this line of research by examining the precise role of patents throughout the OI process. In so doing, we address a substantial gap in the innovation literature which limits itself to a general approach on the use of external knowledge (Chesbrough, 2006; Huang & al., 2013). Both the literature about patents (Myrick et al., 1993; Kim & al.,2016; Suh & Jeon, 2018; Masayuki, 2019; Mezzanotti & Simcoe, 2019) and the one about OI have focused on how innovating companies can benefit from external

sources of technology through corporate venturing, alliances, and licensing (Vanhaverbeck & al., 2008). However, the attention towards external knowledge encourages us to focus exclusively on patents as a source of information to better understand its contribution.

To better comprehend the use of patents in the OI process, we focus through the lens of a leading global automotive company, which offer a particularly suitable context for such an investigation. This is because the automotive industry is well known for its technical innovations and intellectual property management. With the rapid change in markets and technologies, it is becoming essential for automotive firms to open up their innovation process in order to use external knowledge sources to increase their innovative potential. Our study deals with a French multinational automotive manufacturer which is also one of France's leading patent filer, with 1 021 patent applications published in 2017 (960 patent applications published in 2016). This is a promising context within which to study the OI process and to generate policy recommendations for intellectual property management. In examining patents as an input in the innovation process of an automotive firm, we are particularly interested in understanding the absorptive capacity which is assumed to be a set of organizational capabilities by which firms acquire, assimilate, transform, and exploit external knowledge to produce a dynamic capability (Zahra & George, 2002). By approaching different patents from the open innovation perspective, we focus on the integration of patents throughout the innovation process. In so doing, we are particularly interested in providing answers to the following question: Why and how do firms integrate external knowledge from patents throughout their innovation process?

Based on extensive field research we offer grounded empirical insights into how patents are used as an input to the OI process. Our findings lead to one main contribution. We provide emerging theoretical insights into how external knowledge from patents is integrated into industrial firms and how it is managed to foster the OI process. Based on our findings, we then highlight specific policy implications that suggest a more holistic approach for firms intending to encourage the use of external patents. We conclude by outlining limitations of our work and proposing potential future research opportunities.

1. LITERATURE REVIEW: PATENT AND OPEN INNOVATION

Drawing on Fantoni & al. (2013) and Granstrand (1999), the patent system is based on the so-called contract theory. The granting of a patent establishes a contract between the applicant and the State. The State grants the inventor a monopoly position as a "*reward*" for their innovation.

Patents are limited-term grants of rights to inventions, issued to inventors in exchange for detailed specifications of the invention. In return, the patent applicant must fully disclose their invention to the public. Patent documents generally disclose technological information by describing the inventions in accordance with the requirements of the patent law and by indicating the claimed novelty and inventiveness in reference to the existing state-of-the-art. They are thus sources of knowledge, and in many cases furnish the history, in summary form, of the technological progress in the field of technology to which they relate.

1.1. OPEN INNOVATION AND THE IMPORTANCE OF THE OUTSIDE-IN PROCESS

OI originates from the private sector where it is seen as a model or a system in which organisations open up their innovation processes and combine internally and externally developed ideas and technologies to create value (Chesbrough, 2003 ; Chesbrough, 2006 ; Brunswicker & Chesbrough, 2018 ; Pedersen, 2020). According to Chesbrough (2003; 2004), OI is an innovation management model which assumes that innovation is based on the firms' need to combine their internal and external technological developments to produce a successful innovation that creates added value (Chesbrough, 2012). In other words, it means a situation where an organisation doesn't just rely on their own internal knowledge, sources and resources for innovation but also uses multiple external sources (competitors ; customers, published patents, etc.) to drive innovation. Reflecting on works by Tether & Tajar (2008) and Talaga (2009) works, OI can be understood as a form of external orientation for commercializing both internal and external ideas. It helps organizations look beyond their boundaries to seek and utilize inflows and outflows of knowledge in order to accelerate the internal innovations, and to expand the markets for the external use of the innovation (Chesbrough, 2012).

There are three different kinds of OI processes which can be categorized by using firm's process perspective (Enkel & al., 2009) : the outside-in process, the inside-out process and the coupled process. (1) The outside-in process expands the companies's knowledge base through the integration of suppliers, customers and external resources from other organisations (competitors, universities, etc.) into innovative processes (Gassmann & Enkel, 2004, p.6 ; Dahlander & Gann, 2010). This process is guided by the belief that ideas and knowledge from the outside are the keys to success. This means that any organization interested in this approach shall be determined to collaborate with other stakeholders (public organizations, customers, competitors, etc.) or to set up a technology watch in order to identify the ideas and technologies used by other actors in the market place. However, for successfully implementing the outside-

in process organizations (private and public) must possess the necessary capabilities and skills for absorbing external inputs. (2) In the inside-out approach, internal knowledge is exploited externally. It focuses on placing some of the organisation's assets outside its own walls to generate innovation in collaboration with other organisations. This approach is guided by the belief that the inner strengths and capabilities of the organization will enable the organization to prevail. The goal is for organizations to appropriate value by bringing ideas to the market, trade their intellectual property (Gassmann & Enkel, 2004, p. 6), or negatively influence competitors with decoy patents. This process enables organisations to profit from unused innovations through exploitation so other organisations utilise them via their business models (Chesbrough & Bogers, 2014). For Lichtenthaler and Ernst (2007), through multiple contractual forms (out-licensing agreements, spin-offs, etc.), organizations can try to externally leverage their technological knowledge in order to generate additional revenues. (3) The coupled process combines the outside-in and inside-out processes. It refers to a kind of co-creation with complementary partners through alliances, cooperation, and joint-ventures during which give and take are crucial for success. Organizations that decide to set up this process are involved in a set of inter-firm relationships that essentially are a cooperative pattern for R&D to obtain and give complementary know-how (Enkel & al., 2009).

1.2. CONNECTING OPEN INNOVATION AND ABSORPTIVE CAPACITY

Theoretically, OI has been perceived and researched as a way of increasing an organisation's absorptive and dynamic capabilities (Lichtenthaler & Lichtenthaler, 2009; Mbongui-Kialo, 2013), which becomes increasingly important for fostering innovation. Brunswicker and Chesbrough (2018) showed that OI is now a standard practice, with nearly 80% of organizations adopting its methods. In line with the three OI processes categorized by Enkel et al. (2009), Cohen & Levinthal (1989) argued that in order to properly leverage the OI, firms need to very carefully think about their capacity to absorb external technologies and also their capacity to invest in internal research in order to be able to manage external knowledge and ideas. In this context, by embracing an open-innovation corporate culture, patents can be seen as a valuable asset that can deliver additional revenues to the current business model. A great deal of researchers considers patents as the least important mechanism to appropriate the returns of R&D efforts (Cohen & al., 2000; Graham & al., 2010). As claimed by Cohen & al. (2000), most of them do not perceive patents as an effective instrument to protect their innovation. Moreover, patents appear to be a strategic tool to codify and protect knowledge, and as such have an impact

on how knowledge is disseminated (Pries & Guild, 2011, cited by Pénin & Neicu, 2018). As OI revolves around knowledge-sharing, patents can be used to transfer knowledge between actors in the OI environment (Pénin & Neicu, 2018) as well as foster innovation. For a great deal of researchers, OI can have positive impact on business performance by increasing innovation capabilities, increasing access to new knowledge, technologies, and markets (Chesbrough 2006; Huang & al., 2013; Parida & al., 2014). As far as patents are concerned, to benefit from external knowledge, firms need to identify such knowledge, acquire it, and be able to combine it with the firm specific internal innovation to produce a product tailored to the firm's specific needs. In their article, Cohen & Levinthal (1989) referred to it as absorptive capacity (AC) which is assumed to be a set of organizational capabilities by which firms acquire, assimilate, transform, and exploit outside knowledge to produce a dynamic capability. These authors point out that AC is enhanced through the following activities: basic skills, shared language, knowledge of the newest progress and practice, and technology ability to try and apply the latest technologies. Zahra & George (2002) go on to suggest a series of indicators that can be used to evaluate each element of the absorptive capacity: (1) knowledge acquisition capability (the number of years of experience of the R&D department, the amount of R&D investment); (2) assimilation capability (the number of cross-firm patent citations, the number of citations made in a firm's publications to research developed in other firms); (3) transformation capability (the number of new product ideas, the number of new research projects initiated); (4) exploitation capability (the number of patent, the length of product development cycle).

AC seems to be crucial in explaining why some companies are much better than others in creating and capturing value from in-sourcing externally developed technology and from collaboration with innovation partners (Cohen and Levinthal, 1990 ; Zahra & George, 2002). Therefore, AC and the outside-in approach of OI are inevitably linked to each other. The purpose of this paper is to analyze the use of patents within the innovation process. The idea is to consider patents as an input (and no longer as an output as they are mainly considered in the literature), and to study the use of patents at the various stages of the innovation process. In this context, factors that influence the use of patents can include not only the characteristics of the external source, but also internal factors such as R&D capabilities and complementary assets (West & Bogers,2014). According to Nonaka & Takeuchi (1995), to ease the assimilation of new knowledge, the firm needs previous knowledge that is closely related to the new one.

Although a great deal of studies suggest that the cumulative experience of innovators does not affect AC, we argue that AC is path-dependent, resulting from the cumulative nature of knowledge (Cohen & Levinthal, 1990), and therefore is influenced by the contribution of past experience to the organizational memory (Zahra & George, 2002). AC potentially bridges the fields of OI (Chesbrough, 2003), organizational learning (Kim & al., 2016) and knowledge management through patent data.

In sum, previous OI researches have often assumed that internal and external sources of knowledge are complements to each other (Chesbrough & al., 2006) and have therefore adopted a general approach on the use of external knowledge (Huang et al., 2013). Such works do not allow us to better understand why and how external sources of knowledge are integrated into the different stages of OI. They also focused on OI and absorptive without linking them to each other in a systematic way although it is clear that the firms' absorptive capacity, as defined by Cohen and Levinthal (1990), determines their ability to in-source externally developed technology or ideas. In this article, we seek to tie these two concepts together and demonstrate how patents can be integrated throughout the different stages of OI. Therefore, further empirical research is needed to illuminate the intricate use of patents within the innovation process.

2. RESEARCH CONTEXT AND METHOD

Qualitative research methodology is considered to be suitable when the researcher, either investigates a new field of study or intends to ascertain and theorize prominent issues (Corbin & Strauss, 2008). As is typical for grounded approaches to theory building, we entered the field with an understanding of preliminary theory on our focal phenomenon – in this case, the use of patents as input in the OI process. There are many qualitative methods which are developed in order to have an in depth and extensive understanding of the issues by means of their textual interpretation. In recognizing that the OI process assumes that firms can use external ideas as well as internal ideas in its natural contextual setting (Zahra & al., 2014), we chose to pursue our examination inductively relying on an interpretative approach (Lincoln & Guba, 1985). As Bevir & Kedar (2008) discuss, interpretative research encompasses an experience-near orientation that sees human action as meaningful and historically contingent. In this view, our study was conducted from an experience-near perspective in that we did not start with concepts determined, a priori, but rather sought to allow them emerge from encounters in the “field”. In order to get an insight into the complexities of the use of patents in the OI process, we employed

a qualitative approach whose data collection was made possible through (1) semi-structured, one-on-one interviews and (2) written and electronic documentation.

2.1. RESEARCH CONTEXT

Our case study research design, involving a leading global automotive company, is well suited to our research, because this industry is well known for its technical innovations and intellectual property management. This is why we chose Groupe PSA (known legally as Peugeot S.A) as a setting for our examination, since it continuously offers sustainable and innovative solutions to meet the challenges of tomorrow's mobility. Groupe PSA is a French multinational manufacturer of automobiles and motorcycles sold under Peugeot, Citroën, DS, Opel and Vauxhall brands. With sales of 3.146 million units, it was in 2016 the third-largest Europe-based automaker. After the completion of the agreed acquisition of Opel and Vauxhall brands from General Motors, PSA is ranked as Europe's second largest automaker. The company' institutional website indicates that Groupe PSA innovation strategy is focused on the customers, the environment and the products: (1) innovating to meet customer expectations, (2) innovating Moreover, in order to respond rapidly to market trends and anticipate technological and social disruptions, Groupe PSA fuels its innovation momentum by: making the Group's innovation processes more competitive and fostering R&D vitality through OI and patenting activities. Groupe PSA is an insightful and "particularly revelatory" case (Eisenhardt & Graebner, 2007, p. 27) due to the fact that it is one of the France's leading patent filer and was the first filer nine years in a row. Therefore, this research context is indeed an appropriate setting for studying how engineers can contribute to innovation activities by integrating external patents into their innovation process.

2.2. DATA COLLECTION

Owing to the Groupe PSA's specificities, we employ a case study approach, defined as "*an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used*" (Yin, 1994, p.13). Furthermore, because we are interested in how firms use patents in the context of OI, we sought data from multiple sources and levels (Eisenhardt & Graebner, 2007). A triangulated qualitative data set, including one-on-one interviews and documentary searches (Eisenhardt & Graebner, 2007) were gathered over a seven-year period (from 2010 to 2017).

2.2.1. Semi-structured interviews

The first source of data was semi-structured interviews conducted with 22 people involved in innovation and patents strategy within Groupe PSA's design offices (c.f., Table 1).

Table 1 : Overview of interviews.

Section	Theme	Example question types	Insights particularly for
1	**Patent roles**	What are the main roles of patents in your company? Have you ever used patents as input into the innovation process? If so, what was the purpose? Do you think one patent can hide another? In other words, can we innovate from an existing patent? What are the organizational challenges of patent management for your company? What tool do you use to research and analyze patents?	Strategic use of patent within the organization
2	**Creativity and patent use**	When, how, and why are patents used to promote creativity? What difficulties are experienced?	Creativity and patent use
3	**Design process and patent use**	Does your company use patents as a product design tool? Why?	Designing process and patent use
4	**OI and patent use**	How is an innovation project structured, and what are its main phases? What role can patent analysis play in each of these phases? Do you think that interpersonal interaction facilitates the use of patents in the OI process? What skills and capabilities are needed for the use of patents in the innovation process?	Relationship between innovation process, absorptive capacity and external patents Absorptive capacity and patent use

The in-depth interviews were conducted on the issue of the patent and its use in the design offices, with a special focus on the innovation process, in order to have a broader view of staff practices. 15 of the interviewees were engineers and familiars with the problematic of patents and innovation. 5 of the interviewees were experienced managers who had a holistic view of patents strategies. 2 of the interviewees were people supporting patenting activities within the company. This selection of interviewees allows us to obtain insights about patents use from multiple perspectives and temporal stages (Gümüsay & Bohné, 2018): those who use or do not use patent as an input in the innovation process, those who manage the innovation teams and are involved in patent strategies within the design office, and those who support patenting activities. We conducted in-depth interviews to gain insights into how individuals viewed and experienced the process of OI (Chesbrough, 2003) and the strategic use of patents. No statistical method was used to obtain a representative sample of staff, but we have identified people with a sufficiently varied profile so as to collect a variety of points of view. As interviews are

managed verbal exchanges and, as such, their effectiveness heavily depends on the communication skills of the researcher (Clough & Nutbrown, 2007), our access to the interviewees was obtained through the head of patents department who transmitted our request for interviews to the staff, which allowed participants to approach us directly. In all, the 22 interviews varied in duration but averaged 60 minutes in length. Each interview was recorded and transcribed verbatim. They were administered face-to-face at three sites of the Groupe PSA. Thanks to our ability to clearly structure questions, listen attentively (Clough & Nutbrown, 2007) and encourage the interviewees to talk freely, we were able to collect the desired information.

2.2.2. Archival documents

A second source of data was the internal and external publications by Groupe PSA. This included two categories of sources: (1) pre-existing qualitative data derived from previous research studies that took place in Groupe PSA's design offices and (2) general documents derived from a great deal of sources. Therefore, aware of the fact that application of appropriate set of criteria to select secondary data to be used in the study, plays an important role in terms of increasing the levels of research validity and reliability, we decided to include these criteria: date of publication, credential of the author, reliability of the source, quality of discussions, depth of analyses, the extent of contribution of the text to the development of the research area, etc. The first category of our second sources includes semi-structured interviews, responses to open-ended questions in questionnaires, and a report that present the findings. The semi-structured interviews were accompanied by extensive description of methodologies employed (qualitative and exploratory) to collect the data, verbatim, etc. These data allowed us to understand examined processes, relationships, and subjective meanings (Miles & Huberman, 1994). They were holistic data that revealed the complexity and the importance of the original study (Miles & Huberman, 1994) that we wanted to evaluate: (a) motivations and obstacles to filing patents; (b) the channels through which the patent filing incentive system is likely to influence the motivation of engineers; (c) the diffusion of a "patent culture" throughout the innovation process in the design offices. Did this culture lead to more innovations? The second category derived from Groupe PSA's Web site, magazines, journals, online portals, newspaper, and press releases from Groupe PSA. Because press releases reflect the image a company wants to portray to the general public, the media, and investors, these documents can be used as indicators of the strategic intent on the part of company managers (Humphreys, 2010). Multiple

documents were chosen for corroboration (Golder 2000). Although the content of these documents is constructed by the interests of a particular author, in the aggregate, it has been used as a reliable indicator of engineers' opinion (Humphreys, 2010). In total, the two categories of secondary data amounted to about 3000 pages. In principle, they were used for two main purposes: to investigate engineers' practices and gain insight into the roles of patents throughout the innovation process.

2.3. Data analysis

To analyze the data, we employed a theory-building approach, which comprised of several stages and followed established procedures for analyzing qualitative data (Charmaz & Mitchell, 2001). In line with Glaser & Strauss (1967), we used a constant comparison technique in order to be able to analyze data and also determine the sampling and content foci of subsequent data collection efforts (Gümüsay & Bohné, 2018). Data analysis progressed in three rounds of coding. The first round of coding undertaken during fieldwork developed descriptive categories through an open coding process across collected data, with a focus on how and why do interviewees use patent as an input in the OI process. Reading through our transcriptions and notes, we searched for depictions of practices based on patent use, links between patents and OI, patent absorptive capacities, barriers of using patents and patent users' depictions. We, hence, recoded the data to identify descriptive categories such as the importance of patents, the profile of users, their motivation, the reluctance to use patents, the methods used, etc. A second round of coding then sought to develop more conceptual themes, allowing us to refine the data into three principal categories: integration of external knowledge from patents, patent absorptive capacities and the management of new ideas within the OI process. During the third round of coding using an iterative process, we looked for relationships and comparative themes among the lower order concepts (Langley, 1999, cited by Gümüsay & Bohné, 2018) so that we could categorize them into higher level theoretical themes through axial coding (Corbin and Strauss, 2015). Four dimensions emerged strongly from our data: (1) strategic use of patents, (2) integration of patent data within the OI, (3) patent absorptive capacities and (4) connection of patent, OI and absorptive capacities.

3. FINDINGS

Far from being limited to their traditional roles such as protection roles, blocking roles, etc., patents seem to experience new roles associated with OI logic. According to this logic, Groupe PSA does not strive to generate the best ideas entirely by itself. Rather, it seeks to utilize internal

and external patents in an optimal manner, to be more effective at managing cost and risk and to accelerate technology development.

3.1. WHY IS IT IMPORTANT TO USE PATENTS IN THE OPEN INNOVATION PROCESS?

Engineers and managers consider that the technical and scientific information contained in patent documents can provide them with important insights that may be used to get ideas for further innovation and avoid unnecessary expenses in researching what is already known. During the innovation process, comparative technological information may determine the success or failure of an innovation and, in turn, the success or failure of the firm itself. In the design offices, there is a kind of process called patent watch which is a process of monitoring external patents to assess whether any of these patent rights might be advantageous or, on the contrary, disadvantageous. According to patent users, an existing patent may be of interest if it appears to cover one or more products or processes sold by a given firm. With constant monitoring, it is possible to determine the strengths and weaknesses of the competitors within the market, strategies that will provide the firm with a distinct advantage, the barriers that can be developed in order to prevent competition from entering the market, and exploit competitors' weaknesses that can stimulate creativity within the organization. There is a strong recognition of the value of patents and their strategic use throughout the innovation process. Using patents as an input in the innovation process seems to be valuable in monitoring competitors' patents, identifying competitors' attacks and also in keeping abreast of new developments, in a particular technology, mainly so as to direct research and development activities.

Despite this strong recognition, there is no systematic or collective procedure of capturing, analyzing and exploiting useful patents for strategic decision making. Each employee has her/his own way of using patents. The use of patents is favored either by the patent culture in the organization or by the employee's previous experience. Patent culture, comprises, in reality, the pervasive values, beliefs and attitudes that characterize Groupe PSA and guide its practices. In this firm, patent culture appears to be the collective behavior of employees harnessing common corporate vision, goals and shared values. It is also shaped by past experiences that play an important role during the innovation process. In fact, past experiences helped to deeply understand patents and their contribution within the innovation process, and provide Groupe PSA with a portfolio of transferable skills. For top managers and a number of engineers, patents are no longer viewed mainly as the province of the legal department, they are rather considered as an integral part of corporate strategy.

Whereas our findings underscore the positive influence of patents we, nevertheless, must relativize the effectiveness of such influence. A very limited number of users recognize the professionalism of the patent department, and justify their attitude by valuing the work done by the patent department, as illustrated by the following statement: **"***The "patent" department is doing a great and useful job for our design offices. To avoid wasting too much time, we always send our requests to the concerned department. I also remember that we are not evaluated on the patents that we integrate in the process of innovation, but rather on our daily missions which consist in designing products and finding good ideas for the company*"**.** There seems to be a notable distrust, at times, almost hostility towards patents and their potential contribution. We found out that a very limited number of users displayed a strong sense of opposition against patent use. They do not really understand the utility of using patents. This highlights the difficulty of using patents and the problem of motivation, as this insight was largely missing among the majority of users.

During our fieldwork, this sentiment came up quite explicitly and was manifested in statements such as: "*Honestly we do not see the value of using patents in the innovation process. We see them more as an obstacle to our ability to find new ideas. We prefer to innovate with our own ideas to fuel our innovation process. Personally, I do not believe that patents can fuel the process of innovation ... They represent a kind of output, not the starting point*". More importantly, this very limited number of users included the risk of imitation in their criticism describing it as a "*creativity inhibitor*" and a "*time-consuming tool*". Therefore, trying to get ideas from patents can't stimulate creativity, however it is a rather time-consuming tool that provides no particular advantage. Caution is also required because some companies use the patent as a real strategic tool to influence competitors, usually by providing them with false information. Even if patents represent a tremendous source of information for innovation, innovators should focus their attention on the fact that knowledge outside the boundaries of the firm cannot be effortlessly absorbed by the firm. Instead, effort and expertise are required to better harness external knowledge.

3.2. Integrating patents within the innovation process

Our results illustrate the fact that patents are not just static rights, but key strategic drivers for technology-based companies (Granstrand, 1999; Blind et al., 2009; Kim & al., 2016; Rudy & Black, 2018; Suh & Jeon, 2018; Mezzanotti & Simcoe, 2019). As such, it becomes essential to consider a patent as a strategic instrument for innovation that involves the establishment of a

process of its integration within the innovative organization**.** Some researches already propose patent documents as resources that can help companies to innovate (Suh & Jeon, 2018; Masayuki, 2019) but do not explain how can patents be integrated within the organization.

To better understand the integration of patents within the firm, we have first identified the different phases of the innovation process. The interpretative analysis of the corpus of the patent users reveals five phases of innovation process: Exploration, Screening, Transfer, Development and Market. The first phase called *Exploration* provides power to the innovation process through the acquisition of patent information. During *Exploration,* there is a kind of knowledge acquisition which refers to a Groupe PSA's capability to identify and acquire externally generated knowledge. Within the organization, the ability to recognize new external knowledge depends on respondents' prior knowledge base, which can equally either enhance or hinder knowledge absorption. The involvement of the patent department in this introductory phase is useful and essential as "*exchanges with the patent department greatly help our engineers to better understand the patent and especially better read it*." After this first phase, there is the *Screening* phase which refers to the design office's routines and processes that allow it to analyze, process, interpret and understand the information obtained from external sources. In this phase all ideas generated in the preceding phase are reviewed. Through a patent analysis, this phase will contribute by eliminating "a *false good idea*". "*In this phase, the use of patent information will allow us not only to feed the innovation process but also to avoid developing something that already exists*". The third phase called *Transfer* is the one that allows engineers to understand how innovation will interface with other vehicle functions. Here the concepts are linked and validated further, patent information can help understand the different "*possible connections*" or applications that may be associated with the projects developed. According to some respondents "*transfer will be possible if everybody is motivated and tries to validate the new ideas and concepts that will be connected to new projects. It is also important to be able share the patent language with all the team and to develop our skills and knowledge in order to foster innovation in a dynamic organization*". In line with this quote, Groupe PSA seems to have developed high level of professionalism and organizational capabilities to be able to assimilate and make use of the pool of relevant patent information. The fourth phase which is *Development* materializes innovation and gives full meaning to the innovation process. In this phase, all stakeholders should to be able to develop their capacity to learn and solve problems and also to confirm or deny the merits of the new ideas. Based upon the results of the tests, the

employee decides on whether to undertake large-scale production or not. This stage generally allows new products to be developed with the undeniable contribution of patents: "*with patents we can easily design new products […]. They give us good ideas and suggest good practices that we discover in the sections where they describe the invention and the fields of application of patents*". In lots of industrial firms, designing new products or technologies requires extensive planning and work. One of the problems inventors or product designers regularly face is in knowing where to begin the design process: "*It is not easy to design products; sometimes we do not know where to start or what to do. When you get ideas from external patents you can cope to try something different or test new ideas*". Introducing patents in the OI process will provide a jump-start on the entire process and direct engineers toward concrete solutions for creating new products or improving existing ones. The last phase refers to *Commercialization* or *Market*. This final phase aims at creating market value for a new technology (or product) by focusing on its potential impact. During *Commercialization* the firm tries to introduce new products, production method or a new patent into the technological market. This introduction can be used as an asset proving value to Groupe PSA. For some respondents, it is much simpler to use patents or competitive products as the basis for a contract instead of defining an area of cooperation. They emphasize that there is a close link between patents, competitive products and the market, which, in simple terms, can be characterized by the fact that patents contribute to a fair market behavior. To this effect, a manager remarked: "*Our target is not to be powerful or to struggle against other companies. No matter who you are, if you can bring us something, we are ready to analyze your requests for collaboration. As far as we are concerned, if a competitor or another actor has a useful technology we are ready to establish a contact to negotiate with the concerned* company". Our findings show that the integration of patents within the innovation process depends on the ability of the respondents to recognize and exploit valuable external patent information. By analyzing the OI process in terms of the absorptive capacity (Zahra & George, 2002) and of OI, the results highlight five steps of how patent information is absorbed by the company and its members (Table 2). The first step is a kind of an exploratory learning which helps to recognize and understand the potential value of the new information. After acquiring patent information, patent users set their attention toward the interpretation and the understanding of the information obtained from external sources. This operation is largely influenced by the contribution of past experiences (Zahra & George, 2002) and also by their familiarity to patent document during the innovation

process. The assimilation of patent information refers to the process of converting information into "*substances*" suitable for incorporation into the innovation process and its stages.

Table 2: Absorptive capacity of patent information throughout the innovation process

Dimension/Capability	Components	Role and importance	Innovation process
Acquisition of patent information	-Prior knowledge - Identification	- Recognition of information's potential value - New connections with new technologies - Speed of learning technological information	Exploration
Assimilation of patent information	-Framing -Understanding the patent information	-Learning -Comprehension -Interpretation	Screening
Transformation of patent information	-Internalization -Conversion	-Recodification -Connection to current and future projects	Transfer
Exploitation of patent information	-Use -Implementation	-Realization of projects -Core competencies	Development (Prototyping and Industrialization)
Diffusion	-Communication -Enrollment -Mobilization	-Product and technology spread -Creation of market value -Adoption of new products and technology	Commercialization or Market

Our results show that it is generally accepted that engineers assimilate patent information better when it is provided in their mother tongue. During the assimilation stage, people try to learn patent information and understand it thoroughly in order to better transform the external information. When transforming external information, the respondents recognize that it is useful to develop and refine the routines that facilitate the combination of existing knowledge with newly acquired and assimilated information. Although the integration of external patents within the firm is a complex process, engineers agree that it is imperative to operate in an open system in order to create something different and seek to exploit it in commercially viable ways.

4. DISCUSSION

Using the case of Groupe PSA, we have documented the use of patent and its implication to the innovation process. In this respect, this article depicts how actors can engage in patent management by marking the starting point of the innovation process and defining the process steps derived from it. According to the results, considering a patent as a valuable external source of knowledge does not imply that the inflow of new ideas into the organization is an automatic or easy process. To be able to integrate external knowledge, firms should have experienced

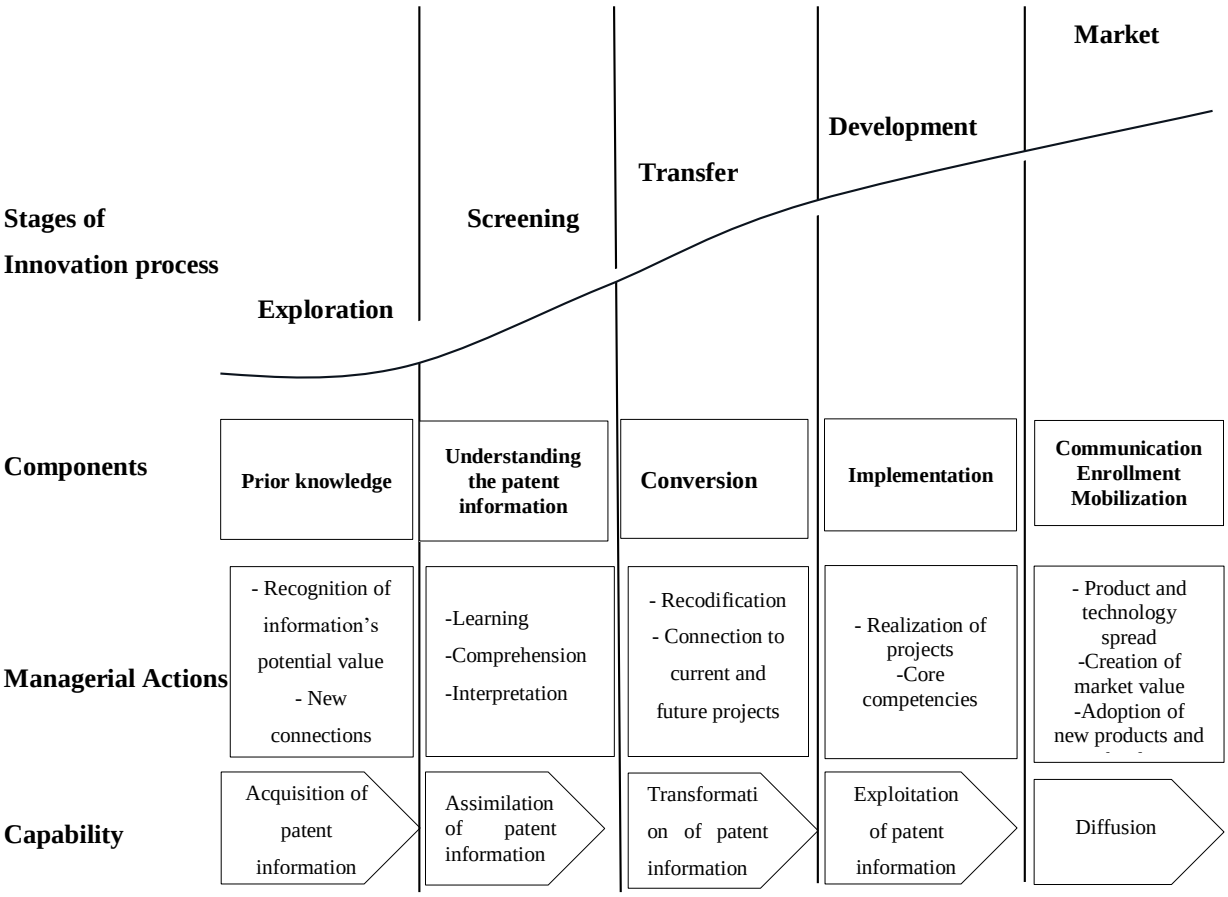
staff, develop new routines and endlessly adapt their organizational structure and culture to facilitate OI processes (Dalander & Gann, 2007). Using patents as an input leads to a structured process that opens up possibilities for breaking down innovation barriers and, at the same time, creates efficient innovation management. The contribution of this research to both managers and scholars is to show that patents can be used as an input in the innovation process. Our findings have a number of implications for our comprehension of the use of patents along the innovation process, in particular, but not exclusively, in the case of Groupe PSA's design offices. In this section, we will explain how our insights contribute towards the way a firm can undertake to create new competitive advantages.

4.1. MANAGING THE OI PROCESS BY INTEGRATING EXTERNAL KNOWLEDGE

While intellectual property management research has made substantial progress in identifying and describing the new roles of patents (Rivette & Kline, 2000; Corbel & al., 2007; Graham & al., 2010; Mbongui-Kialo, 2013), a similar effort in understanding the way firms absorb external knowledge from patent has been in shortfall. Previous intellectual property management research has often assumed that patent is purely an output of R&D activities and therefore has focused on its role outside the innovation process. Such work deals with two important functions (protection and disclosure) to suggest that a patent allows the patent holder to exclude others from commercially exploiting the invention covered by the patent rather than considering a patent as an input to the innovation process in order to stimulate innovation and contribute to economic growth (Senarathne & Wei, 2018; Suh & Jeon, 2018). This is troubling because we know from the OI literature that patents are linked to the innovation process (Chesbrough, 2003). At present, however, we only have limited understanding as to which patent users (or non-users) affect the innovation process, and how innovating companies can benefit from external patents (Vanhaverbeck & al., 2008). This is problematic because understanding the way patents can be used along the OI process is crucial to our understanding of innovators' behavior and the way they manage patent information.

From this research, several recommendations for managing patents in industrial firms can be made. In order to evaluate the appropriate strategic action, however, it is necessary to determine the different stages of the innovation process using and integrating external patents. Figure 1 demonstrates how this process might work. The managerial task is to first identify these stages and then select the appropriate strategic action.

Figure 1: Stage of innovation process and patents' absorptive capability



Stage 1*: Exploration.* In the first stage of innovation process, the objectives are not clearly defined and a number of contradictory meanings are available. It is therefore important to begin by formulating the problem. A good formulation of the problem increases the possibilities of finding good ideas and durable solutions. In this context, formulation must involve making an exhaustive inventory of all the information relating to the problem to be solved. More precisely, it is a matter of clearly defining and formulating the problem, identifying different angles of approach, and also taking steps backwards when necessary. This stage, known as exploration or specification, is also the act of searching for the purpose of the discovery of information or resources contained in patent documents. Once the problem is formulated, the search in the patent databases can begin. First, practitioners need to identify a set of keywords for each selected theme. When searching for information, a company has to select keywords that define the object sought after. The managerial task in this stage is to narrow the scope of research in order to collect the most relevant patents or those with a proven link to the problem to be solved. That means that actors should clearly define the object of the search: the different parts or

concepts of the search, the geographic area, the firm or time period, etc. Once these elements have been defined, actors should choose the best keywords describing the invention. For instance, they can find synonyms of the terms describing the invention they are looking for, trying to avoid terms with double signification/homonyms. This phase will be concluded by writing a summary of the key information contained in patent documents. There must be an awareness of competitors' strategies that can be used by competitors to mislead their rivals. For example, some firms use "decoy patents" to direct competitors into unprofitable fields of research (Langinier, 2005). Indeed, a company can decide to patent strategically in order to mislead its rivals. This strategy must be taken into account by managers during the exploration stage. An understanding of the competitors' strategies can provide strategic insights that can be used to design around a patent, an innovation or simply to counter competition.

Stage 2*: Screening*. In the second stage of the innovation process, the target is to quickly and efficiently weed out those ideas that do not meet basic selection criteria. Not every idea that is generated is worth implementing, for that reason; practitioners must screen all the ideas contained in patent documents. When screening, it is fundamental to first gauge the benefits and risks of each idea to determine its viability. If an idea is not accepted, managers should properly communicate with the person who had suggested the idea in order to encourage and keep him motivated. In addition, managers should provide a broad set of rewards to honor innovative efforts, offer incentives, and continue to instill an innovation culture by giving more flexibility to employees. To better manage this stage, practitioners ought to take three steps within it: (1) ensure the screening process takes place in a transparent way in order to generate and identify most promising ideas upfront. It is important to find out what exists already, check on novelty, and improve the quality of existing ideas; (2) create a link with previous knowledge that is closely related to the new one (Nonaka & Takeuchi, 1995) and (3) facilitate the flow of information between stakeholders, so as they can easily build social networks.

Stage 3*: Transfer***.** In the third stage, people try to understand how patent information or idea acquisition from patents will interface with the other functions of the innovation. If an idea is too complex for the organization or it is a premature idea, then it should not be implemented, managers should set aside premature ideas in a kind of idea bank or pool. Idea transfer requires that an idea be palatable and concrete to multiple stakeholders, not only to experts (managers or engineers) but also those who are involved in the innovation process, regardless of their position in the organization. During the transfer, ideas are validated and converted into possible

solutions to effectively address the initial problem. Ultimately, this stage favors the emergence of innovative solutions that respond to the initial problem. During the implementation of solutions, an evaluation can be carried out to verify the adequacy between the proposed solutions and the problems to be solved. The solutions contained in patents offer multiple possible answers to current projects (and future projects). Thus, integrating a patent into the innovation process is like looking for compromise, and finding complementarities between the existing patents and the concepts to be developed. This third stage can reduce the time needed to develop and launch innovations, shrinks the lifecycle of new products and services, and above all provides companies with the possibility to cross-fertilize their knowledge base with technologies they are not familiar with.

Stage 4: *Development*. Product development has been acknowledged as a crucial activity for the growth and survival of firms. It requires an understanding of customer needs, the competitive environment, and the nature of the market in order to design competitive products. With the introduction of patents in the first stage of the innovation process, development becomes a stage through which an innovative firm routinely converts ideas into commercially viable products. It is also time to ensure that patents fit into the strategic plans of the organization and determine the possibility of creating a prototype product. Thanks to patent documents and its contents, practitioners can easily create or improve their products with new or different characteristics that offer new or additional benefits. By recognizing patent value, the company leaves out a fashion classical thought - considering the patent as a result of research and development activities - to move towards an innovation management that considers patent as a source of information for the innovation process (Chesbrough, 2003). This stage requires being agile with patents as well as having experience in product development.

Stage 5: *Commercialization or Market.* When you get to this stage, just know that the product is ready for the market. The major work at this stage is to persuade your target audience that the innovation is good for them. For innovation process that involves the introduction of new products or technology into the market, it is imperative that the product meets the needs and the preferences of consumers and potential partners. Failure to go through this stage would mean that the innovation will not be commercially viable. To avoid this, managers should undertake extensive and in-depth patent information research before committing limited resources to its development and production. It is essential to be very specific about the idea in regards to any patent information that could improve the firm's existing products and create new ones. With

trends in the market constantly changing and many innovations emerging, it is possible that a profitable innovation today may become redundant in the near future. To counter this, there should be constant patent monitoring to identify unreliable new patents, and encourage grassroots activities against them. It is also helpful to initiate and support legal challenges against existing and future patents. In a word, results of patent monitoring can help practitioners ~~to~~ determine if any newly issued patents are beneficial or of any interest to the company.

4.2. LIMITATIONS AND FUTURE RESEARCH

As with any study, limitations need to be considered in the interpretation of results. A focus on patents, and their use as an input in the innovation process, provides new insights into the process of managing intellectual property, though not exclusively, in automotive industry. The study was conducted in the specific context of Groupe PSA. Respondents were drawn from a great deal of design offices with the participation of the patent department. These particular design offices offered useful insights from the perspectives of R&D, innovation and intellectual property management that might be transferable to other similar contexts. As Lincoln & Guba (1985) remind us, theory emerging from interpretative research can be transferred to contexts sharing key characteristics. In this sense, we believe that our setting is transferrable and representative of other large organizations (Gümüsay & Bohné, 2018) both within and outside the automotive industry, and that our theoretical framework can serve as a springboard for more theorizing on the process of innovation and intellectual property management. This research has been bound by its necessary focus on a single industry rather than multiple emerging industries (Humphreys, 2010). Therefore, to introduce a richer understanding of patent use in the OI process, further research could study the integration of patents both within and among other industries. Indeed, for further validation and refinement, it is necessary to recommend, first, that patent users should be examined in other industries, public organizations, universities and countries. For example, what is the innovation process like in countries or firms in which the patent culture and regulatory environments are quite different from our own industry/company? In drawing comparisons between varying contexts, we could assess the effects of different patent cultures and their use within the OI process.

Second, we have argued that patents can be a very rich resource that could create value and provide interesting solutions (Corbel & al., 2007; Kim & al., 2016; Rudy & Black, 2018; Senarathne & Wei, 2018; Suh & Jeon, 2018; Masayuki, 2019; Mezzanotti & Simcoe, 2019) if innovative organizations are able to integrate and absorb external information (Zahra & George,

2002). Interestingly, we have seen that setting up such practices is risky for these innovative companies owing to some strategies used by competitors and other actors to mislead their rivals (Langinier, 2005). Understanding these strategies can be useful to better manage the integration of patents throughout the innovation process. Consequently, future studies should be based on additional case studies in various contexts to deepen literature on innovation and also to assess various strategies deployed by competitors in order to be able to detect a "trapped patent" or counter a competitor using defensive or offensive strategies.

Third, the integration of patents in the first stage of the innovation process may also facilitate an interface for external stakeholders (partners, competitors, clients, etc.). Consequently, future research could focus on inter-organizational relationships and a relative collaboration of these different stakeholders. In this manner, patent integration could be investigated in the context of relationships and networks, which form an integral part of the innovation management literature (Granstrand, 1999; Langinier, 2005; Vanhaverbeck & al., 2008). The use of patent database in managing innovations is an exciting arena, as digital technologies are at the cutting edge of not only the business performance that they support but also at the heart of future developments at this pivotal period, given the growing prominence of innovation. Moreover, fast paced developments in the use of digital technologies, coupled with free-of-charge or commercial patent databases and use of analytical software for rapid and detailed analysis of patents, have opened new opportunities for innovative organizations in their strategic use of patents. Future research investigating these elements, therefore, has the potential to make significant contributions to our understanding of the use of digital technologies associated with patents.

CONCLUSION

In this article, we have demonstrated that patent documents can provide useful information and ideas that help firms to understand and foster the technological innovation process. Thanks to the rapid developments in the computer industry in recent decades, patents can be obtained in a simple, digitalized form. Using suitable software, the digitalized data in patent documents can be transformed into information, which is then used as an input in the innovation process. A key factor to enhancing the firm's ability to harness externally acquired knowledge is its absorptive capacity. New technologies and other causes of continuous changes in an organization's internal and external environment are continually emerging, which triggers the need for organizations to perpetually manage their knowledge base and foster their innovation

process. These insights highlight the need for a considerate and comprehensive approach by practitioners to confront patents and facilitate their integration into the innovation process.

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