Strategic intellectual property rights of start-ups in the innovative ecosystem: the case of mobility

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Abstract

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In an innovative ecosystem, actors collaborate more and more with others actors outside their companies and open their innovative process to construct innovations. This openness presents some questions about intellectual property rights (P?nin et al. 2011; Chesbrough, 2003). According to the literature, intellectual property rights are important elements to structure collaborative relationship within innovative ecosystem (Attour, Ayerbe, 2015). However, the literature of intellectual property right in open innovation has a focus on property right strategies of large firms. Studies are often concentrated on the use of patent to evaluate the different property right strategies. However, small firms and niches are necessary to the dynamic of ecosystem (Iansiti & Levien, 2004). Thus, we may wonder what are property right strategies of start-ups in an innovative ecosystem.

While literature considers essentially the case of large innovative firms, the goal of this research is to spotlight strategies used by small firms within innovative ecosystem. We will explore the property right as a driver of the entrepreneurial dynamic within mobility ecosystems where the ecosystem construction is a major challenge of smart cities’ development and where the dynamic engage a large variety of actors and diverse cross-sectoral collaborations.

This research has a focus on urban mobility sector in a French medium size city and uses a qualitative
A method. Diverse sources of data have been collected: non-participative and participative observations to understand and analyse the different actors and the dynamic of their relations in this ecosystem. Thirteen interviews have been conducted nearby diverse actors in the mobility ecosystem in Strasbourg: six start-ups, two large companies, two intermediaries organisations and two institutional actors. The conversations were conducted face to face, by phone and one by email during 16 minutes to 1h30. The set of interviews are codified with help of software N’vivo in three stages (Gioia, Corley, Hamilton, 2012), the first order concepts, the second order themes and the aggregate dimensions. We obtain to main results about the intellectual property right strategies of start-ups and diverse collaborations between start-ups and others actors of their ecosystem. Intellectual property right strategies depend on specific factors, the nature of technology developed by firm, the position in ecosystem, the culture who is different according to the activities sectors. Particularly, we show the role of the partner’s size in collaboration with a start-up and the influence of cultural dimension on the use of intellectual property right within ecosystem. The mobility ecosystem is in construction, thus institutional actor has an orchestrator role to reduce asymmetric information within ecosystem, construct dynamic relationship between actors and guide the innovation strategies for the city.
Strategic intellectual property rights of start-ups in the innovative ecosystem: the case of mobility

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Intellectual property strategies are important elements in structuring collaborative relationships within innovative ecosystems. While the literature mainly considers the case of large innovative firms, the objective of this research is to highlight the strategies implemented by start-ups within these innovative ecosystems. We study intellectual property as a driver of entrepreneurial dynamics within mobility ecosystems, whose the construction of which is a major challenge for the development of smart cities and whose dynamics involves a wide diversity of actors and cross-sectoral collaborations. We identify specific factors that guide start-ups’ intellectual property strategies. We show the role of the size of the partner firm, distinguishing between large and intermediate size firms, and the cultural dimension of intellectual property within ecosystems.

Keywords: property right, innovative ecosystem, cooperation, collective innovation, open innovation strategies, start-ups, smart-city

1. Introduction

The development of innovative ecosystems supporting collective innovation dynamics (Oruezabala, 2017, Spigel, 2017, Ben Letaifa, Rabeau, 2012, Owen-Smith, Powell, 2004) is at the heart of the strategies implemented by “smart cities”. The concept of "smart city" refers to a context favourable to the emergence of innovative urban services that meet the dual objective of promoting the city's economic dynamics and increasing the population's quality
of life (Attour, Rallet, 2014). The innovations that enable the city to gain in intelligence affect different structuring fields such as transport, energy management, housing or data management. They are collective by nature because they involve many actors in their design and implementation, including network operators, urban infrastructure managers, local collectivities, users, service producers, data managers, traditional suppliers and start-ups in the fields of transport, energy, housing and telecommunications. Interactions and cooperative relationships that are being built between a diversity of actors are necessary for the emergence of innovation and are at the heart of ecosystem dynamics.

Actors open their innovation processes and face intellectual property protection problematics (Ben Lataifa, Rabeau, 2012, Chesbrough, 2003). In the literature, these issues are mainly studied from the point of view of large companies (Vahter et al. 2013) and the emphasis is placed on the role of patents, as a tool protecting the inventor in a given territory and enabling firms to engage in cooperative relationships (Attour, Ayerbe, 2015). The intellectual property protection strategies implemented by start-ups are sparsely studied. Their interactions with other actors and particularly large companies are though essential in the dynamics of these innovative ecosystems. The cooperative relationships that they establish enable to commercially promote the technologies developed by small businesses, in a logic of complementarity of assets (Isckia, 2011, Ayerbe, Chanal, 2011, Bercovitz, Feldman, 2007, Bresnahan et al., 2001, Saxenian, 1994). However, the cooperative relationships are asymmetric between the companies involved, in terms of their size and in terms of the difference in their resources in terms of quantity and quality. These asymmetric relationships generate specific issues that require research focused on the strategies implemented by small firms (Kohler, 2016, Hogenbuis et al., 2016, Weiblen, Chesbrough, 2015).

The objective of this research is to highlight the intellectual property protection strategies adopted by start-ups within innovation ecosystems. We will study these relationships in the context of a mobility ecosystem, involving a diversity of actors among which start-ups engaged in open innovation process. We show that start-ups perceive the interest of using patents differently and adopt specific intellectual property strategies. The article presents a literature review on the role of intellectual property in innovation ecosystems (1), the methodology adopted in the research (2) and the results obtained (3) that give rise to a discussion (4).
2. The role of intellectual property in innovation ecosystems

Intellectual property strategies are central to an ecosystem vision since they allow stakeholders to appropriate the returns of their invention and manage their cooperative and competitive relationship.

2.1 The intellectual property strategy and the positioning within ecosystem

In an innovation ecosystem, the firms’ openness raises directly the question of the appropriation of the value and the protection of intellectual property by the various actors (Ben Lataifa, Rabeau, 2012, Chesbrough, 2003), which is at the heart of relational mechanisms and internal dynamics of creation and exchange. Intellectual property rights condition the sustainability of ecosystems. The sustainability of ecosystems depends on the capabilities ‘ecosystems to renew and to evolve over time through their internal dynamics (Lansiti, Levien, 2004, Jackson, 2011). The intellectual property strategies chosen by firms differ according to their objectives and their positioning in the ecosystem (Cohendet, Benin, 2011, Ayerbe, Azzam, 2015, Ayerbe, 2016). For Iansiti and Levien (2004), the latter depends on two factors: the level of turbulence in the ecosystem and the complexity of the relationships between actors. They distinguish three types of strategic positions within an innovation ecosystem that determine the relationships with other actors: dominant positions, central positions and niche positions.

To maintain their position in the ecosystem, mature companies can adopt a dominant position, often aggressive towards other ecosystem players. It is based on a horizontal or vertical integration strategy in order to controlling the various actors in the value chain, from ideation to distribution, preventing the emergence of actors who could challenge this dominant position. The company strongly protects its knowledge through the management of intellectual property rights and notably patent of invention. It has a rather aggressive intellectual property strategy to defend its position against that of others. The management of the patent portfolio can then pursue several objectives: to defend itself in the event of litigation, to have blocking patents to protect itself, or to increase its bargaining power during collaborations with other actors (Pénin, 2017). These intellectual property strategies, by
protecting dominant positions are likely to harm sustainability of the ecosystem on the long run by inhibiting its internal capacity for evolution and renewal (Iansiti, Levien, 2004).

In contrast to these offensive strategies, actors who adopt a central position choose strategies oriented towards increasing the creative potential of the ecosystem by encouraging the emergence of new activities, which contribute to increasing internal diversity, thus creating the internal conditions favourable to the evolution and renewal of the ecosystem. A firm can have an interest in taking a central position when it is at the centre of a complex network of relationships and when the level of turbulence in the ecosystem is high due to high innovation activity. The central actor promotes exchanges, actors coordination, resources sharing, collective value creation and the emergence of entrepreneurial activities, in order to benefit from the dynamic of the ecosystem necessary for its own performance (Isckia, 2011). The development of information and communication technologies has led to innovation dynamics structured around the creation of digital platforms by central actors. These platforms constitute collaborative spaces around which the dynamics of collective innovations are built (Iansiti, Levien, 2004, Nambisan, 2017). Intellectual property rights influence the degree of openness of platforms because they condition access to resources, appropriability of innovation rents and number of actors (Ayerbe and Chanal, 2011).

In these approaches to collective innovation, the emergence of new players in niche positions is encouraged. In a turbulent environment, the niche position permit to develop a field of expertise based on specific capacities and permit to protect oneself from the complexity of the relationships between actors (Iansiti, Levien, 2004). Within an innovative ecosystem, the multiplication of niche activities is a source of diversity and so a creative potential increase, that’s why the emergence of start-ups plays a fundamental role within an ecosystem. To promote entrepreneurial dynamics, ensure the sustainability of the ecosystem and thus be able to develop better there, central actors provide access to resources and allow the various actors to find their place in a logic of collective innovation (Attour, Ayerbe, 2015).

The literature on strategies shows that patent is an important tool that support the openness of innovation processes (West, 2006). Patent enables to signal skills on the market (Hilaire-Pérez, 2013, Richard, 2011), to control shared information and to facilitate the identification of partners. "Fil patents becomes necessary not so much to block the access on the market of potential competitors as to open us other markets" (Corbel, 2003). The role of patent is not only to exclude rivals, but to include the different stakeholders in the innovation process.
through the creation of a common language, the sharing of collaborative results and the securing of openness (Cohendet, Pénin, 2011, Attour, Ayerbe, 2015). Clauses of licence enable firms to adjust their degree of openness (Muselli, 2008, Ayerbe, Azzam, 2015). The use of open source licenses secures collective innovation and permit that knowledge created being open and available in turn to encourage new innovations and ensure the development of the ecosystem (Ayerbe, Chanal, 2011).

The innovative ecosystems developed in smart cities have specific characteristics that require the definition of appropriate intellectual property strategies. They must allow a wide diversity of public and private actors, some of them are in competition, to agree to pool resources and cooperate to produce innovations through a collective dynamic. The central actor is not a private company oriented to generate profit but a local collectivity responsible for ensuring the coordination of local actors to emerge innovations specific to the context, ensuring that they simultaneously enable the economic development of the city and the improvement of the inhabitants’ quality of live, considering the imperatives specific to the various actors (Attour, Rallet, 2014). Strategies are not developed in the context of dyadic cooperation but in the context of collective processes to product innovative services. The logic of actors who guide intellectual property strategies needs to be studied specifically, notably for start-ups in a niche position. In their situation, intellectual property is important because it reduces the situation of dependence on other actors and is a tool that rebalances power relations (Iansiti, Levien, 2004).

2.2 Intellectual property strategies of small businesses and start-ups

Startups and small businesses in niche positions have specific characteristics that have an impact on the intellectual property strategies chosen. The issue of intellectual property in the process of creating a start-up has been the subject of numerous contributions in the field of academic entrepreneurship (Rothaermel et al., 2007). In this literature, patent filing and the development of licence transfer strategies appear to be important elements in the long process leading from scientific discovery to the creation of a start-up by researchers (Siegel et al., 2004, De Coster, Butler, 2005, Bradley et al., 2014). However, these results cannot be transposed to the intellectual property strategies of start-ups and small businesses created in the context of innovative ecosystems in smart cities because the academic entrepreneur has
incentives to file patents that other entrepreneurs do not have: he files patents in order to be able to diffuse knowledge in academic publications without began his commercial potential (Schaeffer et al, 2018); universities are engaged in competition based on the number of patents filed and license grant activity and thus encourage inventors to file patents (Siegel, Wright, 2015); inventions from chemistry and life sciences are an important source of entrepreneurial opportunities that are well suited for patent filing (O'Shea et al, 2005); the time between the detection of an opportunity and the commercialization of a product or service can be very long, which implies the adoption of strong knowledge protection mechanisms (Moray, Clarysse, 2005, Bradley et al., 2015).

The strategies deployed by start-ups and small firms remain poorly studied, with the literature on open innovation being more focused on the strategies adopted by large firms (Vahter et al., 2013). Existing research shows that patents and licenses are lowly used by small businesses (Leiponen & Byma 2009, Holgerson 2013). Patent applications are long and costly, making it difficult for young companies with lowly resources to access them. The delay for filing can limit the use of patented technology because patent owners must wait until the patent grant in order to be able to use it, which they cannot necessarily afford. Furthermore, the patent is valid only in one country, it must be filed several times and translated into different languages if the inventor will develop his innovation in several countries. Beyond the time and cost of implementing the patent, it is only useful to the company if it can use it to defend itself and often small firms do not have necessary resources to do so (Acs, Audretsch, 1988, Lanjouw, Lerner, 2000). Thus, when they file patents, it is not necessarily to defend themselves but to attract customers, venture capital and thus gain importance on the market (Holgersson, 2013). In the interests of efficiency, small companies can choose to focus on certain key patents.

The intellectual property strategies adopted by small businesses also depend on the sector of activity to which they belong, and the nature of the technology developed (Hall et al., 2014). When innovation is a product innovation, firms are more likely to use patent while they protect themselves more by secrecy when it is a process innovation because a process is less visible to external actors. This phenomenon is observed in large automotive companies where product inventions are patented while inventions relating to manufacturing processes are kept secret. Furthermore, depending on the technologies used, not all innovations are patentable. In sectors where technologies are easier to define and describe, such as the chemical or pharmaceutical sector, inventions are more easily patentable than other sectors of activity,
such as computing technologies. Companies developing innovations that are not technological, such as social, service-oriented or organizational innovations cannot protect their invention with patents. In these cases, both small and large firms use other forms of intellectual property protection, such as copyright, trademark, design and model. They can also develop an informal intellectual property strategy such as secrecy, lead time or the development of complementary services (Hall et al., 2014, Leiponen, Byma, 2009, Holgerson, 2013).

The secret is costly and difficult to maintain in collaborations, small businesses want to access rapidly on the market in order to protect their innovation, to face possible imitations and to limit the bargaining power of external partners (Leiponen, Byma, 2009). Secrecy is a strategy adapted to a situation where R&D investments are low and external collaborations that lead to diffuse information are rare. Secret is therefore difficult to implement in a context of collective innovation where cooperation requires information sharing. The work of Hall and al. (2014), Leiponen and Byma (2009), Holgerson (2013) highlights the gap between theoretical approaches focused on patent and secrecy, and empirical work integrating other intellectual property tools. They call for further research to have a better understanding of the intellectual property strategies of small businesses and start-ups, the possible interactions and overlaps between the different IP mechanisms that they use. Our research proposes to characterize the logics that guide the choice of start-ups’ intellectual property strategies within innovative ecosystems based on collective innovation logics.

3. Methodology

In order to characterize the logic of actors guiding intellectual property protection strategies in cooperation between large and small companies, we conducted a qualitative case-based study (Eisenhardt, Graebner, 2007, Siggelkow, 2007). We have adopted the grounded theory approach (Glaser, Strauss, 1967, 1971) to bring out the theory of studying a real ecosystem. This methodological approach proposed by Glaser and Strauss (1967) in response to the gap that they observe between certain theories and the reality (Partington, 2000), appears relevant here to understand the logics of actors that are not explained by research conducted mainly on large firms and in specific technological fields (Hall et al., 2014, Leiponen, Byma, 2009).
3.1 Field of study

We have chosen the case of the urban mobility ecosystem of the city of Strasbourg, integrated into an urban area of about 770,000 persons in 2018 and very committed since the 1990s to the evolution and restructuring of urban mobility around the construction of a tramway, the encouragement of intermodality, a very large pedestrianisation of the city centre that strongly impacts traffic flows and the establishment of a developed system of shared car and bicycle services. In addition, at the regional level there is a competitiveness cluster: “Vehicle of the Future”, who’s the role is to animate a cluster and to promote the emergence of innovation projects around transport modes.

This case presents the characteristics of a mobility ecosystem that is being built around the logic of collective innovation and promotes the development of a context that encourages entrepreneurial initiatives. The city of Strasbourg, which is the central actor in the ecosystem, conduct a voluntary open data policy to support innovation projects. It is involved in the organisation of events around entrepreneurial projects, as well as the creation of support mechanisms for start-ups and spaces such as incubators, co-working, creation and experimentation spaces. A wide variety of actors are involved: industrial companies, transport companies with a public service mission, start-ups, innovation intermediaries, institutional and political actors and a strong academic presence with an internationally renowned university and 63,000 students. The various actors interact and collaborate to produce innovations around mobility. Here we consider by “start-up” a young company that has a desire for rapid development to ensure its survival but without necessary having a global ambition.

3.2 The collection of data

We collected data on the relationships between large and small firms and the role of intellectual property at the heart of these exchanges from a variety of actors: start-ups, large companies, intermediary structures, local institutional actors (Table 1).
The main source of data collection comes from the 13 semi-directive interviews conducted in March and April 2018. 6 interviews from 50 minutes to 1h30 were conducted face-to-face. 6 interviews from 20 minutes to 1 hour were conducted by telephone; and one interview was conducted by email exchange, due to lack of availability of its founder. The interviews were recorded and fully transcribed.

We also made direct observations at events organized for ecosystem actors. Two types of observations were made during this study, participatory and non-participatory. The non-participatory observations mainly concern two events, the "meeting of mobility actors" in Strasbourg on 13 February 2018 and the conference on smart cities in Strasbourg on 15 March 2018. Participatory observations were made during two hackathons, the Industry Challenge in Mulhouse from 8 to 10 February 2018, and Start-up weekend in Mulhouse from 23 to 25 March 2018.

* For confidentiality reasons the name of these companies is fictitious
Furthermore, additional documentary sources were used to enrich the quality of the study (Gioia, Corley, Hamilton, 2012). These additional resources in the form of documents, allowing a better understanding of the mobility ecosystem, its dynamics and construction, have been provided by the Eurometropolis of Strasbourg and different start-ups.

3.3 The processing of data

To build this study, we have followed different steps of qualitative data analysis (Chamaz, 1996, Glaser, Strauss, 1967, Bryman, 2012). The data analysis was carried out in two stages, a first analysis and review were carried out after the interviews and field notes were transcribed. This first analysis was conducted as the interviews progressed in order to create time for reflection, to take a step back and then to re-appropriate the data. The second phase of analysis led to the creation of structured codes in three phases. “Coding is the pivotal link between collecting data and developing an emergent theory to explain these data” (Chamaz, 1996). Our approach is based on the coding procedure described by Strauss and Corbin (1990): the data were systematically coding by an open coding. After, axial coding led to the grouping of the data that appeared to be linked and finally, selective coding revealed the main themes around which all the data analysed are structured and which constitute the basis of the emerging theory.

4. Results

The results of the codification process are of two types (Figure 1). The characterization of the intellectual property strategies of start-ups and large companies reveals the specificity of startup intellectual property strategies (4.1). The diversity of forms of collaboration between start-ups and actors of their ecosystem is also highlighted (4.2).
4.1. Intellectual property strategies of start-ups

Start-ups, concerned about protecting their ideas, orient their intellectual property strategy to protect their innovations. None of them use the patent, unlike large companies. Some start-ups use copyright, others use additional tools to prove prior art, while others prefer to keep it
secret. In many applications developed around urban mobility, innovation comes from content and not from a technological invention relating to an artefact. The means of protection is then copyright: "All content made by us is protected by copyright." (Lignes de ville, Start-up). "All the texts write by me are simply protected at the INPI" (Cityquizz, Start-up).

Start-ups are also protected by copyright through membership of a platform that permit to prove the anteriority of an innovation in the case of a litigation. "In the general conditions of use and general conditions of sale, there is an automatic copyright. From the moment you work with Apple or Google, there are conditions imposed, and the fact that you can prove that at Google you have this application that is three years old proves the prior art" (Cityquizz, Start-up). Within the competitiveness Cluster, some start-ups that collaborate with the automotive industry use the soleau envelope to prove the prior art of an invention. "The soleau envelopes prove a prior art and if someone else files a patent after them, it allows you to have the right to exploit your invention because you have proven that you have the prior art and exploit it on your own account" (Competitiveness Cluster).

The approach to intellectual property is different in the large companies that we have met. The urban transport services company, whose capital is mainly owned by the city, which has adopted an open data policy, has a central actor approach. "There is a lot of data in Strasbourg that we put in open data, so we are not in a logic of closing, we are in a logic of opening [...] You have lots of applications that use our open data to produce value. They have the right, they just have to sign a charter" (CTS, transport company). This company has a broad vision of intellectual property that it uses not only to protect itself, but especially to share resources, encourages the emergence of innovations around mobility and benefit from the fruits of inventive activities and communicates in the market.

The industrial company Elect uses intellectual property to protect itself. "We will be able to tell the partners with whom we work: know that on this work that we have in progress, we are the inventors, we have filed. [...] We do protection, that is to say that everything we put on the market we try to protect it" (Elect, intermediate size company). However, they do not have the same approach as start-ups. They use more patents and licenses in their intellectual property strategy that start-ups. "Companies that have technical solutions of interest to us, and that are patented, we can take licenses" (Elect, intermediate size company). They also use copyright, trademarks, designs and models to protect their non-technological assets.
Start-ups mention various obstacles to use patent: the lengthy and costly patent filing process, the unpatentability of certain ideas and the issue of disclosure of information associated with the patent (Table 2).

**Table n°2: Start-ups' intellectual property strategy: obstacles to patents**

<table>
<thead>
<tr>
<th>Start-ups</th>
<th>Patentable innovation</th>
<th>No patentable Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knot</strong>:&lt;br&gt;Self-service scooter solution</td>
<td>&quot;I attach more importance to speed, market access&quot;.</td>
<td>&quot;The paper chase exists, it has always existed, to protect it as such we cannot&quot;. &quot;All texts are protected by the INPI&quot;.</td>
</tr>
<tr>
<td><strong>Cityquizz</strong>:&lt;br&gt;Paper chase</td>
<td>&quot;Intellectual property makes no sense in electronics because of the speed at which technologies evolve, the Chinese competition compared to the number and quality of control and the cost of implementing intellectual property&quot;.</td>
<td></td>
</tr>
<tr>
<td><strong>Pollem</strong>:&lt;br&gt;Air pollution sensor</td>
<td>'Intellectual property makes no sense in electronics because of the speed at which technologies evolve, the Chinese competition compared to the number and quality of control and the cost of implementing intellectual property&quot;.</td>
<td></td>
</tr>
<tr>
<td><strong>Lignes de ville</strong>:&lt;br&gt;Application of cultural video content on the tram route</td>
<td>&quot;There is no patent, it is a solution that cannot be patented&quot;; &quot;All the content we make is protected by copyright&quot;.</td>
<td></td>
</tr>
<tr>
<td><strong>Gestage</strong>:&lt;br&gt;Management of electric vehicle charging stations</td>
<td>&quot;Impossible, he is code, patenting code is extremely complicated&quot; &quot;He made the choice of secrecy, clearly a real choice&quot;.</td>
<td></td>
</tr>
<tr>
<td><strong>Locaborne</strong>:&lt;br&gt;Charging station card for electric vehicle</td>
<td>&quot;Company Locaborne had no intellectual property, it's database, data accumulation&quot;.</td>
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</table>

The notion of time and market access are very important for start-ups because their survival depends on it. For them, the time to obtain a delay is too long to be compatible with this economic constraint. "I attach more importance to speed, market access. Concretely, the patent is only used when you have a size, a certain mass, the start-up will not lose time to defend the technologies" (Knot, Start-up).

Furthermore, the patent generates significant costs for the filing but after for being able to defend itself. If the company cannot use its patent to defend itself, the cost of filing is unnecessary. "Having a patent is worthless if you are not able to defend yourself and it costs money to file a patent" (Competitiveness Cluster).

Moreover, not all companies have the possibility to use patents to protect themselves. In some cases, the ideas on which the creation of companies is based are not patentable, that they are
in the digital field or not. These are companies that process data to facilitate the mobility of people in the city, develop mobility services or create cultural content related to transport. "There is no patent, it is a solution that cannot be patented" (Lignes de ville, Start-up).

The last point concerns the problem of disclosure of information throughout patent application and which leads the creators of the company Gestage to choose to keep it secret. "Gestage didn't want to file a patent because it was complicated but also because he didn't have the willingness to share what he was doing. If I file a patent, I reveal everything, and he said to himself, I prefer to keep it secret" (Incubator).

4.2 The specificities of start-ups’ collaborative relationships

Intellectual property strategies are fundamental throughout the collaborative relationships of start-ups; initially when each party brings its know-how and knowledge, during the collaboration when knowledge is created and at the end of the collaboration for the sharing of the fruits of the inventive activity.

Depending on the origin and nature of the relationships between start-ups and ecosystem actors, the management of intellectual property is different. The relationships that start-ups have with actors of their ecosystem are not only coopetitive relationships. Four forms of collaboration are identified here: incubation, proof of concept, service sales and experimentation.

A start-up can be incubated by a large firm in order to complete the intelligent mobility service offer. "It is a form of incubation, a kind of coaching through the mission of promoting the transport network and innovations around transport networks, I have helped them to mature, to advance the project, to frame a certain moment" (CTS, Transport Company). Other collaborations are built so that the start-up can realize its proof of concept and thus enhance its innovation. This form of collaboration generates relationships of trust, where the secret’ policy remains strong. "It is a relationship of human beings, Gestage gets along very well with these people and has become a real partner, its collaboration is really based on a relationship of trust" (Incubator).

In the case where the relationship is based on the sale of a service, the relationship of trust does not have the same importance. "It's a relationship that is really commercial, it's the more customer-oriented part of the solution. There is no particular relationship, it is not a support or
partnership, it is really a customer-to-provider relationship" (Lignes de ville, Start-up). Knowledge is shared between partners through negotiations. "The patent is only a part of it, we can buy market access, we buy the distribution network, the customer portfolio" (Elect, intermediate size company).

Innovations in the mobility sector require the ability to test the feasibility of these innovations in cities and to consider the views of users. Thus, start-ups, often in partnership with cities, experiment their projects. However, these forms of start-ups – publics actors’ collaborations do not necessarily lead to the use of intellectual property. "The city has proposed a partnership for a European project related to air quality for which it has applied, [...] we have no intellectual property on this project" (Pollem, Start-up).

The actors interviewed also mentioned the difficulties that start-ups can encounter in working with large companies. The main risks mentioned are the suffocation of the start-up by large firms, the abuse of a dominant position and power by large companies, the difference in the culture of innovation and the sector of activity to which the companies belong. The protection of inventions by intellectual property titles is a major challenge for small structures, despite they are not always sufficient. "There are many projects that are killed by their rapprochement with large companies. A small firm face to a large firm even with a patent is still in an unfavourable position no matter what happens" (Competitiveness Cluster). Moreover, start-ups, by their specificity, have an innovation culture that is different from those of other actors such as large firms more traditional. This difference can complicate cooperation. "It is an asymmetrical collaboration, an asymmetry of information that is enormous between both. It is a problem of a culture of innovation" (Incubator). This cultural difference is very strong in the mobility sector because it’s transversal sector and involves a wide variety of actors. The actors belong to various sectors of activity where the modes of cooperation are different and the intellectual property strategies are different.

5. Discussion

5.1 The role of intermediate size firms in intermediate size ecosystems

In our study, whatever the modes of protection of intellectual property chosen, start-ups of the ecosystem are not in a legal battle logic, but purely in a logic of trust. In our cases, as in the
literature, patents appear to be a tool to secure exchanges when firms open their innovative process, for mature companies of sufficient size whose innovation has a high technological content (West, 2006, Cohendet, Pénin, 2011). In contrast, start-ups use secrecy a lot, however this mode of protection is not adapted to collaboration, that leads to the disclosure of secret information (Leiponen, Byma, 2009). We note that they develop collaborations with mature local companies. The relatively small ecosystem size in a medium-sized city explains this result. Start-ups that we have met explained their cooperative behaviour by the trust that they have in their interlocutors within mature firms.

Founders of start-ups know personally their contacts in mature firms and develop informal relationships with them that enable cooperation and co-creation of knowledge. This type of collaboration relationship is facilitated by the fact that the partner of start-up is a local intermediate size firm\(^2\). Founders of start-ups have for interlocutor people that they know. The intermediate size company itself has a local reputation and its managers are involved in local professional networks. When start-ups collaborate with multinationals they have met through contests, relationships are more impersonal. The interlocutor can change because he can assume other new functions within the group (Bertin, 2019). Intermediate size companies play an important local role as facilitators of innovative ecosystems and partners with start-ups. They are themselves in niche situations face much larger competitors and have a greater interest in strengthening the local ecosystems in which they operate than in acting as a dominant player.

5.1 The cultural dimension of intellectual property within innovative ecosystems

The actors of a mobility ecosystem and more generally of an innovation ecosystem are heterogeneous by their role, their objectives (economic, environmental, social...), their size, their maturity, the technologies used (digital, electronic, mechanical...) but also their culture of intellectual protection. Some actors, such as those in the automotive sector, have a strong culture of contractualization for relations with external partners and formalization intellectual property protection. Beyond the influence of technology (Hall et al., 2014), we have observed the influence of this intellectual property culture within the mobility ecosystem that we have studied. The mobility actors, who are membership to the competitiveness cluster in which the

\(^2\) According to the INSEE definition, ETIs have from 250 to 5000 employees, have their sales of revenues less than €1.5 billion and a balance sheet total of less than €2 billion.
The automotive industry plays an important role, are bring to the fore the role of patents and their fundamental role in relations with start-ups. Beyond the technological aspects, one explanation is that this sector has a strong risk management culture due to security and financial issues related to failures. As a result, the use of contractualization is culturally embedded to establish the nature of relationships with external partners and the use of the patent is part of this logic.

The development of digital technologies brings another culture within the mobility ecosystem. They are the source of many entrepreneurial opportunities and are at the origin of the development of mobility ecosystems. They have conducted some actors less innovative such as transport service companies to engage, under the drive of local collectivities, in open innovative process. These actors have a completely different culture from the management of external partnerships, for technological reasons but also for cultural reasons related to the nature of the relationships with external partners. They make resources available to start-ups and collaborate with them in a much more informal way, sometimes outside any contractual framework.

In this heterogeneous group, the city plays the role of orchestrator and influences innovation and collaboration efforts according to a local strategy (Attour, Rallet, 2014). It stimulates the construction of the ecosystem through its strategy of open data, transparency and information sharing. It also contributes to the dissemination of a culture of intellectual protection within the ecosystem in order to support cooperative relationships. It stimulates and diffuses a dynamic of innovation and cooperation to all actors of the ecosystem by creating a context favourable to interactions. Various tools are used to encourage meetings and support the emergence of projects, which were mentioned during the interviews as important elements of the start-ups careers: hackathons, entrepreneurship support programmes, support for entrepreneurship training, conferences, creation of innovation intermediaries, start-up ‘contest, creation of incubators, co-working and experimentation spaces. The formation of a community around smart-city makes the actors of the network more identifiable and finally facilitates cooperation between actors, and particularly small businesses in search of trust’ relationships. Small businesses' knowledge of the various uses of patents and more generally, of all intellectual property rights are reduced, an awareness of these tools can enable them to acquire the necessary knowledge to develop more in details their formal and informal intellectual property strategy.
6. Conclusion

These different results lead to broader literature on intellectual property protection strategies within innovation ecosystems through the study of a sector where the nature of innovations is varied and based on diverse technologies, leading to the adoption of specific protection strategies. The size of the ecosystem as well as the strong local involvement of intermediate size firms are factors that influence strongly the intellectual property strategies of start-ups. They enable collaboration between actors despite the adoption of informal protection of intellectual property that are sometimes constructed during the relationship and not at its start. It also appears that the cultural dimension linked to the sector of activity influences intellectual property strategies. The ecosystem that we have studied is emerging, and not all companies, large and small, have a culture of innovation and therefore cooperation. While for some people the use of patents is a common practice, it is a relatively unknown tool for others, who will opt different methods of protection. The management of a collaboration can appear easier to control when there are only a limited number of partners, involving contractualization and lighter intellectual property protection issues. The use of intellectual property differs according to the sectors of activity and the nature of the technologies, but also because the ecosystem is under construction and patent related habits do not exist. When the mature companies haven’t this culture for themselves, they do not diffuse it to the small businesses with they collaborate.

This study open perspectives for future research. It would be interesting to reinforce the results on the influence of the nature of the ecosystem by comparing them with other cities where the orchestrator’ actor has not adopted an open data policy, as in the case studied. In addition, the study of other ecosystems with different degrees of maturity, such as the health sector, could strengthen the results concerning the influence of the culture and habits of actors on intellectual property strategies. Finally, future research on cities of different sizes will make it possible to capture more precisely the effect of city size on the dynamics of an innovation ecosystem and the importance of proximity between actors.
References


