How to effectively communicate university patents: a framework based on signalling theory

Ciro Troise[a]*, Serena Strazzullo [b], Nicholas O'Regan [c], Guido Giovando [d]

[a] *Department of Management, University of Turin, Turin, Italy; email: ciro.troise@unito.it; Orcid: 0000-0002-8899-8949*

[b] *Department of Industrial Engineering, University of Naples Federico II, P.le Tecchio 80, 80125, Naples, Italy; email: serena.strazzullo@unina.it*

[c] *College of Business and Social Science, Aston University, Birmingham, B4 7ET, United Kingdom, email: n.oregan@aston.ac.uk*

[d] *Department of Management, University of Turin, Turin, Italy; email: guido.giovando@unito.it*

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University patents are a critical tool for firms seeking to gain information from universities. However, the potential of this tool is frequently constrained by ineffective communication and commercialization strategies. University patents must be successfully advertised and disseminated to third parties to have an impact outside academia. In this scenario, inventors, universities, and technology transfer offices (TTOs) (which manage their patent portfolios) are encouraged to increase their efforts to promote and communicate patents. This article uses signaling theory to examine the key features of university patents that influence the investment or acquisition decisions of entrepreneurs and investors. Our findings can help TTOs, inventors, and universities strengthen their patent communication and commercialization strategies, and also help third parties secure more successful university patents.

Keywords: Patents; Universities; Technology transfer offices; Knowledge transfer; Inventors; Market.

1. Introduction

In the current competitive scenario, academics and practitioners are increasingly investing in new technologies by patenting the results of their research. In particular, companies, especially medium-large ones, which operate in highly technological and innovative sectors (e.g. digital, pharmaceuticals, healthcare etc.) invest heavily in research and development, producing a lot of inventions and technologies that are then patented. This phenomenon is well-documented by the increase in the number of patents filed in the last 20 years. In this context, universities represent a vital source of technologies and new knowledge for every company (Teixeira et al., 2019). Over the years, the transfer of knowledge and innovation between universities and businesses has attracted the attention of researchers and practitioners (Kang, 2016; Bigliardi et al., 2022)

and the awareness of its importance to global development has grown (de Almeida et al., 2019; Ferreira et al., 2019; Hooi & Wang, 2020; Kaiser et al., 2009; Venkitachalam & Ambrosini, 2017).

Most universities are now aware of the importance of transferring their knowledge externally (Bigliardi and Filippelli, 2022). Daniel and Alves (2020, p. 278) underlined that "Universities are regarding their third mission as an important challenge in the current era of knowledge-based economy".

In particular, several studies have underlined the relevance of patents – a specific output of research and technology transfer activity – as tools for knowledge transfer, as well as the difficulties or barriers related to their commercialization and external communication (Hermans & Castiaux, 2017; Valkokari et al., 2012). Among the major challenges for universities posed by the technology transfer process, in fact, the main one is the commercialization of university patents (Daniel & Alves, 2020).

Patents are strategic knowledge assets (Bontis, 2001; Marr et al., 2002) and represent a key component of the intellectual capital's structural dimension of both universities and businesses (Elia et al., 2017) with a potentially relevant impact on companies, in particular in terms of innovation outcomes (Agostini et al., 2016; Zakery & Afrazeh, 2017; Danish et al., 2020; Grimaldi & Cricelli, 2020).

Traditionally, patents represent valuable sources of information (Utterback & Brown, 1972) and they can be considered as an output of university technology transfer that needs to be communicated to third-parties such as businesses to increase their external impact (Netval, 2016, 2018).

These actions and, in general, the management of patents (or industrial proprieties) are among the main activities of the technology transfer offices (TTOs hereafter) of universities (Netval, 2018, 2021). These offices foster the patenting activity

of their universities and promote their links with industry (Cantu-Ortiz et al., 2017; Cartaxo & Godinho, 2017; Coupé, 2003; Siegel et al., 2003; Thursby & Thursby, 2002). TTOs manage the patent portfolio of universities and continually face challenges (Cantu-Ortiz et al., 2017) such as an effective transfer of knowledge to companies, a proactive commercialization of patents, a promotion and communication of these assets aimed at maximizing their impact.

The current scenario in which businesses, universities, TTOs and inventors operate is characterized by strong dynamism and growing competitiveness, as well as an increasing attention to communication. To be successful, it is required that these actors increase their efforts in promotion and marketing activities. In particular, TTOs should proactively communicate and promote university patents to increase their impact on the market and attract interested third parties (such as businesses, investors, buyers, and other partners).

In order to increase the promotion and valorisation of these assets, new platforms and tools have been activated in recent years, for example, the web platform 'Knowledge Share[1]'. Besides, the number and quality of dedicated initiatives, such as innovation fairs, is growing. Examples are 'Epo Patent Knowledge Week', 'Tech Share Day' and 'Innovagorà'. Platforms act as intermediaries between the universities and the main stakeholders of the ecosystem, while innovation fairs are useful opportunities for meeting and promotion activities.

The purpose of participating in both platforms and fairs is to interact with third-parties, such as investors and companies, interested in investing or acquiring the outputs of technology transfer such as patents (and sometimes academic spin-offs). On these occasions, TTOs and inventors communicate university patent information to third parties through short presentations or pitches and marketing sheets. They can increase third

parties' knowledge and interest in a given invention through specific presentations of patents characteristics with the aim of positively influence their subsequent acquisition and/or decisions to collaborate.

Relevant information asymmetries, in fact, exist between the parties: on the one hand are universities, TTOs and inventors characterized by high level of knowledge in terms of academic and advanced scientific research and who have a deep knowledge of university patents value; on the other side are external actors, such as investors or firms, which are characterized by limited scientific knowledge, experience and capability to evaluate or to fully understand their value, utility and potential. A good communication of the characteristics of university patents can reduce information asymmetries towards external actors and, overall, increase the impact of academic research into the business world. However, how to effectively communicate university patents, seems to be a much less explored topic than other aspects of technology transfer, like, for example, the communication of the characteristics of academic spin-offs (Fu et al., 2022; Huynh, 2016; Troise et al., 2023).

Given the growing attention towards university patents in recent years (Netval, 2018, 2021), and the strong growth in the number of patents in the portfolio owned by universities[2] around the world, it is particularly interesting and useful to understand what are the factors that can lead to an effective communication to external actors. Currently, university patents are not adequately valued and exploited. Effective communication could benefit all the involved actors since universities would attract financial resources and businesses could identify more easily valuable knowledge and technologies.

The research question this paper addresses is: what university patent characteristics influence third party investment and acquisition decisions?

This research offers an analysis of the main characteristics of university patents that influence investment/acquisition decisions by third parties. These characteristics emerged from the interviews with a group of experts in the field - entrepreneurs and investors - operating at the international level. The study depicts a framework identifying the characteristics useful to act as signals for third parties and reduce their information asymmetries and increase their knowledge. In doing so, the study lays the foundations for the possible application of signalling theory (Connelly et al., 2011; Spence, 1973) to university patents' communication.

Results are helpful for businesses interested in acquiring knowledge from university through university patents. It will benefit, besides, TTOs, universities and inventors by proposing a potential solution to a current issue in the activities of university patent communication/promotion, namely the little knowledge of the characteristics that are relevant for companies. Universities and TTOs historically face difficulties in promoting/communicating these assets, also given the scarcity of capabilities, competences, human resources and the less importance paid to complementary activities such as marketing, communication and networking (suitable targeted activities, for example, related to marketing, often are not adequately developed due to the different activities in which the human resources present are engaged which are sometimes undersized compared to real needs) (Netval, 2016); hence, our framework could be a useful tool and offer a practical guide for TTOs, their managers (e.g. knowledge transfer managers) and inventors in helping their promotion activities such as the preparation of specific presentations.

The paper is organized as follows: the next section presents the background of the research, followed by the description of the methodology. After that, findings are

presented and discussed. Finally, conclusions and the related contributions are outlined, together with the limitations and the avenues for future research.

2. Background

Patents are a typical signal used by firms to communicate quality and innovativeness (Conti et al., 2013; Hottenrott et al., 2016; Mason & Stark, 2004). They are useful to attract financing (Fischer & Ringler, 2014; Gredel et al., 2012). The ownership of patents is a criterion that influences the decision-making process of mainly two types of investors: Venture Capitalists (VCs) (Baum & Silverman, 2004; Hsu & Ziedonis, 2013) and Business Angels (BAs) (Audretsch et al., 2012; Maxwell et al., 2011). In the context of crowdfunding, and, in particular of equity crowdfunding (Troise et al., 2020, 2021), firms can disclose specific signals such as their patents that can be reported within campaigns and influence the decisions of crowd investors (Ahlers et al., 2015; Troise et al., 2022; Vismara, 2018).

While many studies examined the signalling role played by patents for third parties (see among others Audretsch et al., 2012; Hsu & Ziedonis, 2013), they largely focused on patents related to the companies that own the rights (i.e. whether or not the presence of patents can influence the decision-making process of investors), while an aspect neglected in the current literature seems to be that relating to patents by individual inventors or by universities (that become owners following the transfer of the relative rights by the inventors). Another critical aspect, is related to university stakeholders. The type of university stakeholders is very broad and complex and includes government, industry, TTOs and IP offices, business incubators, venture capitalists etc. that can act as a knowledge facilitators or producers. The different collaborations among these variety

of stakeholders on knowledge spillovers has the potential to influence university entrepreneurial outcomes (Radko et al., 2022).

Currently, little is known about the effects of patent characteristics on third parties such as investors and companies and what may be influencing their acquisition decisions. The lack of knowledge of these effects is even more evident in the field of technology transfer and especially in that of patents owned by universities. These assets make up the patent portfolio of universities and are often not linked to a company (e.g., university spin-off); in many cases, these assets remain unused and necessary to be properly communicated and promoted (as highlighted by the main reports in the field of technology transfer, see among others Netval reports).

The characteristics of patents could play a key role in influencing investment/acquisition decisions by investors and firms. Indeed, previous studies have attempted to define mechanisms to support patent value estimation by considering different patent features (e.g. owner, applicant, patent breadth, technology, cashflow produced, etc.) (Bessen, 2008; Cricelli et al., 2021; Grönqvist, 2009; Lawryshyn et al., 2017). The information provided by TTOs, and inventors may increase the latter's knowledge about the value of the patents and induce them to commit funds to acquire them. As previously discussed, the presence of information asymmetries is a non-negligible problem in this context, where investors and companies are potentially in a worse position to assess the value of university patents. Signalling theory is one of the major theories helping to explain the behaviour of two parties that have access to different information (Connelly et al., 2011; Spence, 1973). This theory, in fact, represents and established reference to explain how signaller actions and attributes affect the likelihood of obtaining funding and achieving acquisition, hence alleviating the information gap between the parties. In this scenario, university, TTOs and inventors, can act as signallers

and undertake the actions to send signals to influence the views and behaviours of receivers, i.e. investors and companies. Characteristics and information related to university patents can be perceived as quality signals by the latter and induce them to invest or acquire these assets, thus mitigating the information asymmetries. These patents' characteristics and information can help universities and their TTOs/inventors to communicate the value and quality of their patents. These parties, in fact, can proactively send observable signals to the less informed party and disclose useful information.

In the current scenario characterized by considerable efforts by universities and governments to promote patents and innovations, understanding what are the characteristics that can favour the sale of these assets and support their adequate valorisation assumes a great relevance. Based on the above, this study explores the characteristics of patents useful to act as quality signals to third parties and tries to shed some light on this topic by exploring directly the views of specific experts.

3. Method

This study is of qualitative nature (Dana & Dumez, 2015; Groenland & Dana, 2020) and, in order to add new knowledge to this research field and identify which characteristics of patents serve as signals for third parties, interviews were carried out with a panel of entrepreneurs and investors – including senior managers of leading consulting companies in the field of university technology transfer, university-industry collaboration and seed investment funds – with specific experience in the field of innovation and intellectual property. Qualitative analysis proves particularly useful in studying complex and new phenomena such as the identification of the characteristics of university patents influence investment decisions and third-party acquisitions.

In particular, the interviews were carried out with experts who already had experience with university patents, that is, individuals who have invested in this type of asset acquiring patents from universities. The experts were selected through purposeful sampling and leveraging the authors' previous experiences and connections in the specific field. Table 1 presents an overview of the experts interviewed. The study interviewed a panel of 39 experts. The interviews were conducted between October 2020 and January 2021.

*** *please insert table 1 about here****

Table 1. Overview of the experts

For this study, an inductive qualitative research design is used (Eisenhardt, 1989; Eisenhardt & Graebner, 2007) with open and in-depth interviews with the panel of experts. The interviews, conducted in English, were transcribed and examined. They focused on open questions relating to the main characteristics that a patent must possess in order to be of interest to the interviewee, thus being useful both for limiting information asymmetries and for positively influencing their process of acquisition/investment. The authors pursued the open and inductive coding (Strauss & Corbin, 1998), and the process - based on informant experience/information - led to the identification of the first order concepts; after examining the emerging patterns and relationships, in line with the grounded theory approach (Charmaz, 2006; Langley & Abdallah, 2011; Locke, 2001), these were grouped into categories, namely second order themes. Next, the latter were combined into aggregate dimensions. In this process, the first two authors focused on open coding after having examined the interview transcripts, while the other two authors have adopted an independent view and have favoured the theoretical interpretation; based

on a discussion between the authors, the set of codes was agreed, and second-order themes were developed; this process have included the analysis of existing theory as well as the emerging patterns or relationships. Finally, as last step of the process, second-order themes have collapsed into aggregate dimensions.

4. Results and discussion

As illustrated in Figure 1, seven main information categories related to patents' communication emerged from data analysis: utility and advantages; value; status; coverage; background and reputation; market; impacts. The first five information categories collapsed into two main aggregate dimensions, namely "utility and value" (including the first three categories) and "status and progress" (including the fourth and fifth categories), while the last two categories collapsed into a main dimension, namely "external conditions and impacts". As further step, these three aggregate dimensions were combined into two general categories, namely "internal aspects" (including the first two dimensions) and "external aspects" (including the last dimension). Table 2, instead, highlights the above reported categories and provides representative examples of each.

*** please insert figure 1 about here***

Figure 1. The data structure

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Table 2. Emerging categories

Interviews with experts revealed key information on the main characteristics of the patents that are of prime importance to them. Our results reveal the key role of both internal and external aspects, with the first category prevailing over the second.

As for the first category, the findings highlight that both utility-value and the status-progress of patens are crucial characteristics to which the interviewees pay particular attention. The first includes critical characteristics such as utility-advantages and value. This information is often included in presentations and marketing sheets of patents[3] provided by TTOs and inventors at innovation fairs or other events, and in dedicated platforms. The interviewees pointed out that useful information on the advantages of the (patented) invention has positive effects on their decision since it improves the understanding of what is the 'added value' that an invention may offer compared to other inventions or to already existing products/services, as well as in relation to its competitors. Some examples reported by the interviewees related to: low construction costs, efficiency, practicality, simplicity and speed of use/application, economy, sustainability (both from an economic and eco-sustainability point of view), the resolution of certain problems, difficulties for competitors in re-inventing or inventing around, the multiple functions of use. Along with the advantages, the areas of application are also among the elements most indicated by the experts in the interviews. Applications represent the main parameter for evaluating the potential impact of patents. These assets can have various uses and areas in which they can be usable. The concepts of multi-sectoriality and ductility are also connected to this parameter. When inventions are a highly useful solution in multiple sectors and in different fields, this constitutes an added value useful for signalling the quality of the invention. The value of patents is the second aspect that emerged, and it includes their economic and strategic value, the exploitation from an economic/industrial point of view, and the potential commercial use of the

inventions. The potential economic returns deriving from the use/application of the invention play a significant role in the investment decisions of many subjects. The economic value of the patent can represent a positive signal capable of influencing the decision to commit financial resources by investors or entrepreneurs. To estimate this value, there are various measurement tools and various qualitative/quantitative indicators or methods useful for analysing the economic returns of patents. Apart from their economic value, also their strategic value is valuable information as assessed by the interviewees; for example, patents may be useful for specific firm strategies, to gain new alliances and to increase their competitiveness or strategic flexibility (Ndofor & Levitas, 2004).

The category internal aspects include also a second dimension, namely status and progress of the patents-inventions and it covers their status, level of protection, background and reputation. They are useful parameters to represent the current state of the invention by providing additional elements of evaluation for entrepreneurs and investors. The development stage of the invention and the phase in the life cycle (of the patent) outline the stage in which the invention is (for example: conceptual, experimental, simulation of the operating model, working prototype, proof of concept, etc.) and the possible need for further development. The parameter 'time to market', on the other hand, identifies the time that elapses between the current stage of the invention and its entry into the reference market, i.e. the extent to which the invention/idea covered by the patent is close to the commercial stage. The other categories of interest of patents for companies and investors are both the patent coverage and the background-reputation. The first parameter indicates the degree of territorial coverage of the patents or defines the countries in which the invention is protected (national or international level). An international extension of patents can favour the interest of certain

entrepreneurs/investors, while the opposite case, or a reduced territorial protection of the patent, can represent a limitation. As for the background and reputation, it emerges that the team of inventors have a central role. The interviewees highlighted that the team of inventors, their research and reputation can improve the judgment of third parties and can transmit a quality signal about the value of the invention. As reported by Grimpee and Fier (2010, p. 647) "scientists are able to report their quality to industry not through publications that would rather contribute to academic merits, but through patents"; however, we can affirm that with regard to patents, the opposite is also true, namely the effect deriving from the reputation of the inventors: patents also benefit from the prestige of their inventors. The interviewees also pointed out that scientific research or publications and research funds or projects, especially at international level, act as certifications and are therefore highly appreciated and consequently increase the likelihood of influencing their decisions.

The second macro-category resulting from the analysis is the external aspects and includes market and impacts. For entrepreneurs and investors, it is particularly important to have knowledge about the market characteristics, in particular: the existence of a specific market to serve (such as a niche market), its breadth/size, its trends and forecasts/prospects of growth, its economic value, reference legislation/regulation to consider and align with, the number of final users/beneficiaries of the invention as well as that of competitors, the level of product customization for the reference market. Finally, the interviewees underlined the importance of impacts of various kinds, in particular from a social, economic and industrial point of view. Patents and in general inventions have known economic and industrial effects – such as impacts for specific sectors/industries, economic effects for countries (or local contexts) and actors, commercial or industrial application effects – but, interestingly, entrepreneurs and

investors are particularly influenced by their social effects. High attention is paid to the influence of patents/inventions for the whole community, the environment, the multitude of stakeholders involved, future generations and the future of the planet.

5. Conclusion

This paper identifies the relevant factors that contribute to effectively communicating a university patent. In this way it is possible to facilitate the process of technology transfer which can benefit companies, universities and society in general.

The characteristics discussed above in section 4 are relevant to third parties like companies and investors, as they increase their understanding of the inventions, and can be considered useful signals for them. Therefore, TTOs and inventors should pay special attention to them as well as include this information in their patents' presentations.

It is important to understand the characteristics that the third parties are interested to, in order to have a clear representation of the recent trends of interest of these primary stakeholders and a focus on their perspective. The research offers a valuable contribution to research, that is the depicted framework for the university patent characteristics, reported in figure 2; it consists of internal and external aspects that may act as signals, thus opening the way for a subsequent study to empirically test the framework and its dimensions. Our study contributes to research stream exploring information mechanisms to achieve university patents valorisation and exploitation, as well as to reduce potential information asymmetries issues; furthermore, it advances a potential application of signalling theory which is scarcely used in the field of technology transfer, especially in that of university patents.

At the same time, the proposed framework could represent a model to be leveraged and used from a practical point of view by interested actors – such as TTOs

and inventors – to implement next communication patent strategies, preparing pitch and presentations and so on.

*** *please insert figure 2 about here****

Figure 2. Proposed framework

This study has interesting practical implications for many different stakeholders including universities, TTOs, inventors, innovation managers, platform managers, policymakers, governments and public agencies, and other players of the innovation ecosystem. It is critical today to know which patent characteristics drive third party investment/acquisition decisions. Knowledge of these characteristics will help inventors, TTOs and universities to implement their valorisation strategies and design consequently the communication activities. In particular, in recent years, TTOs are increasingly involved in the promotion of patents held by universities and proactively participate in innovation fairs, in specific meetings with investors and in implementing dedicated platforms with marketing sheets. Based on the results of this study, universities and their TTOs can define and implement their communications strategies as well as improve their presentations/pitches or marketing sheets with the categories of characteristics that emerge from this research.

The implementation of active policies for the enhancement of existing patent assets (Crittenden et al., 2015) is a recurring problem within Universities (Cesaroni & Gambardella, 2001). The commercialisation of patents requires interaction with investors and interested firms (Daniel and Alves, 2020). Hence, these patent characteristics can be a key factor in the successful transfer of the patent from universities to companies. TTOs have different commercialisation strategies for their university outputs (Dias and Porto,

2018), therefore our research could be particularly important for universities in defining these strategies with the aim of increasing their valorisation and communication capacity.

The study could be useful in solving a recurrent issue in the communication and promotion of university patents, that is the limited knowledge of the key characteristics for third parties; the proposed framework is a useful tool and guidance for inventors and especially for TTO managers (e.g. knowledge transfer managers) in promoting these assets and in preparing presentations for specific events.

This research is particularly topical and interesting considering the entry of new players into the ecosystem such as crowdfunding, and in particular equity crowdfunding (Troise and Tani, 2021), which involve a range of investors who decide to finance certain initiatives and/or products based on some characteristics that are relevant to them.

This research is, to our knowledge, the first to explore the views of experts and build a framework, and accordingly, is not without its limitations. First, the qualitative nature of the research limits the generalizability of the findings, however, as above discussed, this will pose the bias for a subsequent study to test the framework and the hypotheses related to the categories emerged; in doing this, the lens of signalling theory is clearly a suitable theoretical framework. Hence, further studies should provide insights from quantitative research and highlight the signalling role played by these patents characteristics in affecting the investors' decisions. Secondly, the number of experts to be interviewed could be further increased and considering the specificities for each category. Future research in this field might investigate how the use of knowledge visualization tools can increase the knowledge of third parties and influence their investment/acquisition decision making. The use of visualization tools (Troise, 2022) could allow universities to increase their performance related to technology transfer

activities, in particular those related to the transfer of patent knowledge from universities to external actors.

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Declarations of interest statement

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Notes

1. Knowledgeshare is an online platform (https://www.knowledge-share.eu/) launched in 2019 by Netval, MiSE-UIBM and Polytechnic of Turin that Knowledge Share is an IP platform that facilitates the interaction between university TTOs, academic researchers and industry partners, by providing a portal that enables users to easily access information related to patents and technologies.
2. Considering for example the Italian context, based on the latest reports (see among other Netval report, 2021), which show the trend of patents for each year, over 7,800 patents are held in portfolios by Italian universities (with an increase of over 40% on the previous survey).
3. An example in this sense is represented by the marketing presentations requested by the platform “Knowledge Share” platform.

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