Efficiency in Technology Licensing of Science and Technology Institutions for Companies: a Systematic Rewiew.

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Abstract

The licensing of technologies of Scientific, Technological and Innovation Institutions (STIs) is recognized as a traditional and established vehicle for bringing the knowledge produced in universities and research centres to consumers, using companies from the production environment as intermediaries. To better understand the factors related to efficiency in the licensing process for STI technologies for companies, a search for studies that addressed the subject was carried out, using the method of systematic literature review (SLR). The review presents the aspects indicated by the authors as responsible for the efficiency in the process. The results were used to answer descriptive questions, such as in which situation and how the licensing occurred and which aspects impacted on the commercial success of the product arising from the technology. Also, the results were used to answer prescriptive efficiency questions, such as when and how licensing should occur and what should be done to influence the success of economic exploration. The structuring of questions and answers, together with the review, contribute to present the state of the art of the literature on procedures related to efficiency in technology licensing.

Keywords: Technology transfer; Technology licensing; Universities; Research Centre; Efficiency.

1. Introduction

Technology licensing activities are understood as the main way of taking what is developed by universities and research centres to the production environment (Chapple et al. 2005, Ho et al. 2014). The main responsible for this action is the fact that universities and research centres rarely produce and commercialize their technologies directly with consumers (Elfenbein 2007, Jensen and Thursby 2001), thus having licensed companies as intermediaries between research and the final market.

The process for technology licensing is complex owing to the interaction between various actors and to the direct influence of different contexts, in which are inserted the companies receiving the technologies, as well as universities and research centres, called by Brazilian legislation (law 13.243/2016) as Scientific, Technological and Innovation Institutions (STIs). To contribute to the technological and economic development strategy of nations, STIs have been driven and encouraged by governments to protect their inventions by obtaining intellectual property rights and, subsequently, licensing them to companies in the production environment (Sapir and Kameo 2019). This licensing generates a new source of funds for institutions, assisting in economic development in their respective regions (Becerra et al. 2018, Kim et al. 2014, Lee and Win 2004, Muscio 2010). Considering that the government incentive is often financial, it is necessary to carry out evaluations on the efficiency in protecting and licensing technologies (Necoechea-Mondragón et al. 2013).

The systematic evaluation of efficiency in technology licensing processes, however, does not have a unanimous method in the academic community. There is a lot of information about which critical factors influence the process of transposing from the academic technology stage to the product inserted in the market. One of the parameters to

evaluate the efficiency in the performance of this activity is the number of licenses carried out and the annual income earned (Chapple et al. 2005, Secundo et al. 2016, Siegel et al. 2003). On the other hand, Secundo et al. (2016) state that this is a debatable way of measuring efficiency in technology licensing, since few STIs have businesses that fully finance them or are focused on financial returns.

Abundant literature describes aspects related to the efficiency in the STI technology licensing process for the production environment, describing the factors that positively impact the activity. However, most of these factors appear in a fragmented way (Perkmann et al. 2013), requiring a comprehensive analysis of conditions favourable to the process. Due to this situation, the objective of this work is to produce a global understanding about the efficiency in the licensing of STI technologies, through a systematic review of the literature. Thus, it explores the existing studies that deal with this subject and presents in a structured way the circumstances and conjunctures that contributed positively to the effectiveness in taking the technologies developed in STI to the production environment, as well as to the success in the economic exploration, by the licensed companies, of the products derived from the referred technologies.

The review process focused on the research problem related to aspects concerning the existing difficulties in patent licensing of universities and research centres for companies, being guided by the following research questions: What factors impact on technology licensing efficiency at a university or research centre? What is the connection of these factors with the success of the product resulting from technology?

2. Methodological aspects

Literature reviews make it possible to explore the existing knowledge on a given subject, visiting the various understandings on the topics of scope, allowing the assessment and framing of the research objective, in addition to finding gaps to be worked on (Denyer and Tranfield 2009, p. 671).

Mulrow (1994) highlights the contributions of the systematic review, which range from the possibility of filtering information, reducing a large number of knowledge to a set that can be analyzed. By doing so, it allows discerning decision-making about the research to be conducted, until the feasibility of verifying the localized results.

Objectively, it seeks to answer critical questions that will guide research to be developed, providing inputs and possible limitations (Eriksson 2014). The rigorous process for locating relevant studies generates reliability, also bringing objectivity to the procedure, thus avoiding generalizations (Davies 2000).

The present study sought works related to factors that impact the efficiency of technology licensing by science and technology institutions, in addition to works that address the interaction of these factors with the commercial success of the product generated by licensed technological knowledge, through a flow of procedures for systematic literature review, shown in figure 1.

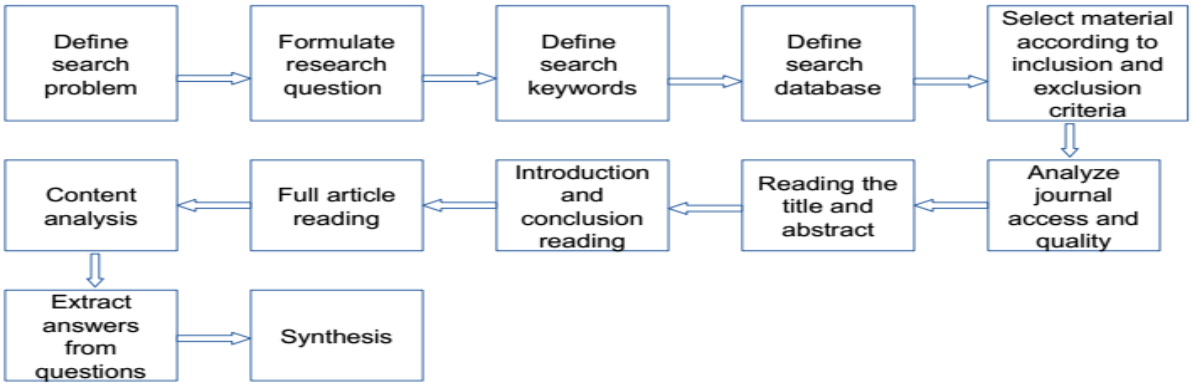

Figure 1 - Stages of the Systematic Literature Review

2.1 Choice of the review procedure

This work was guided by the method prescribed by Tranfield et al. (2003), starting from the question: what are the boosters of patent licensing of universities and research centres for companies?

2.2 Planning and scope

Searches were conducted in the Scopus and Web of Science databases, selected for providing broad academic coverage. One difficulty encountered in relation to the topic of technology licensing by STIs is the different terms used by the authors to describe this process. Therefore, combinations of the search terms were used, with the use of the Boolean operator 'AND' and also the asterisk in the word stem, aiming not to limit the search for different modes of expression, with the keywords: 1 - "patent licens*" AND universit* AND effic*; 2 - patent licens* AND universit* AND effic*; 3 - "patent licens*" AND "research centre" AND effic*; 4 - patent licens* AND research centre AND effic*; 5 - "technology transfer" AND universit* AND effic*; 6 - "technology transfer" AND "research centre" AND effic*; 7 - "technology Licens*" AND "research centre" AND effic*; 8 - technology Licens* AND research centre AND effic*; 9 - "technology Licens*" AND university AND effic*; 10 - technology Licens* AND university AND effic*; 11 - "Technology Commerc*" AND university AND effic*; 12 - "Technology Commerc*" AND "research centre" AND effic*.

This search focused only on works in English language and in areas related to production engineering, such as social sciences, engineering, management and business, to safeguard the significance of the study. There was no time filter limiting a period of publication, due to the fact that results obtained in older studies could represent interesting findings.

2.3 Execution

The search was carried out between the months of May and June 2019, with a total of 1446 articles being found, in the period from 1978 to 2019. After applying the filter in which peer-reviewed articles were selected, discarding, among other chapters, books and congresses, 990 works remained to be considered. The next filter aimed to select studies related to the areas (business, management, engineering, economics and finance, social sciences, decision science and operations research), with 456 articles suitable for the next phase being counted. In this, repeated articles were removed, with 331 papers selected for reading the title and abstract. After this evaluation, 100 articles were considered relevant for the next filter, which was the reading of the introduction and conclusion. Following the selection by filters, 58 studies were chosen for a complete reading, being added to the 34 articles in snowball, in a total of 92 contemplated articles. Of these, 45 articles were selected as the final result, as shown in Figure 2, which effectively contributed with answers to the following research questions: a. What factors impact the efficiency of technology licensing at a university or research centre? b. What factors act in the success of the economic exploitation of the product arising from the technology? c. What reported obstacles hinder or prevent technology licensing actions?

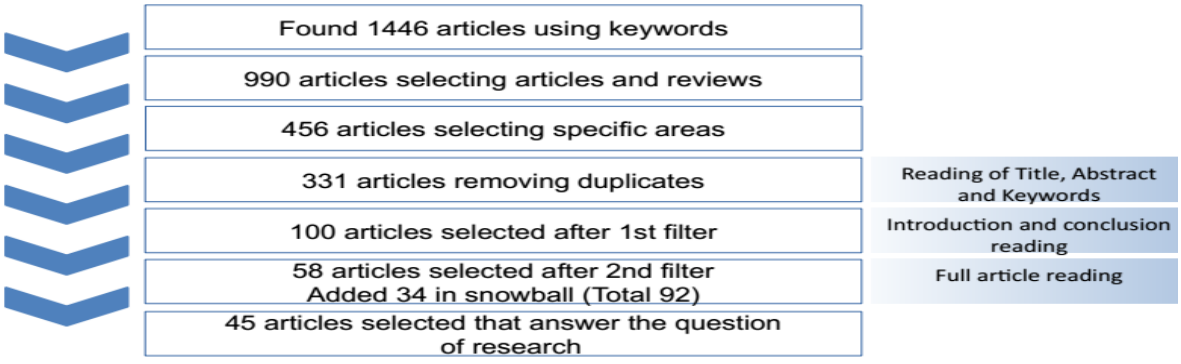

Figure 2. Development of the Systematic Literature Review.

Since this is a complex topic (Necoechea-Mondragón 2013), questions 'a' and 'b' were divided into sections to strategically map the factors that affect the process:

a 1. The context of technology licensing, in the external and internal environments, to describe: a.1.1. Under what circumstances did licensing occur; a.1.2. What was the technological and institutional context when licensing took place?

a.2. The prescriptions of procedures for the licensing of technology, to determine what the studies prescribe as positive actions in the process, verifying: a.2.1. When licensing should take place; a.2.2. What are the favourable technological and institutional circumstances for licensing to occur?

b.1. What influenced the success of economic exploration.

b.2. What must be done to influence the success of the economic exploitation of the product arising from the transferred technology?

The use of this division is justified by the dynamism of the markets in which the relations between STIs and companies are inserted since they normally have as their object innovative technologies, which are highly influenced by the interests of consumers and the competitiveness of companies (Meyer 2007).

3. Results

In this section, we report the results of the systematic review as an answer to questions related to context, process and results. Each question is part of the proposed division for a better understanding of the theme, due to the complexity presented.

a.1 Context - description of how occurred the technology licensing.
a.1.1 Under what circumstances did the licensing occur?
Several studies have addressed the circumstances existing at the time of STI technology licensing. Internal situations in STIs, most reported in the literature as influencing technology licensing, had greater convergence in the existence of technology transfer offices (TTOs), referred to by Brazilian legislation, law 13.243/2016, as Technological Innovation Nucleus (TINs), to prospect and mediate relations with companies in the production environment (Andersen and Rossi 2011, Anderson et al. 2007, Barra and Zotti 2018, Becerra et al. 2018, Cardozo et al. 2011, Chau et al. 2017, Kim 2008, Lafuente and Berbegal-Mirabent 2019, Siegel et al. 2008, Debackere and Veugelers 2005).

Specifically at this point, some authors believe that the simple existence of TINs is insufficient, requiring a composition of these by specialized professionals, for example, in areas related to marketing and law, to launch more effective strategies in licensing actions (Barra and Zotti 2018, Cardozo et al. 2011, Chapple et al. 2005, Chau et al. 2017, Geuna and Muscio 2009, Rossi 2018, Siegel et al. 2003). Also, the size and structure of the TIN, by the number of employees, provide a more specialized service (Cardozo et al. 2011, Curi et al. 2012) for various types of technologies developed by STIs. This is a point of controversy, as Chapple et al. (2005) claim that smaller, more specialized offices achieve better results. Regardless of the size of the TINs, the dedicated budget, represented in the personnel structure and expenses related to the maintenance of intellectual property rights, has repercussions on more licensing actions, being a crucial aspect (Swamidass 2009). Following the same nexus as the TIN configuration, the experience in relationships with companies, involving licensing, had a positive impact, presenting itself with know-how acquired in previous situations (Heisey and Sarah 2011, Ho et al. 2014, Lafuente and Berbegal-Mirabent 2019, Markman et al. 2005, Weckowska 2015).

Another relevant point, according to Curi et al. (2012), Heisey and Sarah (2011) and Ho et al. (2014), concern the size of the STI, considered as an impacting factor for technology licensing. Following this logic, Andersen and Rossi (2011) affirm that the older ones have a greater orientation towards research and their conduct to the market. The institutional reputation of STI, won by the quality of developments and the commitment to license its technologies to the production environment, is also an important factor (Rossi 2018). The interaction with agents of the production environment in other cooperation brings a relationship of pre-existing trust, which means fewer rejections and mistrust, facilitating and speeding up the licensing. (Ankrah and Al-Tabbaa 2015, Becerra et al. 2018). Also as reported by Anderson et al. (2007), the involvement of STIs with start-ups presents a favourable scenario, given the uncertainties inherent in new technologies, in which these companies are more willing to risk the business. A very specific point concerns the fact of weather the STI is public or private, considering that in the United States private institutions have better results in licensing actions (Thursby and Kemp 2002).

Regarding individual aspects, Elfenbein (2007) reports the role of the prestige of the researcher who developed the technology, which provides greater visibility due to his academic production and the ability to interact with companies.

In the specific question of technology, when the patent is relatively new, it portrays a situation in which the possibility of obsolescence is ruled out, having an appeal to face competition for novelty (Andersen and Rossi 2011). Regarding technology, which is the subject of licensing, the fact that it is complementary to an existing one is a factor that arouses interest in companies (Cartalos et al. 2018).

Little was described in the literature about the situations outside the STIs that acted directly on technology licensing. Participation in external fairs and events for dissemination (Cardozo et al. 2011, Cartalos et al. 2018) were reported, in marketing efforts to attract companies, with the demonstration of technologies and their potentials.

a.1.2 What was the technological and institutional context when licensing took place?
The reports of the existing internal contexts, which narrate the influencers in the act of licensing, were related to the quality of the research produced, in the sense of offering technologies that presented competitive advantages (Cardozo et al. 2011, Kim et al. 2008, Muscio 2010). These are processes marked by the direct involvement of researchers, a fact that brings reliability by clarifying technical aspects of the technologies (Becerra et al. 2018, Cartalos et al. 2018). In the sense of said participation, one of the motivations reported was the payment of a more significant percentage of royalties to the researcher (Chapple et al., 2005). Previous experience in other technology commercialization activities has also been described as an impacting factor in the process (Berbegal-Mirabent et al. 2013).

From an external point of view, STI's positive reputation in technology licensing is a factor that facilitates negotiations with companies in the production environment, as it generates a sense of reliability, which tends to boost interaction with companies (Andrade et al. 2017).

a.2 Procedures prescription for the technology licensing
a.2.1 When should licensing take place?
One of the points that generate greater insecurity in STIs is the correct moment when the technologies should be offered to the market. In this sense, it is prescribed that the technology is in the prototype stage, at level 6 - method prototype, of the Technology Readiness Level (TRL), developed by the US space agency NASA, to estimate the maturity of new developments (Barra and Zotti 2018, Cartalos et al. 2018, Large and Barclay 1992). A condition is also indicated in which intellectual property is relatively new (Andersen and Rossi 2011) and which presents a technological improvement that allows the reduction of uncertainties related to the new technology (Jeong and Lee 2015).

a.2.2 What are the favourable technological and institutional circumstances for licensing to occur?

A clear point for STI is that the fact of developing new technology and patenting it does not guarantee success in commercialization (Alavi and Habek 2016, Berbegal-Mirabent et al. 2013). One of the most effective practices is inserted in the divulgation of technologies produced to potential licensees (Lee and Win 2004). Additionally, interpersonal relationships between STI researchers and company researchers should be used as a strategy to leverage licensing, as well as to facilitate the transfer of tacit knowledge (Alavi and Habek 2016, Berbegal-Mirabent et al. 2013; Fukugawa 2009; Siegel et al. 2003). Still related to the involvement of researchers, when they actively collaborate with the TINs, there is an increase in the speed of licensing (Muscio 2010), and it is recommended that STIs expand the financial rewards for researchers, as a way of motivating greater involvement (Necoechea-Mondragón et al. 2013, D'Este and Perkmann 2011). The literature also addresses that dedication to some areas of knowledge such as engineering and medicine would enable greater chances of licensing their developments (Berbegal-Mirabent et al. 2013, Cardozo et al. 2011, Chapple et al. 2005, Curi et al. 2012, Heisey and Sarah 2011, Muscio 2010, Thursby and Kemp 2002), but this is a factor that generates debates about whether it is effectively an impacting factor (Siegel et al. 2003).

b.1 What has influenced the success of economic exploration?
The literature found shows that the economic exploitation of the product resulting from STI technology is influenced by some factors, such as improving quality through new inventions, reducing production costs, reducing lead time, and opening new markets to be explored (Large and Barclay 1992). In matters external to the STI, the licensed company's technical capacity and marketing strategy are included (Alavi and Habek 2016, Lee and Win 2004). The geographical issue was another highlight, being reported that in regions with the density of technology-based companies, they were more conducive to the commercialization of innovative products (Barra and Zotti 2018, Becerra et al. 2018, Berbegal-Mirabent et al. 2013, Chapple et al. 2005, Resende et al. 2013).

b.2 What must be done to influence the success of economic exploration?
Alavi and Habek (2016) prescribe that STI 's orientation in developing technologies aimed at the market, using the intermediation of TINs, is a primary factor. They may also have the support of business incubators, to support start-up companies that license STI technologies (Berbegal-Mirabent et al. 2013, Siegel et al. 2008).

For an innovative product to be successful in economic exploration, it must be borne in mind that intellectual property documents are insufficient for the transmission of knowledge, and the human relationship is also necessary for the transfer of tacit knowledge from developers, making efforts to transform a technology, which is usually in the laboratory stage, in a commercial product (Agrawal 2006, Alavi and Habek 2016, Hellmann 2007). In the sense of this transformation, long-term relationships between STI and the licensed company (Alavi and Habek 2016, Spulber 2016) must be established, as well as providing technical assistance and training to reduce the risk of non-absorption knowledge needed to produce technology (Lee and Win 2004). According to Jensen and Thursby (2001), additional effort is needed for the technology to have a reasonable chance of success. Muscio (2010) complements stating that the active collaboration of technology developers with the aforementioned offices predisposes to greater generations of revenue in licensing.

On the part of the licensed company, a physical, technical and financial structure is essential to internalize the transferred technology (Alavi and Habek 2016, Kodama 2008, Cohen et al. 2002), given the need to absorb technological knowledge that as a rule has no market characteristics and convert it into a commercial product.

c. What are the barriers to technology licensing?
While conducting the literature review, attention was drawn to the fact that some authors point out obstacles to the licensing of technology by STIs. This is what motivates the inclusion of this topic, with the main difficulty being the difference in corporate culture between the receiving company and the STI, since it does not normally work with the profit logic, but with research and technology development (Alavi and Habek 2016, Siegel et al. 2003). In this sense, conflicts of interest and excessive bureaucracy and inflexibility existing in STIs (Anderson et al. 2007) prevent the commercialization of academic research. Although the TINs have the role of mitigating these issues, they do not

always achieve their objective, since most STI researchers present to the offices technologies to be patented and commercialized (Cardozo et al. 2011) and return to their activities research, not supporting TINs in the licensing process. This behaviour poses a problem, as there is a consensus that patents do not provide enough information for the technology to be transformed into a commercial product, also requiring the transfer of tacit knowledge for its internalization by licensed companies (Alavi and Habek 2016).

Researchers are often unaware of the potential application of the technologies they develop, sometimes underestimating or overestimating it, or which companies would be interested in their inventions. This gap is also shared by companies in the production environment who are unaware of the scientific results of potentially valuable STIs (Hellmann 2007, Jeong and Lee 2015). In companies, other aspects that make technology licensing difficult are the lack of qualified technical staff, equipment and financial resources (Kim et al. 2008). In economic exploration, companies face technical difficulties in the initial stages of introducing the new product, as well as restraint by consumers (Spulber 2016). With regard to technologies specifically, these are usually nothing more than a proven concept (Thursby and Thursby 2002), requiring product development and market positioning (Swamidass and Vulasa 2009).

With regard to STIs located in regions without a vocation for innovation, they have greater difficulty in licensing. Cardozo et al. (2011) note that there is a growing competition between organizations that aim to transfer the results of their research to the market. Finally, in developing countries, STIs are not recognized as essential for cutting-edge innovation, but as places for training people in search of knowledge (Necoechea-Mondragón et al. 2013).

4. Analysis of the integrative view of the technology licensing process and its influencers

Institutional issues proved to be the starting point for a strategic choice to guide the production of knowledge for commercialization. The approximation of the STIs to the agents of the production environment, mainly with technology-based companies (Swamidass and Vulasa 2009), which normally propose to innovate with differentiated products, are a current milestone that permeates positive interactions. This proximity resides in commercial relations of previous technology licenses, as well as in the interpersonal relationship of researchers who have a profile for engagement to bring their inventions to use by the population. These situations create feelings of comfort for companies that are interested in becoming future partners, as they demonstrate tangible stories and these translate into experiences brought from relationships, with learning how to behave in relationships with different cultures and purposes (Okamuro and Nishimura 2013). The combination of technological and commercial knowledge is not a trivial activity. On the STI side, there is the objective of technological development, with a focus on contributing to economic growth (Etzkowitz 2003), and on the side of the company, the focus is on commercial exploitation with profit. In both cases, the common point is a technology to be developed and exploited.

The technology created to be licensed needs to be aligned with the needs of the market, presenting characteristics that enchant entrepreneurs and create interest in them in transforming it into products (Andrade et al. 2017). Such aspects must, in addition to demonstrating the potential in their exploration, show a real condition of being made in an industrial production scale, through replicability, allowing a coherent and consistent market positioning, with costs aligned with the reality of the focused markets.

Typically, technologies originating from research at universities and research centres are not primarily targeted at large companies. They are usually interested in technologies with lesser technical and commercial uncertainties, which become highly profitable products (Debackere and Veugelers 2005, Necoechea-Mondragón et al. 2013), which is not always the reality presented. Small and medium-sized companies are more aligned with the needs of newly developed technologies, due to the agility in management, the belief in achieving success and significant gains, in addition to willing to transform them into products of commercial interest, with the proper positioning in the target market (Baruch 1997, Jeong and Lee 2015, Lee and Win 2004, Mowery 2011) and because they have higher survival rates when supported by STI developments (Swamidass and Vulasa 2009).

According to Jensen and Thursby (2001), the stage of maturity of technologies generated and patented by STIs is embryonic, requiring adjustments for production on a commercial scale. They are also still devoid of the moulding to the market to which they will be destined.

In most STIs, the mission of intermediating interactions with the production environment is the responsibility of the TINs, who assess and legally protect inventions that have a commercial bias, prospecting potential companies for technology licensing, signing contracts for exploration and monitor market performance (Hellmann 2007, Hoppe and Ozdenoren 2005, Sapir and Kameo 2019). For this set of activities, it is clear that there is a need for a specific body, which must work with the specifics related to technologies, as well as with the characteristics and interests of companies to become partners.

The participation of researchers in the activities of the TINs is of great importance for the commercial success of products derived from STIs (Muscio 2010) since it allows more concisely that the described in the intellectual property documents are converted into innovative products (Holgersson and Aaboen 2019, Lee and Win 2004, Siegel et al. 2003). According to Jefferson et al., the alienation of researchers from STIs from TINs causes difficulties in licensing processes. Qin and Du (2017) warns that, in addition to the financial gains arising from the commercialization of intellectual property rights (Muscio 2010), the feedback of the research process by the information generated (Lee and Win 2004), from the product development to the referring ones to the perceptions of consumers, are of great importance (D'este and Perkamnn 2011).

The relationship between purely academic and business interests is complex, sometimes generating conflicts between the authors, due to defences of pros and cons, thus lacking distinct standards of approach, to positively influence the success of the parties (Andersen and Rossi 2011, Andrade et al. 2017, Chapple et al. 2005, Dell'anno and Del Giudice 2015, Gusberti et al. 2018, Jain et al. 2009, Muscio 2010).

Concerning companies to be licensed for the commercial exploitation of intellectual property rights arising from STIs, there is a need for technical, structural and financial capacity, in addition to being aware of the difficulties to be encountered when developing new products and positioning them in the market (Kodama 2008). In some cases, experiences in technology licensing situations of other companies located in the same region allow an exchange of knowledge, which favours interactions with STIs. Geographic proximity also presents an interesting point when it comes to interactions between researchers for the exchange of tacit knowledge, whether due to the technical issue or to the costs involved in the technology licensing process (Alavi and Habek 2016). Still, regarding companies, the perception of markets with the potential to absorb products resulting from licensing is a factor of great importance for success in economic exploration. In certain cases, new markets must be opened, overcoming conservatism in consumption habits and resisting the new (Lee and Win 2004).

5. Final considerations

The present systematic review of the literature generated a rich scenario regarding the factors that lead to efficiency in the licensing processes of technologies developed by STIs. An alignment between the descriptions of the contexts in which technology licensing actions were carried out was demonstrated, with prescriptions of how they should occur. Analyzing the frequency with which the factors that lead to efficiency in the licensing of the results of the research of STIs were treated, it was clear the importance of the technology transfer offices in the role of intermediaries between academic knowledge and business knowledge. These offices operate in fields influenced by technical and economic contexts (Gusberti et al. 2018), with the challenge of establishing successful licensing strategies, with the selection of technologies sent by researchers to focus efforts, since they will need resource allocation and professional commitment (Gonard and Durand 1994).

One of the points that deserve to be highlighted is the need for greater proximity between TINs and researchers, aiming at giving the technologies described in intellectual law documents, which are usually at a level slightly above

proven concepts (Jensen and Thursby 2001), a commercial appeal with market orientation (Holgersson and Aaboen 2019, Jefferson et al. 2017), to increase the amount of knowledge transferred from STIs that reaches the market.

The expanding action is related to the performance of the TINs, using as an indicator the number of intellectual property rights, deposited or granted, which are related to the knowledge stock of an STI (Berbegal-Mirabent et al. 2013), and the number of licensing (Di 2018). This logic of measurement of performance is taken to adapt the measurement respecting specificities (Secundo et al. 2017) and demonstrates to be applicable in developing countries where technology licensing processes are recent, not being fully established, and the use only from the perspective of the resources obtained with licensing as a measure of effectiveness potentially leads to a distorted view (Secundo et al. 2016). Such distortion may occur because the assessment does not take into account the social impacts of technologies, such as job and income generation (Anderson et al. 2007), and also the impacts on the competitiveness of countries' economies (Becerra et al. 2018, Lee and Win 2004). These two dissociated stages are then considered. On the one hand, the complexities of licensing STI technologies for companies (Siegel et al. 2003) added to the difficulties in making the technology a commercial success. On the other hand, the need for greater attention from STIs, due to the fact that less than half of products derived from licensed technologies impact the market (Agrawal 2006), also because of the relationship between STIs and companies in the production environment being marked by cultural differences. Their relationships are complex, with specificities that make it difficult to generalize procedures (Dell'anno and Del Giudice 2015).

Taking into account that when patenting a technology, STI demonstrates the clear intention to license it (Thursby and Thursby 2002), understanding the causes and reasons why much of the knowledge produced and protected is not licensed should be the object of further studies, then focusing independently on the licensing of intellectual property rights and the success of the product in the market, since it is dependent on most strategies and actions of the licensed companies (Bozeman 2000).

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