

The Intellectual Property Protection and Commercialization Management Process in a Technology Licensing Office

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Abstract— In Brazil, the Technology Licensing Office (TLO) is responsible for protecting and commercializing the Intellectual Property (IP) in a Scientific and Technological Institution (STI). When TLO's operation is analyzed, it can be understood that TLOs still need to develop their organizational skills in order to achieve their goals, particularly on technology protection and commercialization strategies. This paper presents a process model with three key processes, namely Admit Technology, Protect Technology, and Commercialize Technology, with their respective subprocesses, and other support processes. With the operationalization of the process model presented, TLO can analyze the technologies and define the strategies for their protection and commercialization, enhancing their transfer to the productive sector. This model was successfully applied to a TLO of a military STI.

Keywords— intellectual property; technology protection; technology commercialization; technology licensing, technology transfer; technology licensing office; technological innovation.

I. INTRODUCTION

In Brazil, most research is done by Scientific and Technological Institution (STI). However, there is a distance between the STI and the companies, which hinders the access of companies to technologies created or developed by STI. Therefore, it is difficult to transfer the technologies developed by STI to companies. Thus, in order to improve the interaction between the STI and the companies, it was created, according Brazil (2004), the law 10.973, known as Innovation Law.

The Innovation Law requires that the each STI disposes of a Technological Licensing Office (TLO), with the aim to manage policies of innovation from the STI, including questions relating to intellectual property (IP). The intellectual property (IP), according WIPO (2015) and INPI (2014), regards the branch of law that deals with the legal protection granted to all creations of the human mind, such as inventions, literary and artistic works, symbols, names and images used for commercial purposes. The IP is divided into three categories: industrial property, copyright and sui generis protection, as will be further detailed in item 2. Santos (2011), describes that the IP is a theme that is gradually gaining prominence in private organizations, seeking as much use it with marketing purposes, such as to

ensure a competitive position in the global economy, and also in public, especially in STI, which increasingly encounter a new reality composed of technology and innovation transfer processes.

Analyzing the statistics given by INPI, according to INPI (2014), it is possible to perceive that Brazil shows a relevant production of high technologies, when observing the quantity and quality of protection order deposits (i.e.: patents). However, to deepen this analysis regarding the commercialization of protected Technologies (i.e.: licensing) that are creating value; it is possible to realize that licensing is very limited. In other words, even though the amount of protection order deposits has increased in Brazil in the last decades and has become very important, this condition hasn't significantly changed the innovative Brazilian environment that continues with a lack of actions to spread output technology.

For this to occur, according to Jannuzzi et al. (2008), the legal instruments to stimulate innovation, should be further worked for the intellectual creations generated from STI convert in technological innovations. In addition, the TLO should assume a role of mediator between the STI and the companies, in this case, for negotiations involving matters relating to IP. For Frezatti et al. (2014), Conley, Bican and

Ernest (2013), Shahraki (2012), Germeraad (2010), Jannuzi et. al. (2008), O'Hearn (2008), Chesbrough (2007), Jain e Sharma (2006), I Gràcia (2005) e Feldman et al. (2002) one of the challenges for the TLO is to use multiple mechanisms to outline strategic decisions for the management of IP, considering the STI innovation strategy. This will allow to succeed in portfolio management technologies. From this perspective, define the organizational processes that will enable the protection and commercialization of creations generated in the framework of STI is essential to ensure efficiency and effectiveness in the management of IP.

Even with the minimal consequences defined by law, when TLO, in Brazil, is analyzed, it's possible to realize that they are organizations that still need to develop their organizational abilities in order to achieve their goals, mainly for technologies protection and commercialization strategies, with the purpose to add potential value to the technology and promote its transfer to the productive sector.

Thus, the aim of this paper is to present a process model for the protection and the commercialization of technologies constant in a TLO portfolio, based on IP. Such model was applied to TLO from the Departamento de Ciência e Tecnologia Aeroespacial (TLO/DCTA), a STI of the defense area, in Brazil. This STI is a military institution that has as a mission "to increase the knowledge and develop scientific-technological solutions to strengthen the aerospace power, using teaching, research, development and specialized technical services, at the aerospace field" (CHIMENDES, 2011). From 101 technologies from the TLO/DCTA portfolio, there is no one commercialized to the productive sector before de development and application of the model that was suggested in this paper.

To achieve this aim, an case study in a TLO/DCTA was performed and supported by a literature review, conducting research in relevant books and periodicals on technological innovation and intellectual property, notably relating to the subject protection and technology transfer. Whereas the duties and responsibilities as well as the activities carried out by TLO vary according to the STI, in the case of the STI under analysis, the TLO functions aim to protect and market the resulting technologies from research and development projects (R&D) that are not considered strategic in to support technology transfer to the productive sector. The management of R&D and innovation management is carried out by other STI departments, without the direct participation of the TLO.

Evaluating the activities performed by this TLO, it was observed that it was a set of bureaucratic tasks, with no

ability to make decisions on the need to protect a technology, the type of protection, the market potential of each technology, as well other issues of strategic nature. Since TLO, which handles complex decision-making issues, should be aligned with the corporate strategy and innovation at the STI. Specifically regarding the protection of technology, these decisions should take into account the potential of technology to become an innovation, and the markets where this technology will be more attractive. Thus, only then it is possible to define the best way for their protection, that is, a protection that adds value to the technology and facilitates its the commercialization and transfer.

This article is structured, considering as fundamental literature Andrade, Soto Urbina, Chagas Jr. and Silva (2018), Andrade, Soto Urbina and Chagas Jr. (2017), Andrade, Soto Urbina and Follador (2016), Andrade, Soto Urbina, Follador and Follador (2016A) Andrade, Soto Urbina, Follador and Neves (2016), Andrade, Soto Urbina, Follador and Follador (2016B) and Andrade (2016)), in four parts, including this introduction. The second concerns the review of the literature that deals with the technology protection and commercialization concepts, according by the fundamental literature. The third presents the technology protection and commercialization process proposed, also considering the fundamental literature, and finally, the fourth part presents the final considerations of this study.

II. LITERATURE REVIEW: PROTECTION AND COMMERCIALIZE TECHNOLOGY BASED ON INTELLECTUAL PROPERTY

2.1 Technology protection

According Cruz (2008) from the time when the nations were recognizing the economic importance of applying knowledge to develop technologies, mainly because they perceive that market were ruled only by the competition among prices, but also by the competition between creations or inventions that were transformed into innovations, began the search for ways to ensure the ownership of such knowledge or technologies. However, the big question was: how to ensure the ownership over an immaterial good, which use or the use or disclosure cannot be restricted?

This question points to the need and the importance of protecting the technologies developed by STI. It is the protection, in its proper format that will ensure ownership of the created technology, making the STI to enjoy the benefits arising from the R&D activities. At this moment, Pinheiro (2012) and Chen e Wang (2010) indicate that protection is one of the basic assumptions to ensure the marketing rights

of established technology, and for Silva e Silva (2013) technology protection goes hand in hand with innovation.

Thus, according to Cruz (2008), the solution was the concept of the extension property, originally created for tangible assets on the intellectual manifestations. However, this extension took place without proper analysis of mismatches generated by this type of appropriation. In this context, to ensure profit from the production and marketing of intellectual property, monopoly rights over these assets were created. However, the protection of intangible assets was not able to exist on its own. That is, it needed the support of a supreme and sovereign authority to guarantee compliance with the rules within a delimited territorial space. Thus, the State was responsible for creating and legitimate rights IP.

Such an statement shows the need to assess what are the markets where the technology developed must be protected, because it is not enough to protect the technology only in the market where it was created. After all, the market for use or manufacture may be other, then it is necessary to adequately characterize the market, and only then, to decide on what would be the viable markets, where to protect technology. This review has positive implications on marketing issues of technology.

Also, before you start formatting protection, it is necessary to perform analysis related to technical issues related to the technology created or developed, and to the marketing aspects of such technology.

Aparecido Dias and Silveira Porto (2013) corroborate such a statement and describes that the technology needs to be understood in detail, including its purpose and the problems that it is intended to solve, the possible applications, the identification of the differential in relation to other existing technologies, among other issues.

Still Jungmann and Bonetti (2010), describe that to protect a technology, another important aspect is the definition of its ownership. In other words is necessary to define who really is the owner of the intangible asset. In this same aspect, as Fitzpatrick and DiLullo (2005) pointed out, joint research with other organizations should be regulated through contractual agreements, which should describe how the u are appropriated, marketed and / or used, protecting, thus, the rights of IP. This definition is important because, as Mello (2009) and Leal Souza and Solagna (2014) discussed, like every right to property, the IP is exclusive, that is, excluding third party use and enjoyment of the right of the object, guaranteeing exclusivity and the control of these to the right holder.

These evaluations indicated in the above paragraphs, among others, are important to direct the strategies and instruments for the protection of technologies. Closs et al. (2012) indicate that the TLO is an organization, whose function is to make such assessments.

Thus, the results of such assessments will subsidize the TLO for choosing the most appropriate instrument for the protection of technology. Legal protection is obtained through protection of IP instruments, which are identified as Copyright, Industrial Property and Protection Sui Generis.

Furthermore, adapting de Almeida, Fleet and Barreto Jr. (2012), Bieberbach (2012) and Jungmann and Bonetti (2010), the same technology could have various types of protection, covering different aspects by the use of appropriate instruments IP, depending on the different protection strategies. Using different options for protection ensures a competitive edge even stronger. Caerteling, Halman and Doree (2008) and Dechenaux et al. (2008) reinforce this point, indicating that different mechanisms, namely the terms of protection, affect the marketing opportunities of technology, particularly with respect to the value of the business transaction. However, this will depend on the strategy used by STI, because not always a STI protects a technology with marketing purpose. There is no single strategy for all technologies to be protected, and not all technologies will be protected by patent. For example, for each technology, one must study what is the best protection format, verifying the need of STI, which may include confidentiality (eg. Trade secret), as in the case of a military STI, which may develop sensitive technologies (sensitive technologies, according to Long (2012), are those which are maintained out of access by a particular country or group of countries, because of usafety reasons, and they can then be protected by trade secret). Other approach considers to include protections to ensure a share of the market for the organization that adopts any given technology (eg. patent). Also, it may be that the same technology can have more than one type of protection format (eg. Utility model patent and trademark registration). Also, it can be that a technology can be divided into parts, so that protection is formatted for each part individually. Thus, in the context of diverse protection alternatives, the strategy for the protection of technology should be defined on the basis of assessments, performed preliminarily, as previously described.

Further reinforcing this issue, considering Spivey, Munson and Wurth (2014) and Gonzalez-Gelvez (2013), to protect the created technologies is a key action for STI. However, in order to make this protection, it is necessary that managers of

the TLO devote more time to the formulation of strategies designed to make the best decision about the format of the most suitable protection for each technology. Thus, the formulation of strategies for the appropriation of technologies, adapting Ram (2007), depends on the organizational capabilities of the TLO, the external environment, and the institutions that the TLO interacts.

Thus, according to Al-Aali and Teece (2013), a very sensitive element of the protection of technology through the IP, is the use that will be given to the technology. Thus, a business model should be developed for this technology, with the purpose of supporting the development of strategies for protection, and subsequent commercialization of this technology. After all, once it is known how technology can be used or applied, it is easier to develop such strategies. To that end, Di Minin and Faems (2013) describe that technology, its business models, and the IP management strategies do emerge as three inextricably linked dimensions. Any change in one of these three strategic dimensions has implications for the other two. Considering and adapting from Teece (2010), a business model will articulate and demonstrate the logic of how the TLO and the STI intend to create value, with the technology, whose IP must be managed taking into account its stakeholders. Almeida, Barreto Jr. and Fleet (2012) point out that a business model consists of the following elements: market segments interested in the technology; value proposition to customers/ potential recipients of technology; cost structure; revenue generation; distribution channels; strategic partnerships and organization's position, namely of the STI, in the value chain; and competitive strategy. According to WIPO (2010), due to continuous changes in the IP system, new business models are emerging, challenging the policies and practices already established. These models aim to increase the efficiency and effectiveness in the management of the IP in a TLO.

Thus, considering the possible business models to be adopted, the chosen protection format will impact directly in the marketing process of technologies, as well as in its transfer process to other organizations. Making an allusion to Arora and Ceccagnoli (2006) and Fitzpatrick and DiLullo (2005), efficiency and effectiveness in protecting a technology do increase the propensity or success to commercialize it.

Another point of great relevance in this context is the monitoring of protected technologies, since the violation of IP rights is a huge matter of concern to the holders of the protected technology. Jungmann and Bonetti (2010) emphasize that to avoid losses, STI must be careful to

manage the protection of their IP assets through periodic assessment, in order to identify possible unfair competition. To define the best mechanisms to ensure compliance with the law, by a third party, reduces or limits the amount of law violations in the protected IP, ensuring to the organization the due benefit or return generated by that intangible assets. Complementing to Chaudhry, Cordell and Zimmerman (2005), the problem of unauthorized use of a technology is significant and growing, and the implementation of actions to curb counterfeiting is still a problem for organizations. These situation points to the need to establish mechanisms for monitoring the protected technologies, in order to assess whether there is misuse of technologies in protected markets, or even in other markets. So, that TLO can take steps to rectify the situation. Such monitoring could also be used to seek technologies that are already more modern than the ones protected by the STI, and thus feed back into the process of commercialization of technologies, and also the R & D processes.

Still, considering this question of the violation of IP rights, you can reinforce the need for a proper analysis of the created technologies, and design a business model to use, and only then develop strategies for their protection, because according to Bezerra (2010) and Pisano and Teece (2007), a strong technology protection hampers its imitation and generates economic benefits for its holder. Still, in this sense, as Bezerra (2010) points out, the protection will be considered weak in conditions in which knowledge is easily disseminated and easily accessible, and will be considered as strong as it is higher the difficulty of imitation.

Finally, from the literature review it can be said that the protection is a factor that directly impacts the commercialize and the transfer of technology. The type or form of protection, including the markets where technology is protected, can make the technology attractive for a given organization, due to the competitive advantage that this protection brings with it. Thus, considering Ritter Junior (2015) and Kelm et al. (2014), developed technologies should be secured in the manner that is most appropriate to STI, without ignoring the issues related to the promotion of innovation. It is therefore necessary that the strategies for protection and commercialize are integrated in order to transform the opportunity that new technology offers into competitive advantage. According to Arora and Ceccagnoli (2006), a strong protection strategy translates into a greater reward in the commercialization of technology. And for Bezerra (2010), protection of technologies is presented as a

way to facilitate technological innovation, among other possibilities.

2.2 Technology commercialization

In cases where it's important to transform technologies on innovations, it's necessary that the developed technology by the STI be transferred to an organization that will use it in its process or will embody in their products and services, creating a competitive edge. Along the same line, Jorge, Lotufo and Cortez (2008) describe that a technology protection is relevant only if it was transferred, generating beneficiaries, thus fostering innovation. However, when Teece (1986) is considered, the invention or creation of a technology by a researcher in a STI doesn't mean that it will be automatically transferred to another organization and it doesn't mean that this technology will turn in an innovation either.

For Mattos and Guimarães (2005), the innovation is divided in two parts: one of them is the generation of an idea or the invention itself; the other is the conversion of that idea or invention in a business or, other useful application. Thus, it can be said: Invention + Commercialization = Innovation. This same concept can be applied to the Technologies that compose a TLO portfolio. Thus, the TLO receives and protect the technology developed by the STI. Afterwards, it's necessary that such technology be commercialized by the TLO, and, only, then, be transferred to another organization that will use it, turning this technology into a process, product or service, making it been part of a society, and potentially creating, innovation. After all, considering Chimendes (2011), a technology developed by a STI and properly protected is an asset able to be Commercialized and Transferred.

Since commercialization promotes technology transfer, it's necessary to establish a set of activities for the commercialization of the technologies managed by the TLO, such as: the strategy planning to search for potential interested organizations of this new technology, offer it to the organizations and, negotiate the transfer of it. To Miller and Acs (2013), Chimendes (2011), and Sine, Shane and Di Gregorio (2003), the commercialization of the Technologies created by a STI is an economic event, once, it's a way to generate value, including social value. Still, to highlight what was already said before, the technology commercialization activities are vital in a STI, because there is no way to accomplish a technology transfer, without a previous negotiation first.

The technology commercialization, according to Bandarian (2007) and Shane (2002), involves an expertise to negotiate it by a STI to another organization, and, still, considering Lichtenthaler (2011), Haeussler (2008), Chesbrough (2007) and Teece, Pisano and Shuen (2000), to commercialize a technology is just an strategic issue, which is linked to the competitive forces of a STI.

In the same way, as there is not only one way to protect the technologies, there is not one way to commercialize it either. According to Jungmann and Bonetti (2010) and Rocha, Sluszz and Campos (2009), from the information analyses about the goods or assets of IP, or, about the technologies, and also the interests of the STI, it is possible to define the structure to access to a particular technology, which is more appropriate. Such structure can consider: making licensing or franchising contracts; sell the good to another company or transfer the know-how, create spin-off or start up and joint ventures; encourage the incubation of the companies or the generation of a company with an specific purpose, licensing in the form of cross-compensation to gain access to a partner's technology, among other possibilities.

It is also necessary to point out that in some organizations, such as companies of capital goods, technologies are developed focusing the market needs, aiming its commercialization. On the other hand, in a military STI, technologies are developed for internal usage, focusing its application. Just some of them in that case, just the technologies which present civil and military application possibilities, will be send to the TLO to be commercialized and transferred. These are only a few examples to show that not all technologies developed by a STI have the goal to be transferred to another organization.

In order to explore the commercialization process, it must be pointed out that for each technology a commercialization strategy must be defined. To elaborate this strategy it's necessary to know precisely the technology and also it's potential in the market. Dechenaux et al. (2008) and Lin and Kulatilaka (2006) deepen this definition, describing that to succeed on a technology commercialization, the market information where this technology will be placed must be considered.

Therefore, to Rocha, Sluszz and Campos (2009), on the whole, the definition of a more suitable modality and, afterwards, the means or strategies to an effective commercialization depends on several factors, among them: the stage of the development of the technology (bench stage, laboratory, prototype, validation, etc.); protection existence and its nature (patent, utility model, register, brand,

industrial secret, etc.); demand a specific market; plan of action (radical or incremental); different kinds of transfer contracts (with or without exclusivity); ease of copying by third ones, applicable law to the technology; and investments to end or to place the product in the market.

Still, Still, Altuntas and Dereli (2012) and Rahal and Rabelo (2006) present a set of other points that are critical to promote the commercialization of the protected technologies, such as the technology itself; the nature and the refinement of it, the scope of the technology; identification of points where technology is more fragile or superior to the others that exist in the current market; the qualitative and quantitative benefits realized by the potential user; the necessary time to end the development of the technology to a market; innovation speed diffusion; the entrance barriers; a prototype available; the technical viability; the rapport with others technologies, the inherent risks, the developing company; the technological market needs; the size and the growth fee of the potential market; the short time to the technology get into the market; and, the short term return on the investment.

Based on this two previous paragraphs, and considering Kotha, George and Srikanth (2013), Mohan (2012) and Dong-Hyun et al. (2007) it's possible to conclude that the commercialization process requires a reliable evaluation method from the incoming technology to the TLO. Moreover, according to Barbieri and Alvares (2005), the technology commercialization, as IP, is different from the tangible assets, including those ones that incorporate new technologies, as machines, equipments and productive inputs. It is a business that happens in a highly asymmetrical market, where the buyer doesn't know what he/she is effectivity buying. That's why it is normal that negotiations flow slowly than in the case of business involving well known goods and services. In this case, the reputation of the company that is selling is also another facilitating factor in the negotiations.

Also, according to Feldman et al (2002), the attractiveness that the potential receiver realizes about the offered technology is an enabler factor to the technology transfer. Fujino and Stal (2004) strengthen this idea, describing that to be succeeded on technology commercialization it's necessary that the potential technology receiver realizes how this technology can add value to his/hers/its business

Therefore, even knowing that the processes of commercializing technologies and the tangible goods are different, there is no way to commercialize a technology, before offering it to the market, or, introducing it to potential demanders. So, it's necessary to utilize, as Turani and Tais (2007) and Santos (2003) indicate, communicative or

promoting marketing tools because they have been essential to activities related to innovation. Thus, Fujino and Stal (2004) and Kotabe, Sahay and Aulakh (1996) describe that a marketing strategy should be used to technology commercialization. They argue that there is not a specific strategy, so that the marketing strategies to offer a given technology must be built focusing in such technology, specifically.

Thereby, it is important to carry out an analysis about the possible consumer markets, which would react to develop strategies to the technology under analysis, including the right way to offer it to all potential stakeholders. According to Kotler and Keller (2006), the promotion covers all those communication tools which get the message to the target audience.

In order to offer a technology to its potential demandant, Dias and Porto (2013) and Keinz and Prügl (2010) indicate that for each technology it should be created a business profile, with a short report describing: the real problem that can be solved by the technology in its specific area of application; the market potential, and its growth rate; the replaceable and/or rival technologies; the potential clients or retailers; the strategic options related to technology commercialization (licensing, exclusive rights, a new company starting, etc.). This profile should be sent to the organizations with potential to receive technology, as a way of disclosure.

Another meaningful issue related to the technology commercialization is the definition of the price, or, placing monetary value to an IP. Although relevant, set a price to be paid for the technology demandant is a very difficult point, because there are no completely clear or accepted methods among the technology managers. Aziz, Harris and Aziz (2012), Closs et al. (2012) and Lopes (2008) corroborate such statement when they affirm that a technology valuation doesn't mean to be an easy task. It's just the other way around, it's one of the most critical tasks in an IP management.

Almeida, Barreto Jr. And Frota (2012) and Chesbrough (2010) describe that the price of a technology is determined by the business model used to bring it to the market. The same technology taken to the Market by different business models will ensure in different settlement values. So, it's important to build a business model to support the preparation of a technology commercialization strategies, which include issues related to valuation or technology pricing. This is important because, according to Reilly (2013), the IP value is affected by the actual value of the

future income expected for the technology. Given this business model it's possible, then, to break through valuation. Marques (2010) describes that there is a wide range of models, approaches, and theories that try to value the technologies. Therefore, Ferreira, Guimarães and Contador (2009) point out that it is necessary to look for the necessary subsidies among the available models so that the price can be better valued.

Considering the available models, Lopes (2008) indicates that, generally, the technology valuation is commonly done following three distinct approaches: one of them is based on price (it's about to define the price that can be supported by the acquisition or a construction of an asset with the same utility); another approach is based on the market (uses the prices of the identical or similar active markets); and, the last approach, the one based on an income flow, calculated using utility tactics to convert future monetary values in a present one, so that this value be based on the expectations of a current market about future returns. To apply these approaches, Oliveira and Beuren (2003), describe that accounting can contribute, establishing standards to measure, register and prove the intellectual property.

For Teece (1998), the value of the commercial transactions with IP may vary depending on the sector in which the technology can be placed, and the kind of protection achieved. This way, Alván (2012) describes that one of the most required instruments to pay a STI for its researches are royalties. The royalties are a kind of compensation paid for those who have the IP rights over a technology. According to Jungmann and Bonetti (2010), the value of a royalty fee is commonly calculated as a percentage of a net value from the selling of the products or the licensing services. To establish a fair and realistic value for royalty to the parts on the contract, it's suggested that a solid business model be used. This must include financial settings and calculation of profitability from licensing objects, as well as the economical advantages it might bring in to the licensing company. The royalties calculation is based on: the competitive advantage from the licensing (distinction of the products due to innovation, impact on the production costs, etc.); the competitive edge time connected to IP protection period (e.g.: validity of a patent); the licensing activity of profitability; the market size opened to licensing.

So, the TLO can to use the business model initially made to support the valuation, yet, during the business commercialization of the technology, it's necessary to request the business model that the potential receiving of this

technology intends to apply to it, in order to get a fair value for both parts.

On the other hand, according to Fujino and Stal (2004), for a given STI, the best conditions during a commercialization technology stage do not end when the price to be paid to the technology transfer is settled. There are other aspects to be considered, such as the human resources training, and the possibility to apply and increase the knowledge about the technology transfer. Another aspect that deserves a special attention at the technology commercialization stage, is the drafting of license agreements, where all the previous traded aspects will be detailed. For Garnica and Torkomian (2009), the technology commercialization using contracts that include IP shown present in the reality of TLO, and, as an identified difficulty factor in all processes, the highlight was the slow pace of legal and administrative area for the execution of the contract. They also indicate that it was clear to everybody involved that it was possible to consolidate the partnership quickly presenting at the beginning to the technology receiver that the transaction has a long waiting period and that sometimes there is a lack of information during the procedure, which could be discouraging. According to Davis (2008), a TLO and the potential receiver of the technology must devote efforts to settle a contractual agreement as soon as possible.

To expedite the legal administrative processes, it's possible to make models of processes previously approved by the legal administrative area, and, in these models the aspects of the negotiation with the company which will receive the technology can be included. For Audrey and Sansing (2014), the legal section from STI can help with these new models of contracts.

Still, according to Jungmann and Bonetti (2010), an extremely important issue to the management of contracts of technology transfer is to make a periodic verification of the performance of the licensing object. That is, to monitor if the contract is been fulfilled, from time to time. This type of monitoring is crucial, inclusively, to guarantee the estimated financial return, and it must be seen as a good business practices, to be adopted by TLO, which can be used to detect plausible problems, and to encourage best performance from whom is receiving the technology.

Considering the issues addressed until here, it's possible to observe that the commercialization of protected technology by IP is not a process completely known by some Brazilian TLOs yet. For Harman (2010) and Lach and Schankerman (2004), this theme is little discussed, and they talk about missing international benchmarking on the market. Harman

(2010) supplement their idea describing that technology commercialization lacks of comprehension, organizational support and a proper set of standard for doing such commercialization. However, the definition of the mentioned process must be discussed and controlled by TLO. After all, according to Buenstorf and Geissler (2012), to succeeded on technology commercialization, among other aspects, it is necessary to have a experienced team experience at the TLO that will negotiate the technology itself.

Although this activity won't be controlled by TLO, the commercialization of the technologies, created and protected by IP, is a very important issue because according to Potter, Minutolo and Mainier (2012), Acuña, Schemal and Klein (2011) and Xu and Qin (2010), these activities represent a source of resources to support or to get the return with Research and Development (R&D) developed by STI. According to Albuquerque (2011), one of the most tendencies to STI is a higher level of the charge by its sponsor, by the income capacity of the commercialization results from R&D. This makes STI looks for innovation in its management models, to search for better efficiency and efficacy in its process. Bhargava, Kim and Sun (2013) indicate that the success of the technology commercialization demands practical knowledge of the business. In the same line, Lotufo (2009) describes that increasingly the STIs are trying to adjust their TLO to a development business profile and Martinez (2013) and Araújo (2010) point that it's necessary to boost the commercialization process of the technology with new techniques and management policies, developed to a more effective way to promote technology transfer.

Strengthen the issues described so far, for Granstrand and Holgersson (2013), Abassi, Attar and, Hajihoseini (2012), Buenstorf and Geissler (2012), Ziedonis (2007) and Sung, Gibson and Kang (2003) the protected technology commercialization is not an ordinary activity, but a complex one, which must be emphasized properly by STI, specially by TLO. It's a much more complex activity than to simply analyze the items of the contract, differently from what it is done in most of the Brazilian TLO. Taking this complexity into account, Barboza (2011) and Lichtenthaler (2011) describe that an important approach to IP management in a TLO, and at the same time a big challenge, is to elaborate and draw a strategy establishing mechanisms for the technology commercialization really to happen. In another words, it's necessary to identify the opportunities to commercialize the technology, to plan and take actions

instead of waiting for the potential receivers of it getting in touch.

III. THE PROCESS MODEL FOR TECHNOLOGY PROTECTION AND COMMERCIALIZATION BASED ON IP APPLIED TO TLO/DCTA

Briefly, it was performed a diagnosis of the flow of activities for protecting and commercialization technologies at the TLO/DCTA, as a first step of this case study, are described below:

- A researcher at a STI (or an independent inventor) invented and developed a technology. If this STI had an interest in protecting it and in taking it to the market, it communicated this invention to the TLO, in an appropriate form;
- When the statement of invention is received by the TLO, it evaluates the technical issues related to the type of intellectual protection (eg.: if meets the criteria for the type of protection required);
- When it was possible to protect the invention (technology), TLO could hire an office to draft the application for intellectual property protection, or could do this essay with internal resources, and submit the application for protection to the protective body (in Brazil, the INPI);
- TLO was responsible to makes the control of the "requirements" and the remuneration to be paid;
- The technology was incorporated into the portfolio of the TLO technologies and is available to companies interested in its licensing.
- TLO waiting for a potential company to get interested in doing business (licensing).

Note, therefore, that the TLO has not a proactive role. In this context, none of the protected technology were transferred. which doesn't mean that the DCTA doesn't make the transfer of the created technologies. On the contrary, there are several technologies that were transferred by other kind of arrangements that do not considerate the intermediary help of the TLO. Despite this type of technology transfer, it should be pointed out that this paper is focused on studying the promotion of technologies that are expected to be transferred only by TLO.

So, it was necessary to review the activities already done and create a model of process to point out the issues related to the Technologies Protection and Commercialization. The guidelines to create this model of process, as well as its activities and tools were chosen after analysis of several

TLOs, performed by the authors of this paper along with other researchers, that were developing a public financed project called PRONIT. Results obtained by this project, which included results obtained from the most important universities centers of Brazil, allowed to construct a benchmarking of best practices.

Then, it was developed, by Andrade (2016), a process model to manage the intellectual property in a TLO and applied to manage the technologies portfolio from TLO/DCTA, which is composed by 3 processes (Admit Technology, Protect Technology, Commercialize Technology) and their sub-process. This process model is presented on the Figure 1.

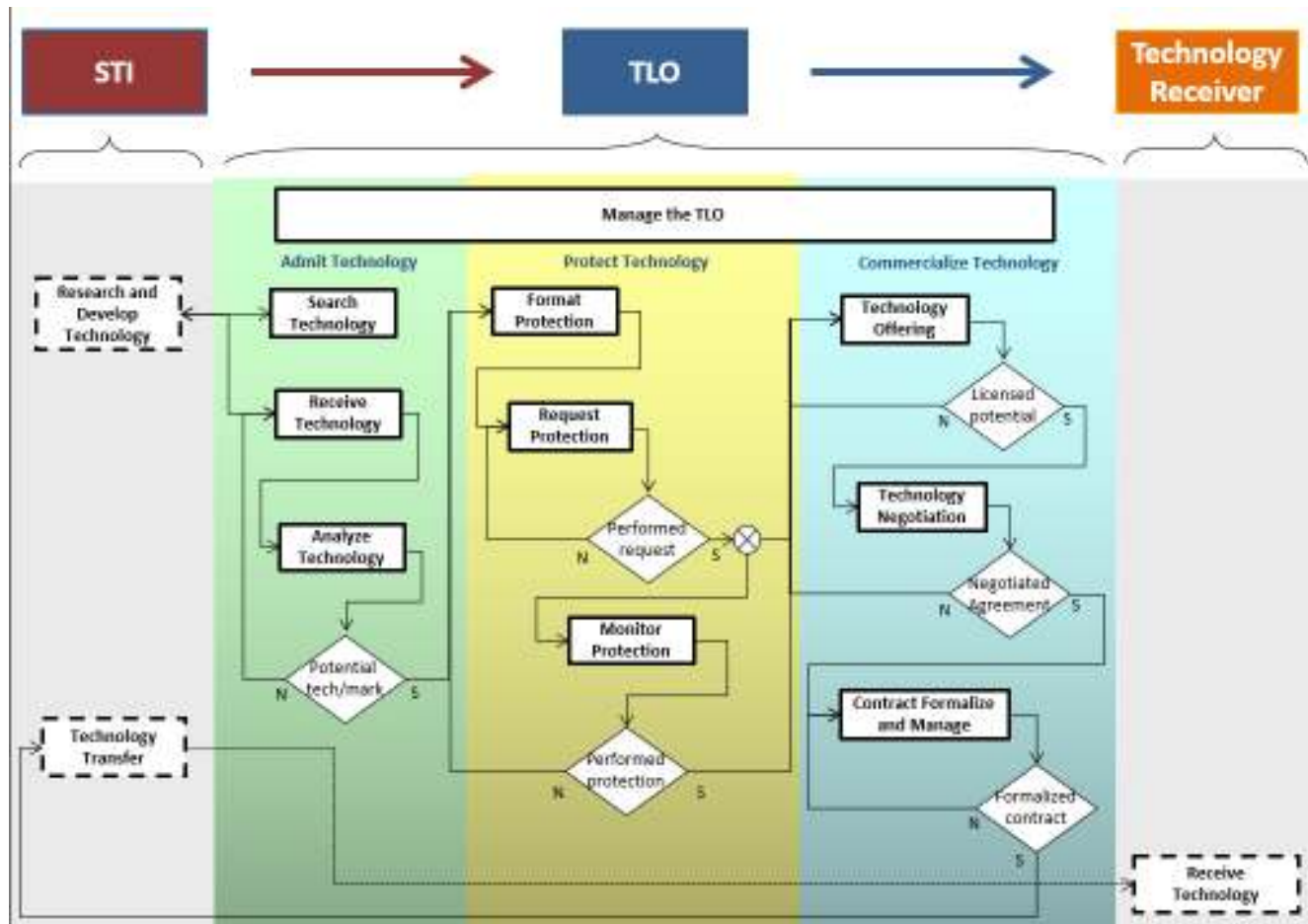


Fig.1: Process model to protection and commercialize the technology in the TLO/DCTA

Andrade (2016)

Theses process model are described below:

- **Admit Technology** (Andrade, Soto Urbina, Chagas Jr. and Silva (2018), Andrade, Soto Urbina and Chagas Jr. (2017) and Andrade (2016)):
 - **Search Technology Sub-process:** this sub-process is the achievement of a diligence to STI to assess whether it has invention or intellectual creation, referred to herein as technology, still not protected. Such due diligence should be performed by a team of TLO professionals and members

of the areas of R&D from STI. The team, to perform due diligence, interviewing researchers at the STI, checks the results of R&D projects developed, including those developed jointly with companies, and at the end of the investigation, describes a report, pointing, or not, invented or created technologies by STI, not yet protected, and which may have the potential for protection and transfer. This report is forwarded to the responsible (higher court) by STI, which

must decide the adoption of the recommendations, or ask or not, the protection of technologies from TLO. In the case of STI decide for protecting technologies found, it must require the protection and transfer of technology to the NIT, which will follow as the process Receiving Technology. This sub-process is justified by the possibility of identifying technologies invented or created within the STI, which the researcher has not identified potential for application, and thus has not requested their protection.

- **Receive Technology Sub-process:** this sub-process is to receive, register and formally verify documents included the protection of applications and technology transfer and opinions on R&D contracts sets with other organizations, submitted to the TLO. Receiving the Protection Application and Technology Transfer, it should be checked all the requirements specified in the rules / procedures / instructions specific TLO, to be observed by the applicant STI. This sub-process is important to identify, preliminarily, if all the elements necessary for the intended protection request are met, and to subsidize the sub-process Analyze Technology, as the technical and market analysis. Reaffirming, in this sub-process, in addition to other items, it is important to evaluate all contracts or research agreements that STI has entered into with other organizations in order to ensure that the rights to the IP, have resulted from this interaction, are safeguarded. With regard to the request for protection and technology transfer, it is necessary to assess whether all documents necessary to promote the drafting of application for protection (Case Protect Technology) were attached to the request, in order to avoid wasting time with the documentation returns, impacting the productivity of the TLO.
- **Analyze Technology Sub-process:** this sub-process is the technical and market analysis of incoming technologies. The

analysis is performed in order to characterize in detail the technology and give its technical and market potential, so that they can support the decision-making process on the protection and commercialization of technology. Thus, beyond the measures listed in item Receive Technology should schedule one or more meetings with representatives of the research unit of STI and the responsible inventor, in order to address any differences and resolve procedural questions, and thus adequately analyze the technology. This sub-process is of fundamental importance to the success of all other processes and sub-processes indicated in this proposal because it is through him that the strategies for the protection and commercialization are developed. As a result, special attention should be given, as an error or mistake in technical or market analysis can mistakenly target the actions of protection and commercialization of technology, including direct to protection technology that presents no technical or market potential for such (protection of a technology that has already Similar to generate better results, for example).

- **Protect Technology** (Andrade, Soto Urbina and Follador (2016), Andrade, Soto Urbina, Follador and Follador (2016A) and Andrade (2016)):
 - **Format Protection Sub-process:** this sub-process is to identify the best form of protection (Invention Patent, Utility Model Patent, Industrial Design Registration Computer Program registration, Trademark, Industrial secret or other more complex forms of protection, or a combination of them) and format protection. This sub-process is justified by the decision on the strategy to be adopted for technology protection and the protection of the adopted format (eg.: drafting the patent application). The items in this sub-process are of fundamental importance because the strategies and decisions set forth herein, and the quality

with which these are performed, influence the potential value added to the invented or created technology. End of this sub-process takes place theoretically for the sub process protection request.

- **Request Protection Sub-process:** this sub-process is to call for the protection of technology, in accordance with the provisions of the preceding sub-process (Format Protection), the competent body (eg.: INPI, STI source technology - in the case of trade secret, or other) and ensure that the request was rejected. In knowledge protection processes, techniques and inventions, attention should be paid to providing for the laws and regulations on the subject, so that it is ensured in a shortest possible time, the privilege of rights, production and / or marketing in selected markets. Protection may be held in the form of statutory or industrial secrets. This sub-process is the implementation of the protection strategy defined and formatted in the Format sub-process protection. End of this sub-process takes place theoretically for the sub process Monitor Protection.
- **Monitor Protection Sub-process:** this sub-process is to monitor the progress of the application of protection, until its consummation, and after that, until the end of its term of validity. After the publication of the deposit protection by the statutory or completed all protection activities through trade secret, you should monitor and control the process, in order to ensure compliance with all legal and administrative requirements for the realization protection as appropriate. Monitoring of protection may be realized in the form of statutory or industrial secrets. This sub-process is similar to a process of controlling, in which case, has three different objectives: 1) to monitor the appropriation of technology, started in the previous sub-process, 2) monitor the misuse of proprietary technology by third parties, and 3) monitor the creation or

invention of similar technologies, and its use. These three elements are important for proper management of the portfolio of technologies in a TLO. This is an ongoing process that provides information to feed himself Technologies protection methods as well as activities related to the commercialization of technologies.

- **Commercialize Technology** (Andrade, Soto Urbina, Follador and Neves (2016), Andrade, Soto Urbina, Follador and Follador (2016B) and Andrade (2016)):
 - **Technology Offering Sub-process:** this sub-process consists of providing intel about the technology, identify the stakeholders (consolidated companies or new ones – spin-off or start-up) and attract them to a possible negotiation with recommendation analysis and technology protection. This sub-process is important because it traces strategies to search for potential stakeholders on the technology and leads the information about it to them. It plays like marketing and promotion. So, the sub-process aims to attract the potential stakeholders on technology to a negotiation of the transfer aspects with TLO. It's a continuous sub-process, and its actions must be held until a potential stakeholder on its transfer and a commercialization contract be formalized. When a letter of interest is received the sub-process should change to Technology Negotiation.
 - **Technology Negotiation Sub-process:** this sub-process consists of the formal presentation of the technology to the stakeholder, besides the main technical and commercial points, related to a better response to the proposal formalization and its closure according to both parts using legal procedures and everything else to keep the information secret. The beginning of this sub-process takes place with the letter of interest from a potential organization interested on the technology transfer, due to the foreseen actions on the technology offering. The technology transfer can be negotiated and done by two

different means: transfer with exclusivity or transfer without it. The definition of the most suitable way of the Technology Transfer is done using drafted strategies, considering the technical and market aspects, the characteristics of the technology, the economic sector and the niche market valued at that moment. The TLO manager with the person responsible for STI have to decide how the negotiation of the technology transfer is going to happen. This sub-process is about the activities related to the protected technology commercialization. It's a vital process, because the terms settled in it will be the terms of the technology transfer to be considered on the formalized/management contract, and, naturally, that will guide the Technology Transfer. After this sub-process is ended, the next step is Formalize and Manage Contract.

- **Contract Formalize and Manage Sub-process:** This sub-process is about a draft contract designed and negotiated at the formalization of the contract and its management activities, to monitor its fulfillment. By the time of the formalization of the contract, the technology transfer can be initiated. During the technology transfer and along the contract, it should be managed. The management of the contract must happen, mainly, as a preventive way to potential problems, because if all the preventive actions were taken and the manage of the contract were serious, problems with the terms of the contract can be avoided. That's why this activity is so important.

Theses process and sub-process create capabilities to make the TLO/DCTA more proactive and dynamic and make this TLO capable of assessing technologies that are forwarded to the TLO, and only then, make decisions, and define strategies for the protection and commercialize of technologies. Such process was successfully implemented, creating the first technology commercialization done by TLO/DCTA.

Afterwards, a pilot study with this same process model was conducted at TLO from the Instituto Nacional de Pesquisas Espaciais (INPE), as reported in Andrade, Chagas Jr., Soto Urbina and Silva (2017). As preliminary results, it was possible to highlight the development of an action plan to realignment the flow of activities as well as to customize the model proposed to culture and INPE-TLO structure.

To enable TLO to carry out its activities more efficiently and effectively, it is important to adopt a management information system, where it is possible to configure the activities provided for in the process model presented, according to Andrade et al. (2017A) considerations.

A technology surveillance system could be implemented within the TLO process framework as a way to collaborate with STI research teams. One of the possible applications for this system is the possibility of anticipating the technologies or technological routes that can be applied to projects under development, or subsidizing the creation of new research projects, as related by Andrade et al (2017B)

This process model can be adapted to other TLOs to assist in intellectual property management and to enhance technology transfer (as reported in Andrade et al. (2018)).

IV. FINAL CONSIDERATIONS

This paper presents a process model for the Intellectual Property Protection and Commercialization performed in a TLO, which allows you to view and analyze the characteristics of the technology developed by a STI, and only then, trace the strategies for their protection and their commercialization. Such strategies should provide the aggregation of potential value to technology. Thus, the strategy used for one kind of technology may or may not be valid or realistic for another one. In other words, for each technology, a different strategy has to be designed.

For a TLO to succeed in the process of protecting and commercializing technologies, thus promoting the transfer of technologies developed in its ITS, it is necessary to go through a technology admission process that enables a thorough analysis of the technology, considering the technical and market aspects. marketing. Only after this, then, should the strategies of protection and commercialization of the technology be elaborated.

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