

The Management of Intellectual Property in the Technology License Office in an Open Innovation Environment: The Context of a Scientific and Technological Institution in Brazil

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Abstract--This paper researches issues related to the management of Intellectual Property (IP) of the results of the Research and Development (R&D) developed by the Competence Center for Manufacturing (CCM) of the Technological Institute of Aeronautics (ITA), which is considered as an Scientific and Technological Institutions (STI) that works in an Open Innovation (OI) environment, involving interaction among some STI with companies. The OI model is different from the closed model because it encourages innovation, not just with ideas that come from inside of the organization, but, also, with the ones that are outside. When the subject is R&D, in an OI environment, where there is an intense cooperation, the IP rights division is not an easy work. In such context, it is important to have an effective management of such IP rights. In order to develop this task, an action-research was done in the Technological Licensing Office (TLO) that supports the CCM of ITA, in Brazil. Based on this research, it was possible to suggest to the TLO the development of a process to search and identify technologies created at STI, giving the TLO higher proactivity to design guidelines for to the R&D teams in the referred STI.

I. INTRODUCTION

The development of the Science and Technology is vital to solve the problems presented by the nations, because, according [13], science searches to explore unknown limits through curiosity, discipline and creativity to fill the gaps and the society needs". The author, Scientific research is part of a nation's culture, that considers, above other things, the need to learn how to use knowledge, and emphasize that "otherwise, to wish for modernization and the competitive raise of the nation will be just a rhetorical question.

References [8], [25], [34], [49], [50], [55] and [57] maintain that technological innovation is an essential tool to drive the economy, raise productivity, competitiveness and sustainable advantages of the organizations, assuring its market survival, as well as leveraging the economy development of countries or regions.

To improve the technological innovation, nowadays, in Brazil, efforts have been done to promote such innovation, like tax incentive, projects financing and trades between public and private sectors, and also legal mechanisms that allow technology transfer, and then, economic development.

References [3], [19] and [35] emphasize that a key element to the economic development is the relation among

companies, Scientific and Technological Institutions (STIs) and the government, which would happen through a specific approach called triple helix, that is is directed to innovation policy which includes issues related to Intellectual Property (IP). In triple helix, according to [33], the STIs contribute with the creation of the scientific knowledge and also contribute preparing human resources. Companies convert knowledge in assets to society, creating, through the needs of the productive process, new scientific demands. The Interaction among STIs and companies allows the creation of a virtuous circle trading scientific and technological knowledge, which is being able to generate the socioeconomic development. Government is responsible for regulation, control and elaboration of the support policies that govern the interaction between these partners. Reference [26] indicate that using this approach, STIs are an important link to the economic development, because they are involved into the generation and capitalization of knowledge, which includes technologies.

A STI is an [7] agency or entity of public administration whose institutional mission, among others, perform basic or applied research activities of a scientific or technological nature (i.e.: research centers and universities).

The aim of this paper is to describe the management of the IP in an open innovation environment, considering the interaction among STI and different companies, based on Research and Development (R&D) activities. In such context, this paper considers the issues related to IP management, that has been performed by the Technology License Office (TLO) from a STI. As a specific goal, this paper aims to present a proposal to search for new technologies that may be appropriate through the IP.

To develop this work, an action-research methodology was performed in the TLO from Departamento de Ciencia e Tecnologia Aeroespacial (TLO/DCTA), and then, it was complemented by a case study at Centro de Competência em Manufatura (CCM), from Instituto Tecnológico de Aeronautica (ITA), that consists in a multidisciplinary environment that develops researches and solutions to the industry development. Both, DCTA and ITA, are considered STI.

In the context of open innovation, [13] reports that increasing the number of the researchers in the companies is very important, just the Innovation Law says. However,

according to the author, based on the UNESCO science report -2010, in Brazil only 38% of the researchers are in a private sector, which means that in such sector there are 1,30 researchers per each thousand workforce people, against 5,53 in Spain and 9,17 in South Korea. In this line, [54] describe that big companies are facing difficulties to keep the innovations development. This happens because of the high costs and development risks. Those two aspects described, just as examples, reveal, even more, the need for interaction between STI-Company. This interaction, concerned to the R&D, is considered relevant in Brazil since innovative activities are considered unique, and they require much more collaboration among the different groups of experts. This is necessary also because there is always a great uncertainty about commercial results. In addition, it's considered relevant, because, according to [13], the transference of the results of scientific production and technological innovation can lead society and nations to richness.

II. MANAGEMENT OF INTELLECTUAL PROPERTY IN AN OPEN INNOVATION CONTEXT

Considering questions about open innovation, which includes interaction STI-Company, it's vital that the IP system constitutes a milestone for the transactions that involve sharing information and know-how, as well as joint efforts to create innovation.

The IP system, according [56], 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. The industrial property has as its object patents and utility models, trademarks, industrial designs, geographical indications, trade secrets and unfair competition repression, being regulated by Law No. 9,279/96. Copyright focuses on subjective character of interests, because basically reflects the authorship of intellectual works in the literary, scientific and artistic field, examples of which are: drawings, paintings, sculptures, books, conferences, scientific articles, music, movies, photographs, software, among others, being regulated in Brazil by Law No. 9.610/98. The sui generis protection involves the topography of integrated circuit, to cultivate, as well as traditional knowledge and access to genetic resources, each type of protection regulated by specific legislation, which are, respectively, Law No. 11,484/2007, Law No. 9,456/97 and Decree 4,946/2003. In this paper, the focus is the industrial property.

The IP system is, therefore, the pillar that holds together the open innovation process itself, so that it's possible to build and keep a friendly environment for innovation, which offers information and knowledge, promote and protect the investments.

For [2], the strengthening of the politics related to IP in a STI has impacts on the technology protection activities

directly, at the same time that makes possible transfer technology to the productive sector. Still, according to [6], [51] and [51], the IP system is a legal mechanism that seeks to ensure technology protection, innovation and, by consequence, economic development.

The Law 10.973 [7], called Innovation Law, requests that STIs have TLO, to manage their innovation policy, which include issues related to IP. Considering [42] and [51], to have an IP strategic management, which is an important encouragement to technological innovation; it is also necessary to do a detailed and comprehensive interpretation of the environment where the company and technology will work.

So, in an open innovation environment, according [10], the STI-Company interaction is steady and uses deliberately internal and external flows of knowledge to rush the process of technology generation. Thus, TLO should have more proximity to researchers, and to other people that work in this environment, in order to enhance the protection and promotion of the transfer technology that have been developed, to the productive sector.

References [17] and [31] report that in an economic global setting most of the companies are paying more attention for new potential technologies for innovation, because that innovation is considered as a key driver of competitiveness.

The Law 10.973, according to [4], indicates that innovation is the introduction of something new or improvement in a productive or social environment that results in new products, process or services. Still, the Oslo Manual, according to [43], suggests that innovation is the introduction of a new good or service or its meaningful improvement, or a new marketing strategy, or a new organizational method on business practices, in the organization, at the workplace or in the external relationships, since that innovation can happen inside of a company or can implicate in an acquisition of goods, services or knowledge of external sources. In the same line, Freeman mentions that innovation is about the word *innovare*, in Latin, which means do something new, and the innovation process happens when opportunities are turned into new ideas, putting them into practice.

For [14], innovation, when understood in its wider sense, involves a number of steps that can begin with R&D activities until commercialization, and those processes themselves occur in multiple forms of organizations of the public and private sector, or both cooperating. This last method, the public-private relationship has frequently been a target of the policies of the governments that are designed to encourage R&D activities. Those activities are in usually the most complex of the innovative process, due to the greater need of tacit and complex knowledge involved in its execution, as well as to the higher uncertainty involved on these projects. Thus, Innovation Law has as one of its intentions the encouragement of this kind of activity.

There are mechanisms that can be used to promote innovation, however in this study, it will be addressed the

R&D collaborative process, STI-company, and in particular, aspects related to intellectual property management.

A. R&D in an open innovation environment

Considering [41], in a company, R&D is one of the most complex processes and it is related with almost every other functions in an organization. To develop a technology, it's necessary to have information and members with different functional skills, like a multitasking activity, at first. However, companies do not always have the information or skills required, or even, many of the professionals involved in the R&D process have only a partial view of the whole, due to the specifications of their work, which can be classified as experts or generalists. In the first case, experts have an extensive experience in a technical area, but very few contacts with other organizational and business aspects. On the other side, managers who have integrated knowledge of the business may not know the technological aspects of the product deeply. So, you can observe that companies don't bring together all the skills needed to do the R&D activities. These lacks of all skills turns the process time-consuming or still it does not achieve the desired outcomes.

Also, according to [30], the product lifetime sets how important innovation is. Because every product has a lifetime (introduction, development, maturity and downfall), the innovation and renovation process has to be cyclical. However, for each cycle, variables change, whether because of market changes or new technologies emerge. That implies that R&D requires high level of investments and expose companies to risks, because when a new project starts, it's not possible to guarantee that the expected results will be achieved. About the companies' investments in R&D, [14] and [39] describe that this is a very important question and that it implies in governmental actions.

So, the organizations of all segments and sizes are motivated to search alternatives to promote innovation. One of the alternatives is about interaction between STI and companies, for R&D. Partnership between STI and company allows to reduce de amount of investment from the organizations on the research and development projects, at the same time it also minimizes and shares the risk of failure on the project, besides, it reduces deadlines. This relationship also benefits STI because it allows the results application of its conceptual project, in a way that it can develop, even more, the knowledge, and, still, have resources to support its research projects through companies. However, R&D cooperative projects are not about an outsourcing of the activity, but about sharing knowledge, skills and resources between STI and companies.

In this line, [20], [46] and [47] indicate that the innovation process is getting more and more collaborative, joining the creation of research nets and integrating STI and companies. Reference [37] describe that in a sound economy, technology innovation must be the result of an environment that produces high tech science and the direct and indirect influence of the

productive sector. This collaboration process between STI-Company is called open innovation.

For [11] and [24], open innovation is a model in which an organization applies external sources in its innovation process, and they are grouped in different categories, depending on the level of the development with external partners, suppliers and clients. Open innovation demands an honest environment, with open dialogue and mutual trust. The open innovation techniques are similar to network practice, as well as in the case of the access to external sources of cooperation, the external relationship, opening up trading relations, learning and sharing, among others. The network relations can be considered as a key to access knowledge from the outside environment that came from external places from the organization. According to [18] and [44], open innovation comes from a open-mindedness process, in which a culture that appreciates external skills and knowledge is vital for your practice.

For [12], [44] and [53], open innovation model is different from the closed one because it makes possible not only the success of the organization with internal ideas, but also with the outsider border. Still, for [24], open innovation request coordination and synchronization of the process over the different departments and companies. It's necessary that the idea can be not just a hypothesis, but something concrete/achievable. To establish both external and internal cooperation is essential to get open innovation. And, according to these values, the innovation idea extent itself for new ideas implementation, both external or internal, which consequently would help companies to achieve competitiveness.

Nevertheless, this is a complex interaction, since that it happens in a scene where the people responsible for the research programs and the ones responsible for the innovation process, in the STI and in the companies, work with different conditions, methods, deadline, worries and goals. So, reference [5] indicate that the cooperation development between STI and company suffer with legal matters in the STI, which impair a closer approximation between companies that work in this area. Therefore, [36] indicates that it's essential to stimulate this cooperation process.

The Guidelines for Collaborative Research and Knowledge Transfer between Science and Industry, according to the [45], presents a summary of the recommendations for research in an open innovation environment to companies, ICT and governments:

- Develop an strategic view on how collaborative R&D activities and technology transfer will help all parties to achieve their goals;
- Define the policies, report them, and assure understanding and alignment;
- Line up, with transparency, from the various partners involved, interests and expectations;
- Apply consolidated practices and adopt them as standard procedure;

- Provide high quality professional support for the management of the collaborative research and for the technology transfer;
- Develop programs and learning environments so teams can get the inherent skills for open innovation (projects management, entrepreneurship, business development, intellectual property management, etc.);
- Achieve an effective intellectual property management, that makes easier to add value in a context of open innovation, maximize the potential for commercialization and motivate future research investments;
- Approach the innovation in an interdisciplinary way, including the innovation in the business model, design, etc.; and,
- Encourage advanced research, high quality education and training and the creation of a TLO with competent professionals inside the STI.

For [24], the capture of external knowledge, through established flows between companies to reach new markets, becomes more efficient when establishing knowledge networks. Open innovation includes use, for the companies, of external innovation sources and the ability to monetize their innovation, without internal solutions needs. There are leverages on searching external technology. Still, there is also, dangerous on ignoring them on behalf of their own technology.

For [16], it's important to highlight that the interaction STI-company is not a magical solution for the troubles and challenges from STI and companies; neither an easy process, with no resistance and opposition. What it's possible to observe is that, besides all the hard things that comes with the process of technological cooperation, it is still possible to align the interests and needs of the academic and business sector adopting more flexible, efficient and effective working practices. So, the academic and cooperative activities can be compatible. In the present context, STI has to participate, stirringly, of the economic and social development as provider of knowledge and professionals ready to face the new reality; on the other hand, corporate segment also needs to participate of the actual technical scientific discussions, to instigate the organizational learning and confirm de social economic development of the country. In other words, the cooperation STI-company is the major driver of the technological competitiveness.

For [22] and [23], there are many mechanisms available that make the cooperation STI-company viable. Among this mechanisms, technology and innovation management on STI, assume a coordinating role on maximizing cooperation opportunities, as well as on working for the improvement of the scientific and technological knowledge available on STI or even using this interaction, making STI more present and effective. In other words, to succeed in this relation, there must be a good management of this activity, which includes the management of the questions related to intellectual property.

B. IP management

For [29] and [44], the management of the intellectual property can be defined as a kind of management that refers to creation, use and transfer of the intellectual resources. It is about making decisions, strategic planning, organization and control, innovation and cultivation of human knowledge to raise the competitiveness, and also, promote the organizational development process. Reference [4] describes that the aim of the intellectual property system is to benefit the economic and social development, promoting the creation and the knowledge circulation and provide its transformation in value for the companies and consumers.

When the subject is R&D activity in an open environment, where there is an intense collaboration, the division of Intellectual Property is not an easy task. So, according [21], the researches that were made with other institutions must be controlled by contractual arrangements, where it must be described how technologies will be suitable, commercialized and/or adopted, so the IP rights can be guaranteed. This definition is important because, according to [32] and [38], just like every property right, IP is exclusionary, this means, it excludes third parties from using the copywrites, assuring the exclusivity and control of it to the right holder. However, considering [28], it's important to highlight that the IP contractual terms must be arranged very carefully, so it can be possible to allow its protection and prevent that the patents become a cut-off market mechanism for the partner of the productive sector, with whom the research was done.

The Technological Licensing Office (TLO) from one of the STI is responsible for accepting, or not, the contractual terms done, specially, in situations called, according to [10], as open innovation. So, TLO must be very careful identifying or making proposals that define, according to [1], the division of the intellectual property ownership arising from the futures technologies that will be developed, so it is not the object of a future dispute or harm the relation between STI and organizations.

For [16], until R&D corporative projects appropriate themselves from the created technologies, the organizations, the same at STI and companies, face great difficulties to establish a balance between what should be hold as a secret, and what can be public domain. So, for [48], it's important that STI has tools capable to identify new technologies that can be appropriated and, promote decisions about how to protect them, and consequently, about how to promote the transfer of the technology. Technology transfer is one of the major steps on R&D process, that, when succeeded, add economic and social value to the available resources for the research.

Considering [22], [30], [40] and [44], the arrangements for a healthy relationship between STI and company have been widely discussed. However, the changing processes involving organizational culture are progressive, requiring time, and demanding a continuous and persistent action to succeed. To promote such change, it should be applied tools

related to an honest communication structure, which must be aligned to mechanisms, metrics, tools and stimulating actions for a proper environment to innovation.

III. THE CASE OF ITA/CCM AND TLO/DCTA: AN OPEN INNOVATION ENVIRONMENT

The description of this item is based on an action-research placed at TLO/DCTA and in a case study that was conducted at ITA/CCM, with information provided about ITA/CCM, according [9] and [27].

The Instituto Tecnológico de Aeronáutica (ITA), founded in 1950, is one of the STIs belonging to the DCTA, which works for the aerospace science and technology Brazilian interest. ITA has an important history of success at the teaching area as well as a R&D relevant in the national scenario, as a sponsor of the national industry. In fact, ITA had an active participation during the development of the plane, named Bandeirante, in the 60's, which originated the national air force industry. Still, ITA had an important role in the development of the aerial sector, and in the civil defense, whether on the research activities or creating important SIT (IAE, IEAv and INPE), and/or even in the industrial sector consolidation (EMBRAER, AVIBRAS, ORBISAT, SAFRAN, MECTRON, TECSIS, among others).

ITA's Centro de Competência e Manufatura (CCM) can be defined as a laboratory or a multidisciplinary environment, which develops researches and solutions to the industry development, encouraging innovation in the manufacturing sector.

It's about a laboratory that works with researches to solve the problems presented by the companies that, through agreements, establish partnership for R&D with focus on the solution of the problems. The CCM's task is to develop a human and technological capital and reputation to apply the engineering knowledge, in managing the development cycle of the product, and to optimize a high-level manufacture. Its position is to allow access of all manufacturing industry to new production technologies.

Between the years 2011 and 2013, 124 projects were executed in partnership with companies totaling a financial injection of R\$ 55 million from industries and R\$ 18,5 million from funding agencies. In total, approximately 100 companies were covered in the last three years.

Still, the main industry sectors that were benefited with these projects were [9]:

- Automotive Industry
 - Fast technologies: materials and processes development.
 - Digital manufacturing: optimization of the factory design, processes simulation, automation processes, remote surveillance.
- Aeronautical Industry
 - Fast technologies: materials and processes development.

- Machining: Difficult tooling materials (Ni, Ti), high speed cutting (HSC), manufacturing assisted by computer (CAM).
- Manufacturing and metrology process automation.
- Steel and Metallurgy
 - Machining: Difficult tooling materials (CGI, ADI), processes optimization, manufacturing assisted by computer (CAM).
- Energy and Environment
 - Sustainability in manufacturing processes.
 - Public policies for the development of Small Hydroelectric Plants: Turbines development, Machining of complex parts (rotors palettes, turbine compressor).
 - Biodiesel development: tribological analysis.
 - Digital manufacturing: drawing factory optimization, processes simulation, automation processes, remote surveillance.

The agreement or scientific and technical cooperation contracts done by ITA/CCM are made with Fundação Casimiro Montenegro Filho (FCMF), and in this case, it's responsible for the administrative and financial management of the research projects, development, innovation and technological qualification.

Nowadays, CCM count on with 36 professionals, among teachers, researchers, students and expert people, working on projects of technology development. For a company all by itself to have all this contingent at its disposal, it would necessary to have a relevant investment, that is taken in a cheaper way, when a partnership with a STI happens, as it is the case of the CCM.

With R&D collaboration, it's possible to broaden its various possibilities for innovation, recognizing the importance of the external sources of knowledge for the innovative process of the companies. With that, one of the freezing points of the innovation concept is the construction of new knowledges. That knowledge shall be properly and strategically managed, in both, companies and STI. In this paper the focus is the work on STI. To manage properly that knowledge it's necessary to approach issues related to intellectual property.

Thus, the settlements or technical scientific cooperation contracts agreed between ITA/CCM and the companies shall provide contractual terms that refer to ownership division of the intellectual property, and the participation features over the exploration of the creation that has resulted from the R&D joint activities, as well as the inclusion of security measures and/or confidentiality agreement of the information that has been considered important. According to [27], ITA has a Regulatory Standard written by the Rectors Council that defines the ownership and co-ownership of the intellectual creations arising from the results of the research and teaching processes development; research and extension that have been developed at ITA. The same applies to the profit distribution as a result of the technology transfer. This policy

determines that every creation or innovation that has come from the activities that happen inside ITA facilities or with its resources, means, data, information, knowledge, and equipment can be source of protection from the intellectual property rights, as ITA's judgement. It will always appear as an exclusive ownership or co-ownership over every creation or innovation resulting from the researches, activities and studies developed at the Institute. It should be pointed out that others stakeholders responsible for the creation or innovation, will be named designers/inventors.

The ownership division of the intellectual property and the shareholding of its commercialization should happen in the same amount of the knowledge value added to that has already existed in the beginning of the relationship, and taking into account the human, financial and materials resources allocated by the contracting parties, like mentioned earlier. Before the contract signature or agreements, a draft shall be sent to TLO/DCTA for evaluation and statement.

The TLO/DCTA is responsible for protection and commercialization of the technologies from Aeronautics Command scope which includes ITA. Local responsibility, at ITA, for the issues regarded to intellectual property is shared between the Dean of extension and cooperation, with strategical action, and the Information and Documentation Division, with operational and administrative action. In relation to the procedures adopted at ITA, it's possible to highlight, according to [27]:

- Spread and strengthen the culture of intellectual property and innovation;
- Support and encourage companies with technological base, through pre incubation companies;
- Contribute to the creation and consolidation of the business start-ups, based on an innovative scientific knowledge;
- Promote licensing and transfer of ITA's creation, through assessment and commercialization of the technologies, partnerships prospection with public or private, national or international institutes;
- Bring the academic community closer to the private productive sector, transferring knowledge; and,
- Protect Intellectual property from ITA

The strategic management of the technologies that were created as solutions for the problems that were presented by companies to the STI must be a STI concern, to ensure the retention of their rights and commercialization, so the possibility to obtain gains with that technology in strategic markets are guaranteed. In that context, ITA has 19 protected technologies, according to the intellectual property right. CCM has developed several projects, as mentioned before, however, only two technologies were suitable.

IV. THE IP MANAGEMENT DISCUSSION: A PROPOSAL TO TLO TO SEARCH FOR NEW TECHNOLOGIES IN THE STI

That situation, described in the item 3, presents an opportunity for the CCM. One proposal is the strategic use of this technology from R&D project with companies, safeguarding to ITA/CCM the property of the created or developed technologies in those projects, regarding issues related to co-ownership. That way, ITA/CCM could use this innovation/creation in other opportunities, to facilitate the knowledge trade, as it happens in technology contracts.

Complementing the previous proposal, CCM could create an internal committee, also constituted, by members of the Dean of extension and cooperation and/or the Information and Documentation Division, to analyze the results of the developed projects, to evaluate the possibility of protecting, by intellectual property, the results of those projects. That committee should, also, assess scientific publications and further ways to disclosure the projects results, to ensure the appropriation of those technologies.

Still, this situation leads to another very complex question: TLO are not properly prepared and qualified to act in an open innovation environment. There are too many administrative obstacles, created in this environment, for the technologies appropriation and its subsequent commercialization and transfer. It's necessary to adapt TLO with tools that facilitate the STI performance in projects of open innovation.

So, it's has been proposed to TLO/DCTA to structure a process to proceed a diligence to the STI, in order to evaluate if it has any invention or intellectual creation that is not protected yet. Such diligence should be done by a team of TLO's professionals and members of R&D areas working at the referred STI. After the diligence, the team should interview STI researchers, verify R&D projects results developed by them, and, at the end of the diligence, to make a report, pointing out the cases of the invented or created technologies by STI, that are not still protected, and that has potential to be protected and transferred. This report must be submitted to the STI responsible, who must decide if the recommendations will be adopted, which means, ask or not technologies protection for the STI. This procedure is important because of the possibility to identify new technologies that have STI requirements, but weren't identified by the researchers yet. Which means, that the protection was not still requested. Also, it is necessary, in order to identify and prioritize the technologies that should receive protection.

V. FINAL CONSIDERATIONS

There are several cooperation possibilities between a STI and a company. This cooperation brings many benefits for both organizations, among them, enhancing competitiveness. Particularly on STI, in this case, about ITA/CCM, some of

the benefits are: insights, better researchers training, financial resources for the group of projects, scholarships for students in scientific initiation and technological development, master's degree, PhD and post PhD, among others.

About IP management, it was proposed a process which allows to search for new potential unprotected technologies. Such process provides the TLO a better proactivity and brings it closer to the R&D teams of the STI, increasing the appropriation of the technologies created and, also, the technology commercialization and transfer.

Also, it's possible to conclude that few mechanisms to manage IP in R&D cooperative projects in an open innovation are known. So, in practice, there are several issues that shall be better approached to facilitate the appropriation of the created technologies. In this line, it's suggested that those questions were approached in future projects.

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