RESEARCH ARTICLE OPEN ACCESS

Risk and Success Factors in Technology Transfer

Herlandí de Souza Andrade*, Messias Borges Silva**, Adriano Carlos Moraes Rosa***, Vanessa Cristhina Gatto Chimendes****,
Milton de Freitas Chagas Jr.*****

**(FATEC - Faculdade de Tecnologia de Guaratinguetá, UNESP - Universidade Estadual Paulista "Júlio de Mesquita Filho" – Campus Guaratinguetá, Brazil. Email: herlandi.andrade@fatec.sp.gov.br)*
*** (UNESP - Universidade Estadual Paulista "Júlio de Mesquita Filho" – Campus Guaratinguetá, Brazil, Email: messias.silva@feg.unpes.br)*
****(Faculdade de Tecnologia de Guaratinguetá, Brazil. Email: adriano@fatecguaratingueta.edu.br)*
*****(Faculdade de Tecnologia de Guaratinguetá, Brazil. Email: vanessa@fatecguaratingueta.edu.br)*
*****(Instituto Nacional de Pesquisas Espaciais, Brazil. Email: milton.chagas@inpe.br)*

ABSTRACT
The Scientific and Technological Institutions research and develop technologies that can be transformed into innovations, when these are transferred to the productive sector in appropriate conditions. The transfer of technology is a process of exchange of knowledge and technological skills performed between two organizations, involving several actors, with pre-established rules and strategies. The transfer of technology is a phase in the process of scientific and technological development considered as of great importance, because when it is successful, it adds economic and social sense to the resources made available for its development. The objective of this article is to report the main risk and success factors for transferring technology from one scientific and technological institution to another organization. At the end of this research, we arrived at the definition of a series of critical factors for the success in the transference of technology.
***Keywords*:** intellectual property, technologic innovation, technology transfer.

Date of Submission: 11-08-2017 Date of acceptance: 09-09-2017

I. INTRODUCTION

Currently in Brazil, efforts are being made to promote technological innovation: tax incentives, project funding, and public-private sector interactions are driving the development of legal mechanisms that allow Technology Transfer (TT). As an example, we can cite the Brazilian Law of Innovation (Law 10.973 sanctioned in December 2004), where it was required that the Scientific and Technological Institutions (STI) have Technological License Office (TLO) to manage their innovation policy.

To innovate is to carry out a special kind of change [13], which takes place when new ideas result in the creation or improvement of products, processes or services. And, the fundamental reason for the constant search for technological innovation comes from the need to be competitive.

Innovation occurs when there is a successful commercial exploitation of a creation, in this case, of a technology. However, in order for this commercial exploitation to take place successfully, the technology receiver must appropriately appropriate itself in all respects. Thus, TT is one of the most important stages in the process of scientific and technological development, which adds economic and social meaning to the resources available for this purpose.

In this same sense, TT is the managerial process of communicating an idea [7, 15], in this case, a technology, for its adoption by another part. Still, technology moves in many ways, and to be valuable, technology must be in use. Thus TT is central to the growth and maturity of most types of social organizations, including business, government, and STI. However, in reviewing the literature, it is possible to verify that there are few publications that report on the success factors for the transfer of a technology, from a STI to another organization. The search for these factors is what justifies this article.

Thus, the objective of this article is to identify and analyze what are the main success and the risks factors for TT, based on Intellectual Property (IP). For the development of this article was used the bibliographic survey as method, conducting researches in the main periodicals and books on the topic TT based on IP. An action research was also carried out in TLO of two STI of the aerospace sector, in the São Paulo State, in Brazil, with the participation of STI researchers that these TLO attend.

II. TECHNOLOGY TRANSFER

In the Innovation Law, to be configured as novelty, a technology must be absorbed by the productive or social environment, that is, concretized in the form of a process, or product or service available to society. To ensure benefits to the STI that developed it, such technologies must be appropriately appropriated or protected.

In order to guarantee the appropriation of the creations, in this case, of the technologies, there are several mechanisms related to IP. IP refers to the branch of law dealing with legal protection granted to all creations of the human mind, such as inventions, literary and artistic works, symbols, names and images used for purpose commercial [9, 19]. IP is divided into three categories: copyright, industrial property and sui generis protection. This division is shown in Table 1.

Intellectual property	Author Right	Copyright
		Related Rights
		Software
	Industrial Property	Trademark
		Patent
		Industrial Design
		Geographical Indication
		Industrial Secret & Unfair Competition Repression
	Sui Generis Protection	Topography of Integrated Circuit
		To cultivate
		Traditional Knowledge

Table 1: Intellectual Property Modalities [10]

The same technology may have several types of protection [1, 2, 10], covering different aspects, for the appropriate use of IP instruments, depending on the Different protection strategies. The different mechanisms or conditions of protection affect the opportunities of commercialization of the technology [3], especially with respect to the value of the commercial transaction. However, this will depend on the strategy used by STI, as STI does not always protect a technology for the purpose of commercialization. In this way, using distinct options for protection ensures a stronger competitive differential.

To define an IP valuation policy is of fundamental importance to the TT process. In this sense, the first obstacle is the absence of an effective innovation policy and/or an IP policy in the TLO. But the absence of this type of policy should be transposed by TLO to fulfill their objectives adequately, mainly through the formulation of strategies for the protection and commercialization of appropriate technologies through IP.

Technologies protected by STI will only become an innovation when they are transferred to companies, which will put them into practice and at the disposal of society. In many situations, the issues related to the technology commercialization process, marked by technical and commercial trading activities, are called TT. In this article, the distinction between these two terms is made. The TT term here refers to the activities of transferring knowledge about a particular technology, in order to enable the organization receiving this technology to use it, for the purpose for which it is intended. The TT starts after the technology is commercialized.

TT is a complex activity and involves several organizations. These factors can be seen in Table 2.

	Fatores de Risco	Fatores de Sucesso
Technology Acquisition	• The ability of the holder of the technology to transfer: it is not enough to stop. • Buyer's ability to absorb technology: technical training compatible with the complexity of technology. • Implementation of the necessary physical structure: compliance with the rules of Law 8.666 / 93 and the established schedule. • Compatibility of the health legislation of the countries involved. • Emergence of new technologies or products during the execution of the contract: when not foreseen. • Oscillations in product price: international market & dumping. • Demand fluctuations - change of the quantity of products by the buyer (MS).	• Increase in institutional technological capacity: - human Resources - infrastructure - incorporation of a new production platform that can serve as the basis for a range of products. • Incorporation of technology.
Technology Offer	• Ability to prospect partners. • Ability to identify strengths and weaknesses in technology for greater success in valuation and negotiation. • Scope of patent and protection in competitive and strategic markets. • Empirical stage of the projects: need for greater financial capacity of the partner for the development & venture venture. • Development cost x remuneration for the transfer. • Division of markets (ex-Mercosur).	• Dissemination of technical knowledge. • Quality of Science: publications / respect in the S & T community / researcher support for interaction. • Financial return: to feed R & D and motivate inventors. • Effective contribution to reducing economic vulnerability.
Joint Development	• Mutual interest in the development and application of the knowledge generated. • Effective know-how of developing parties in products with high added technological value. • The need for significant investments and the ability to manage the contracts and results obtained.	• Exchange of know-how. • Increase of the technological capacity of the parties. • Optimization of the Parties' technical and financial capacity to measure innovative results. • Co-ownership of patents and possibility of economic gains.

Table 2: Risk and Success Factors in TT [6]

Concerning a context favorable to TT, four critical points must be taken into account [12, 18]: the first is the intention, regarding the determination of the receiver in learn what was transferred; The second is receptivity, associated with absorption capacity and exploiting the potential of technology transferred; The third is the transfer level, which refers to how explicit the transmitted knowledge is; And the fourth is transparency, associated with the willingness of the transferor to release information and explain critical points and difficulties related to what is being transmitted.

In order for knowledge accumulated in STI to be effectively useful for economic and social development [8, 14], there must be a willingness to cooperate between business and STI in order to transform knowledge into wealth. TT is, in this context, a faster alternative for innovation in organizations, thus taking advantage of the existing potential in STI.

Therefore, the TT should be a goal to be pursued by an STI, in order to make available the results of the scientific research carried out for the organizations, contributing to improve productivity in these organizations and directly affecting society [19].

Considering the points described above and concluding this item, [8] describe that STI are being structured to manage technology and IP in order to meet the challenges of TT. They also describe that the mechanisms for a healthy relationship between STI and other organizations have been widely discussed.

III. DISCUSSION

To look for the reasons that determine economic growth is an old challenge [4], especially when it comes to Brazil, which presents some characteristics such as passivity in technological learning, a gap between science and technology and national entrepreneurs, and a High reliance on technology from countries with high technology industries.

The engine of economic development is the role of technology in society [17]. The point is that transformative innovations cannot be predicted. Schumpeter seeks to establish where innovations come from, who produces them, and how they are inserted into economic activity. Although consumers' wishes and needs are important elements in the process of innovation and diffusion of technology, it rules out the hypothesis that the origin of innovation is based on the desires and needs of consumers. For the author, innovation is seen as a set of "new combinations": introduction of a new good, introduction of a new production method, opening of a new market, conquest of a new source of raw material or semi-manufactured goods, Establishment of a new organization of any industry.

What is important to note in this context of Schumpeter's thinking is his contribution to the emphasis placed on the entrepreneur and, in particular, on technological innovations.

Thus, based on the bibliographic exploratory research and research carried out with technology managers during the action research in the two TLO, it was possible to identify some of the success factors in TT and, consequently, in the reception of Technologies.

For, technology transfer carried out at research institutes and universities can leverage the country's overall competitiveness indices.

Success factors are important in the transfer of already consolidated technologies or even in those situations related to joint research and development (open innovation environment).

By treating and organizing the responses of the interviews conducted, the following critical success factors for TT can be reached:

- By the Transmitting Organization (STI):
- Disposition to comply with the regulations to which the receiver is subject, and to adapt the technology to these regulations;
- Willingness to incorporate new technology platforms;
- Willingness to improve technology, according to its stage of development;
- Correct understanding of all possible applications for which the technology can be used in the case of technologies consisting of technology platforms;
- Existence and permanence in the STI of human resources with capacity and interest in supporting the subsequent development of the technology;
- Cooperation between researchers from different areas of knowledge, especially for technologies with multidisciplinary characteristics;
- Not all STI have established research groups in the required areas, which requires the formation of a consortium with more than one STI;
- Correct use of the opportunities created by technology;
- Ability to communicate.
- By the Receiving Organization
- Investment in the technical training of employees, to absorb technology and to continue its development;
- Scalability of technology;
- Financial capacity for investment in technology development and scheduling;
- Ability to communicate.

Both the transmitter and the receiver must play an active role in the TT processes.

IV. CONCLUSION

With the research, we arrived at the identification of some critical factors for success in technology transfer, such as: the stage of development of technology, the investment of time by all those involved in the process, training and qualification of researchers and technicians involved in the process, the technical ability of the organization to absorb technology, the ability to stagger technology, financial capacity for the continuity of development, among others.

In Brazil, TT generated in STI for other organizations assumes an important strategic role in increasing industrial competition, as well as in the organization's own market permanence. Efforts between STI and the productive sector are considered as the main drivers for promoting innovation and the scientific, technological, economic and social development of the country.

The TT can still be likened to a teaching-learning process where STI researchers, responsible for technology transfer and those responsible for the absorption of technology, from the receiving organization, should play an active role. Furthermore, in order to ensure successful transfer, the holder must ensure that the recipient understands and knows how to use the technology, for the purpose for which it is intended; and the recipient must ensure that he has cleared all doubts about the technology.

To deepen the knowledge on this topic, we suggest to look for specific factors on the main causes of failures in TT.

REFERENCES

[1] ALMEIDA, M. F. L.; BARRETO JUNIOR, J. T.; FROTA, M. N. Regime de apropriabilidade e apropriação econômica de resultados de P&D: o caso de uma empresa concessionária de energia elétrica. In: ENCONTRO DA ASSOCIAÇÃO NACIONAL DE PÓS-GRADUAÇÃO E PESQUISA EM ADMINISTRAÇÃO, 36., 2012, Rio de Janeiro. **Anais** Rio de Janeiro: ANPAD, 2012.

[2] BIEBERBACH, A. IP strategies in business operations with China. Journal of Business Chemistry, v. 9, n. 3, p. 161-166, Oct. 2012. ISSN: 16139615.

[3] CAERTELING, J. S.; HALMAN, J. M.; DORÉE, A. G. Technology commercialization in road infrastructure: how government affects the variation and appropriability of technology. Journal of Product Innovation Management, v. 25, n. 2, p. 143-161, Mar. 2008. ISSN: 07376782.

[4] CHIMENDES, V.C.G. Ciência e Tecnologia X Empreendedorismo: diálogos possíveis e necessários. Tese (doutorado) Universidade Estadual Paulista, Faculdade de Engenharia de Guaratinguetá, 2011.

[5] DAGHFOUS, A. Organizational learning, knowledge and technology transfer: a case study. The Learning Organization, v.11, n.1, p.67-83, 2004.

[6] EMERICK, M. C. TT: desafios para os NITs e ICTs. Debate FINEP – "Estratégias de Comercialização de Tecnologia pelos NITs: A experiência da Inova Unicamp". Rio de Janeiro: 2011. Apresentação disponível em <<download.finep.gov.br/dcom/debate_celeste_ago2011.ppt>> 22/09/2012

[7] FARIAS, J. L. D. S.; MENDES, M. E. P. Estratégia de transferencia de tecnologia como forma de apropriação do conhecimento: o caso Coomanta. Sobral, CE: Embrapa Caprinos e Ovinos, 2009. 28 p.

[8] GARNICA, L. A.; TORKOMIAN, A. L. V. TT universidade-empresa: fortalecimento de um modelo de cooperação através da propriedade intelectual. Bauru: XII SIMPEP, 2005.

[9] INSTITUTO NACIONAL DA PROPRIEDADE INDUSTRIAL. Página inicial. Disponível em: < http://www.inpi.gov.br>. Acesso em: 05 nov. 2014.

[10] JUNGMANN, D. M.; BONETTI, E. A. A caminho da inovação: proteção e negócios com bens de propriedade intelectual: guia para o empresário. Brasília: IEL, 2010.

[11] LI-HUA, R. Examining the appopriateness and effectiveness of technology transfer in China. Journal of Technology Management in China, v1., n.2, p.108-223, 2006.

[12] LYNKSEY, M. J. The transfer of resources and competencies for developing technological capabilities – The case of Fujitsu-ICL Technology analysis and strategic management . V.11, n.3, p.317-336, sep. 1999.

[13] MAÑAS, A. V. Gestão de tecnologia e inovação. São Paulo: Érica, 1993.

[14] MARKMAN, G.D.; GIANIODIS, P.T.; PHAN, P.H.; BALKIN, D.B. Innovation speed: Transferring university technology to market. Research Policy. Article in press. V.34 Jul. 2005.

[15] PERUSSI FILHO, S.; BISCEGLI, C. I. Um diagnóstico dos resultados das transferências de tecnologias geradas por uma instituição de pesquisa. In: SEMINÁRIO DE GESTIÓN TECNOLOGICA - ALTEC, 11., 2005, Salvador. Resumos... São Paulo: USP-Núcleo de Política e Gestão Tecnológica, 2005. p. 83.

[16] ROSENBERG, N. Inside the black box: technology and economics. Cambridge: CambridgeUniversity Press, 1982.

[17] SCHUMPETER, J. A. (1911). A Teoria do Desenvolvimento Econômico. São Paulo: Abril Cultural, 1982

[18] VILELA, D. C. J.; SCHREIBER, D.; FENSTERSEIFER, J. E. A TT como um componente da estratégia de produção de corporações multinacionais. Porto Alegre: 4° Congresso do Instituto Franco-Brasileiro de Administração de Empresas - IFBAE, 2007.

[19] WORLD INTELLECTUAL PROPERTY ORGANIZATION. What is Intellectual Property? Geneva, 2004. Disponível em: <http://www.wipo.int/edocs/pubdocs/en/intproperty/450/wipo_pub_450.pdf>. Acesso em: 18 jul. 2015.

Herlandí de Souza Andrade. “Risk and Success Factors in Technology Transfer.” International Journal of Engineering Research and Applications (IJERA) , vol. 7, no. 9, 2017, pp. 66–71.