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**A BRIEF REVIEW OF MODELS FOR TECHNOLOGY TRANSFER**

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**ABSTRACT**

Technology transfer (TT) process can be done accordingly to different models. This paper brings a brief review of T concepts and of the most recent models .

Keywords: Technology Transfer; Models for TT; TT Concepts .

**1. Introduction**

Technology transfer is increasingly present in everyday life of organizations, be they small, medium or large size, which increases considerably the studies on this process, thus appearing as various models developed by vendors and / or entities to the transfer of knowledge, these studies make clear that companies prefer to rely on partners to generate innovation, states (OLAZARAN et al. 2009).

From a strategic standpoint, we can say that this passage has favored many technology companies, which makes them somewhat, becoming more competitive on the global stage to interact, whose expectation is based on the ability to create and innovate and remained so active in the market. However, according Jagoda et al. (2009), most SMEs use technology transfer as a key strategy to reduce spending on research and development to respond quickly to changes in the competitive landscape; however, warns Tambunan (2007) by saying that

small and medium-sized enterprises should have some industrial competence and be able to absorb the technology or knowledge.

According Tambunan (2007) although a large body of literature on technology transfer, there are not many jobs, especially empirical studies of how this process works in SMEs, especially in developing countries. Given this aspect, even to be able to define what it is the process of technology transfer, will be addressed first the main concepts of this subject, seeking to characterize this process, so that may contribute to the understanding in general, especially to the community, making it clear their contributions to organizations and entities that operate in the development of technology becoming suppliers, which transfers the developed knowledge to others, whether related to processes, management or the technology itself.

After this stage, some models will be demonstrated technology transfer, by trying to show them how is this process is what is necessary for its transmission, and according to Takahashi (2005) the amount of transferred technological capacity depends on the particular model chosen, in which case we see the importance of choosing the appropriate model TT (Technology Transfer), it is necessary to know in detail the model being proposed by an entity and / or supplier, so that it can make considerable contributions to the business, allowing easy incorporation by the recipient.

Thus, the next item presented relates the main characteristics of the models covered in this research, whose objective is to see the highlights of their methods and steps. Thus, it seeks to know if there is a standard that can be applied and chosen by the organizations, especially regarding the characteristics of the models presented, and, according to Braga (2009) you must select the appropriate form and mechanism of transfer of technology so they can establish appropriate ways to measure your success.

Finally, in concluding remarks, we present the results of this study sought to even answer the question that encouraged the development of this work, namely: What models of technology transfer developed in the last 10 years and its main characteristics.

## **2. Characterization of the process of technology transfer**

As much as there is much research related to technology transfer, we see the need to further expand the concept of this theme, which will increase the possibility of better understanding on this subject, thus allowing an easy assimilation of this approach when it comes to up.

Before characterizing the term technology transfer, it must be clear that this is a method used by many organizations in the process of transfer of know-how, regardless of size or sector of

the economy falls, where an entity develops and provides technology, through its marketing, and other, more specifically companies, absorb and use technology, as a rule, "what is transferred is the how-to-do (as do), the ability to reproduce and use in certain situations, not always (or almost never) are transferred to the scientific knowledge generated technology "(MIRANDA and SIMEON, 2004), Takahashi (2005) complete the definition of know-how to say:" the ability consists of the operating skills and information necessary to operate, maintain and repair the technology, ie know-how ", and ends by saying that this know-how can be obtained mainly through training and technical support from the vendor.

In this sense, for example, can highlight the contribution of Al-Ghailani & Moor (1995, apud TAKAHASHI and SACOMANO, 2002), which represents a transfer of technology as a process by which technological knowledge is a source to a receiver . What suggests that this process to work, there must be an exchange of interests between two entities where one develops and markets, and acquires and deploys another, yet this study, Takahashi and Sacomano (2002) by the research of other authors, says:

“the transfer is recognized as a complex process that involves the identification of technology to be transferred, the selection of modes (joint ventures, research cooperation, mergers, licensing, etc..) and transfer mechanisms (training, seminars, software, technical information regarding the use and maintenance of technology, exchange of professionals, etc..) and the full implementation and uptake of technology”.

Another approach that conceptualizes the transfer of technology is punctuated by the authors Prystyon and Schmidt (2002) where it is said that technology transfer is primarily the absorption of a modus operandi; completing even saying that "the real technology transfer occurs when the receiver absorbs the body of knowledge that allows you to innovate. "Other researchers were also quite emphatic in pointing out that technology transfer is the process of transferring scientific findings from one organization to another for the purpose of developing and marketing, as pointed out by Rapini and Póvoa (2010). Already Etzkowitz, Kemelgor Gupta (2010) consider that the transfer of technology is a hybrid role that incorporates elements of science and business in its professional design, bridging the gap between invention and creation of new economic activities. In the academic literature, the term technology transfer refers mainly to the movement of technical know-how, knowledge, or technology from one organization to another, Bozeman (2000, apud HARMAN, 2010).

It is clear, as pointed out by the authors that this process of technology transfer not only refers to the development of technology itself, but the transmission of knowledge to others or even with regard to operational processes, and also partnership between two companies to create new products, so says Braga (2009) in the following passage: "the transfer of technology can be defined as the translation and transfer of technical knowledge used in developing new products or processes" and ends saying that "technology transfer occurs through the sharing of an invention or innovation."

According to Takahashi and Sacomano (2002):

The term technology transfer can be defined as a social process between two entities, in which technological knowledge is acquired, developed, used and improved by the transfer of one or more components of technology, be it the process itself or any part thereof in order to implement a process, an element of a product, the product itself or a methodology.

Rogers (2001) says that the transfer is the movement of technology through a communication channel between an individual and an organization, from one to another, and also points out that technological innovation is fully transferred when there is a sale of a product that is sold to the market. In this case, two are the minimum conditions for the occurrence of an effective technology transfer, the transferor must be willing to transfer and the receiver must be able to absorb the knowledge transferred (TAKAHASHI, 2005).

These approaches are evident that the transfer of technology can help companies become more competitive, stimulating their creativity and innovation arose, including investments in R & D (Research & Development). In some countries, there is even the initiative and government support to encourage organizations to develop new research, according to their area of expertise, that will gain competitive advantage, an example is given by Olazaran et al . (2009) in their study to analyze some technology centers created by the government in England to encourage the search for innovation in small and medium enterprises.

Note that there are several definitions on this subject and that each author puts his point of view on it, a more broadly contextualized and other more objectively, but it is clear that in general all refer to transmission of knowledge to others. Thus, this concept ends up with the following authors: Simeon and Miranda (2004) with the statement that "the transfer of technology concerning the granting to third parties in a package with a set of information defined routines suitable for reproduction , use and marketing, kept the privileges their legal protection ", and Sacoman and Takahashi (2002) when they say that the success of technology

transfer is defined by the degree to which the recipient firm can increase its field of technology and / or performance by of imported technology being validated, to some extent, by the results obtained with the transfer of technology.

### **3. Methodology**

The research method used for the preparation of this study was based on the literature review, where the contribution of several authors was essential to the presentation of the models studied in this work, among them, cite: Szulanski (2000), Sung and Gibson (2000), Rogers (2000), Takahashi and Sacomano (2002), Jarzemskis et al. (2008), and Gorschek Ivarsson (2009), Choi (2009) and Jagoda et al. (2010).

For the selection of the models we tried to take into account the technology transfer models developed during the period 2000 to 2010, where eight were selected, so that could be briefly presented and analyzed.

### **4. Technonlogy Transfer Models**

Understanding the process of technology transfer is essential for those who are interested in using something that was developed by another entity, even, for that depending on what is being purchased and / or transferred, we can require some adjustments, especially when this transfer process, being so, the receiving organization, ready to use the chosen model to the fullest in order to obtain better results.

However, what can hinder the choice of the transfer of technology is somehow related varieties of existing models, thus requiring more attention and understanding of their steps to implement the same, which should make it easier for is that in the future organization has the ability to interact skillfully with the technology acquired and may even make adjustments which may enable further use of the model purchased.

It is based on this amount that will be presented some models of technology transfer, and with this initiative, seeks to contribute to the understanding and the choice of model according to the authors discussed herein.

Thus, as shown in Table 1 it is clear that the models presented have been adapted and / or proposed between 2000 and 2010, as follows:

Table 1 – TT Models covered during the period from 2000 to 2010.

YEAR	MODELS
2000	Model 1 from Szulanski
2000	Model 2 from Sung e Gibson
2000	Model 3 from Rogers
2002	Model 4 from Takahashi e Sacomano
2006	Model 5 from Ivarsson e Gorschek
2008	Model 6 from Jarzemskis
2009	Model 7 from Choi
2010	Model 8 from Jagoda

As shown in Table 1, eight models were developed by different authors between 2000 and 2010, each one with a different approach.

### **Model 1**

The first model discussed in this study is presented by Szulanski (2000) where it believes that the process view allows a more detailed analysis of the evolution of transfer steps, including considering the difficulties encountered in the process, and complete, saying that the model identifies these different phases during the transfer of technology. Thus, the author presents his model, as shown in Figure 1.

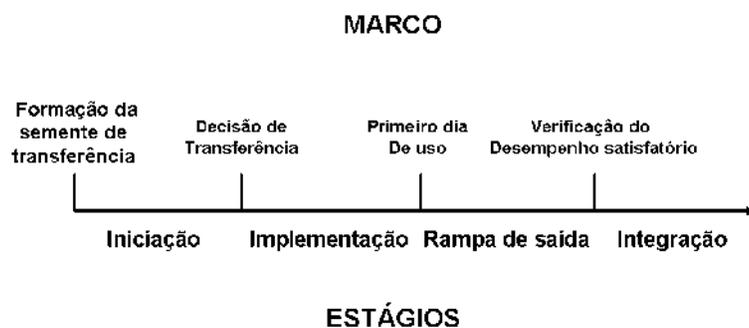


Figure 1 – Knowledge Transfer Process – Szulanski (2000)

It is felt that this model four back-stage (initiation, implementation, integration and off-ramp), considered in the process of knowledge transfer. The proposed model in question is to make it closely followed each stage so that the company will not have problems in the future, and it can at any time make a decision to fix something that can impact the success of it.

## Model 2

The second model is presented by Sung and Gibson (2000), where the authors consider that the transfer of technology and knowledge, as well as its implementation and dissemination are key to sustainable economic prosperity in the emerging 21st century global economy. And so, the authors propose the following model, shown in figure 2:

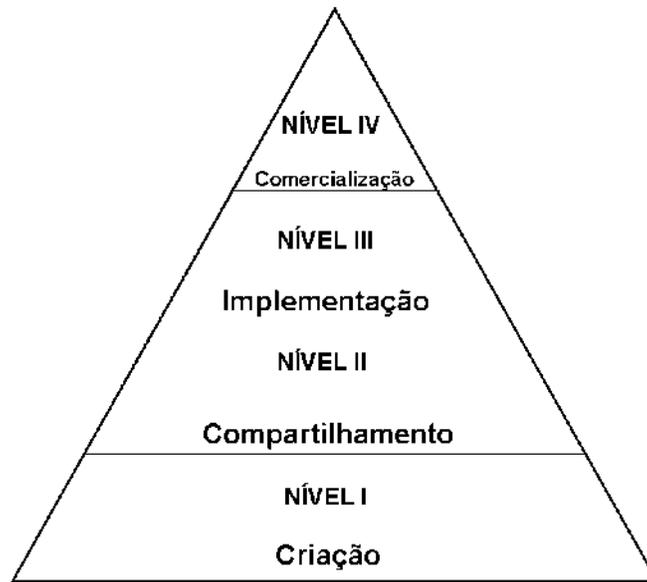


Figure 2 – Four levels of knowledge and TT – Sung e Gibson (2000)

Initially this model was proposed by Gibson and Slimor in 90 years, as pointed out by Vieira and Lucato (2011), but over the years, the model has undergone a few tweaks here and is treated by Sung and Gibson (2000), which include are four levels of knowledge and technology transfer: the first refers to the process of knowledge creation, sharing the second, the third of fourth technology implementation and commercialization of technology developed.

### Model 3

The model number 3 is proposed by Rogers et al. (2000), where it makes a score to say that a linear model of the process of innovation and development, may not take into account the external environmental factors such as market demand or regulatory changes that may influence the innovation process technology. To this end the author suggests the model placed in Figure 3 as a way to validate the effectiveness of technology transfer.

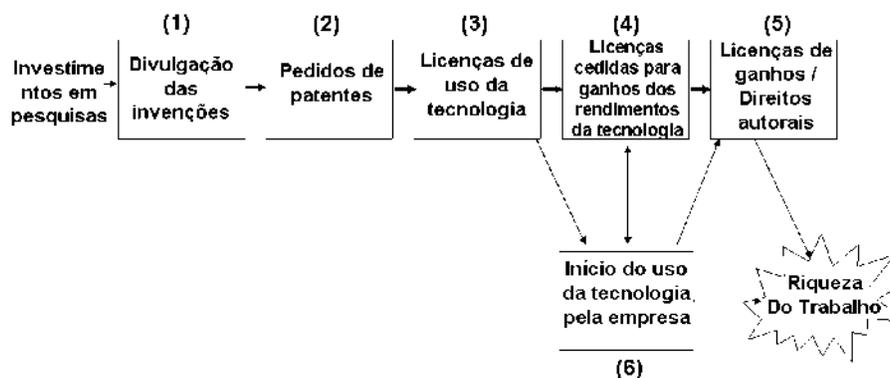


Figure 3 – The process of technology transfer from a research university – Rogers et al. (2000)

According to Figure 3, it is evident that this model covers six steps used in the process of technology transfer, namely: Disclosure of the invention, patent applications, licensing of technology use, license transferred to the income earned leave, earned and copyrights and early use of technology by the company.

#### Model 4

The conceptual model proposed by Takahashi and Sacomano (2002) deals with the essential elements for successful technology transfer, as well as their success factors, as shown in Figure 4. In this model the authors highlight the object of study of his work is to analyze the factors and relationships that affect the success of technology transfer, (TAKAHASHI and SACOMANO, 2002).

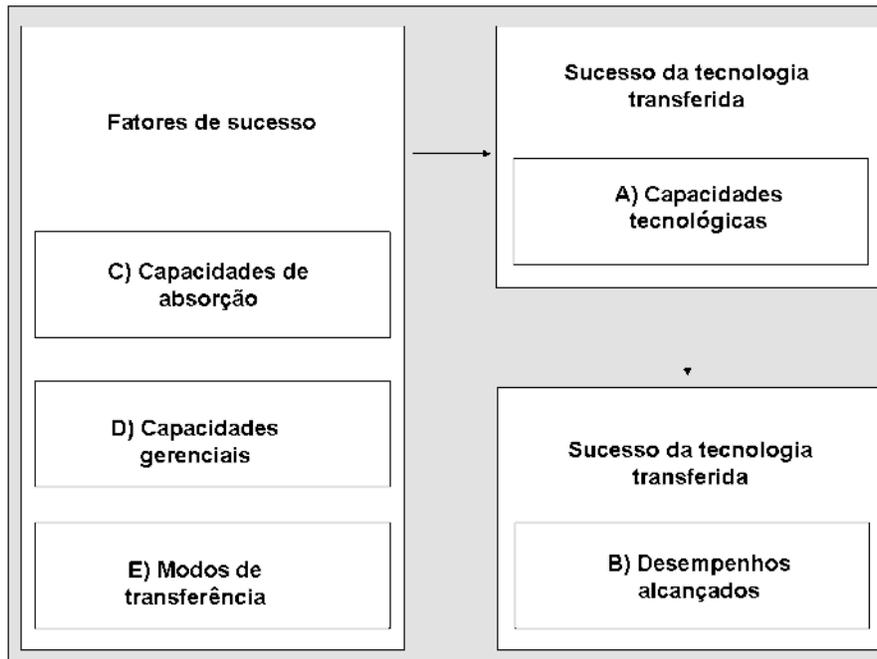


Figure 4 – Conceptual Model – adapted from Takahashi & Sacomano (2002).

The model Takahashi and Sacomano (2002) was developed to represent the theoretical framework to study the success of technology transfer projects in pharmaceutical companies. In this sense they believe that the success of technology transfer is defined by the degree to which the recipient firm can increase its technological mastery and / or performance through imported technology (TAKAHASHI and SACOMANO, 2002).

### Model 5

The next model discussed is presented by Gorschek et al. (2006, apud Gorschek and Ivarsson, 2009), where the author reports the existence of various models of technology transfer in software engineering and suggests a general model for technology transfer, as shown in Figure 5.

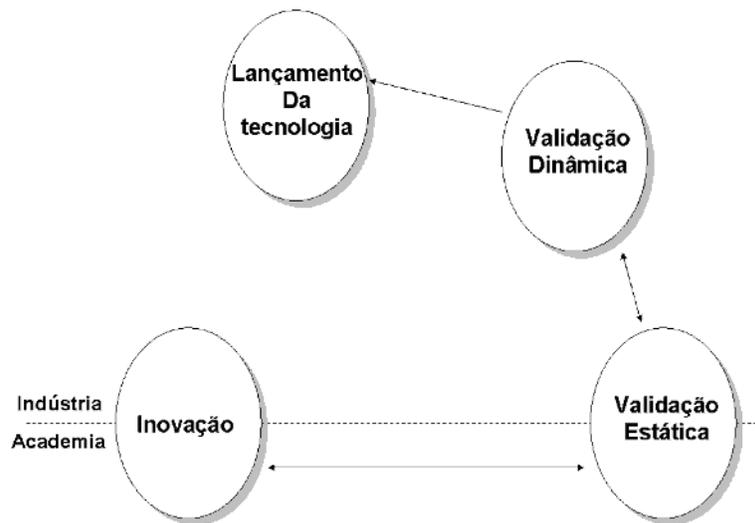


Figure 5 – TT Process – adapted from Gorschek et al. (2006, apud Ivarsson e Gorschek, 2009).

In this model it is clear the practicality of how to develop technology transfer, where the author comes to understand that this four-step process, beginning with the need of industry and academia in search of innovation, so basically the model consists of: innovation, validation, static, dynamic validation and launch of technology.

### Model 6

The model presented by Jarzemskis et al. (2008) highlights the role and initiative of the Government of Lithuania to the development of small and medium enterprises (SMEs), especially with regard to innovation and technology transfer. According to the author, in Lithuania there is still no interaction between academia and business, which somewhat complicates the process of growth of SMEs, thus requiring more government intervention to encourage this process (Figure 5).

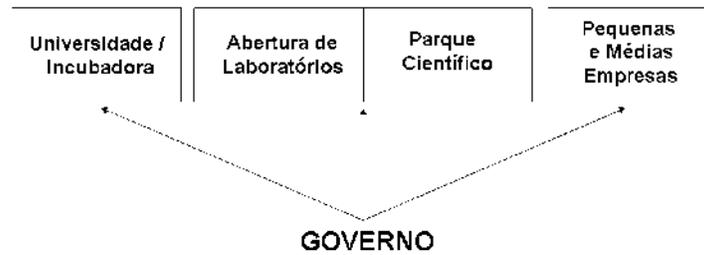


Figure 6 – Innovation and technology transfer model of Lithuania – Adapted from Jarzemskis et al. (2008).

Given this aspect, this incentive by the government, can bring benefits to Lithuania, even for the same depends on SMEs to move its economy, and these companies are not concerned with investments in developing new technologies, says Jarzemskis et al. (2008), which can hinder their growth.

### Model 7

A new model for technology transfer results in competitive advantages for a country, said Choi (2009), and adds saying that more and more the use of technology is associated with the ability to generate innovation, for both, the role of the population is of paramount importance, even to absorb new technologies and incorporate them in the production process, where your success depends on the ease with which people have to assimilate, adapt, modify and create new technology, and as technology transfer is successful, have a major impact on the advancement of a nation. This is shown by Choi (2009) in his model of technology transfer, as shown in Figure 7.

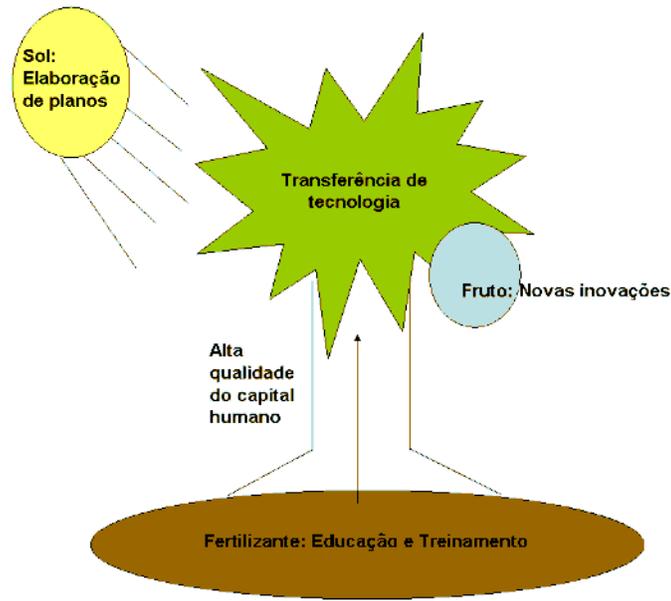


Figure 7 – Change model of technology transfer – Adapted from Choi (2009).

In this sense, it is clear that this model's main objective is the generation of new innovations, and treats people as a key factor for this to be successful, drawing attention, even for investment in infrastructure to train and develop the human capital, becoming a body prepared to deal with new technologies.

### Model 8

Finally, it is covered in this latest model the method proposed by Jagoda et al. (2010), where it believes that the current scenario in the transfer of technology is an important part of the company's business, yet full saying: "Companies are increasingly dependent on the transfer of technology to deal with the complexity of improvement of products, with customer demands and increasing competitive pressure. "

Thus, Jagoda et al. (2010) presents the following model:

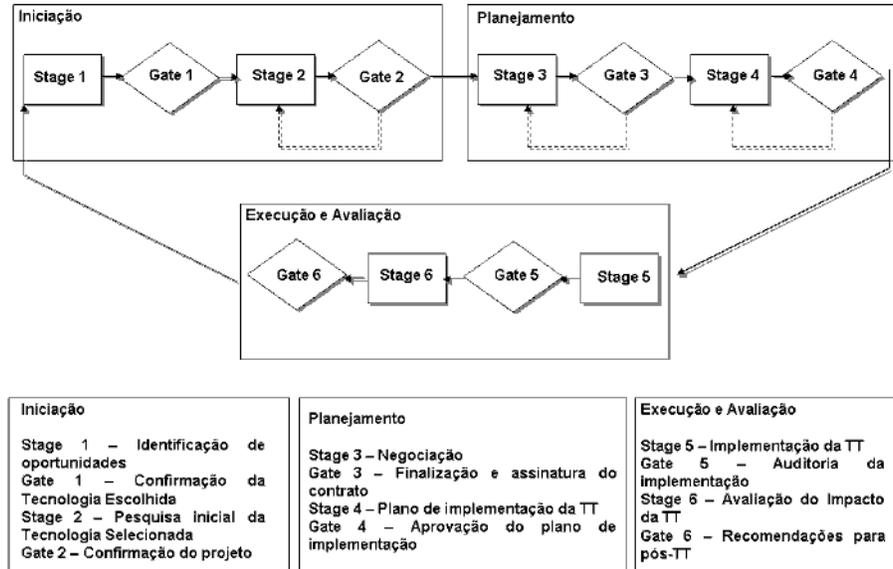


Figure 8 – “Stage-gate” model for TT – Adapted from Jagoda et al. (2010).

Clearly, the international model of technology transfer Jagoda et al. (2010), called "Stage-gate", is very detailed, and follows several stages during its development process, going through stages and gates, where each have a specific contribution in each of the three steps of the process, namely, initiation, planning and implementation and evaluation. According Lonseth et al. (2009) model "Stage-gate" was initially approached by Cooper (2001) and after undergoing some changes, was presented by Jagoda and Ramanathan (2003, 2005) and again by Jagoda et al. (2010).

## 5. Final Remarks

The study addressed some of the models developed between 2000 and 2010, where they were presented and characterized. We come to the conclusion that there is a diversity of models of technology transfer, and that each one follows a line of reasoning.

Among the models discussed, it is clear that some are easier to deploy because of the number of steps to transfer knowledge and / or technology and others due to its complexity becomes a little harder, but nothing that could compromise the success of the transfer of technology.

## 6. Acknowledgements

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## 7. References

BRAGA, Edi Jr.; PIO, Marcello; ANTUNES, Adelaide. *O processo de transferência de tecnologia na indústria têxtil*: Journal of technology Management & Innovation. V. 4, p. 125-133, (2009).

CHOI, HEE JUN. *Technology Transfer Issues and a New Technology transfer model*. The Journal of Technology Studies. p. 49-57 (2009).

ETZKOWITZ, HENRY; GUPTA, NAMRATA. *The gender revolution in science and technology*. Journal of International Affairs. Vol. 64, n. 1, p. 83-100 (2010).

IVARSSON, MARTIN; GORSCHKEK, TONY. *Technology transfer decision support in requirements engineering research: a systematic review of REj*: Requirements Eng – 14:155-175 (2009).

HARMAN, GRANT. *Australian university research commercialization: perceptions of technology transfer specialist and science and technology academics*. Journal of Higher Education Policy and Management. Vol. 32, n. 1, p. 69 -83 (2010).

JAGODA, Kalinga at al. *Key issues in managing technology transfer projects: experiences from a Canadian SME*. Management Decision. V. 48, n. 3, p. 366 -382. (2010).

JARZEMSKIS, Andrius; MARKVENAS, Renatas; JARZEMSKIS, Vytautas; SAMOSKA, Mindaugas. *Research of technology transfer problems in Lithuania*. International Conference “RELIABILITY and STATISTICS in TRANSPORTATION and COMMUNICATION” (2008)

LONSETH, R. J.; LONSETH, A. A; JAGODA, K.I. *Efficacious Management of Technology Transfer Projects: Lessons from a Canadian Case*. POMS – Annual Conference. May (2009)

MIRANDA, Antonio; SIMEÃO, Elmira. *Transferência de informação e transferência de tecnologia no modelo de comunicação extensiva: A babel.com*. Información, Cultura Y Sociedad. N. 10, p. 27-40, (2004).

OLAZARAN, MIKEL; ALBIZU, ENEKA; OTERO, BEATRIZ. *Technology transfer between technology centres and SMEs: Evidence from the Basque Country European Planning Studies* – vol. 12, n. 3, (Mar. 2009).

PÓVOA, LUCIANO MARTINS COSTA; RAPINI, MÁRCIA SIQUEIRA. *Technology transfer from universities and public research institutes to firms in Brazil: what is transferred and how the transfer is carried out*. Science and Public Policy. p. 147-159 (2010).

PRYSTHON, Cecília; SCHMIDT, Susana. *Experiência do Leaal/UFPE na produção e transferência de tecnologia*: CI. Inf., Brasília, v. 31, n. 1, p. 84-90, Jan./abr. 2002.

ROGERS, Everett M. et al. *Lessons learned about technology transfer*. Technovation. p. 253-261. (2001)

SUNG, T. K.; GIBSON, D. V. *Knowledge and technology transfer: key factors and levels*: Proceeding of 4<sup>th</sup> International Conference on Technology Policy and Innovation. p. 4.4.1 – 4.4.9. (2000).

SZULANSKI, Gabriel. *The process of knowledge transfer: A Diachronic Analysis of Stickiness*. Organizational Behavior and Human Decision. V. 82, n. 1, p. 9-27, may. (2000).

TAKAHASHI, Vânia Passarini. *Transferência de conhecimento tecnológico: estudo de múltiplos casos na indústria farmacêutica*. Gestão & Produção. V.12, n. 2, p. 255-269, ago. (2005).

TAKAHASHI, Vânia Passarini; SACOMANO, José Benedito. *Proposta de um modelo conceitual para análise do sucesso de projetos de transferência de tecnologia: estudo em empresas farmacêuticas*: Gestão & Produção. V.9, n. 2, p. 181-200, ago. (2002).

TAMBUNAN, TULUS. *Transfer of technology to and technology diffusion among non-farm small and medium enterprises in Indonesia*. Know Techn Pol. P. 243-258 (2007).

VIEIRA Jr., Milton; LUCATO, Wagner Cezar; *Tópicos em gerência da produção: competitividade e eficiência*. 2011. Aula realizada na UNINOVE em 30 nov. 2011. Notas de aula.