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A MATURITY MODEL FOR TRANSFER OF TECHNOLOGY BACK NITs.

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abstract

In order to deal with the requirements of the Innovation Law and fulfill among its various roles, that of ensuring the transfer of technology, the Technological Innovation Centers - NITs, need to have their processes well defined to obtain efficient and effective results. This article aims to present an approach about the importance of maturity levels for Technology Transfer - TT, proposing a maturity model through an exploratory and descriptive approach for the NITs of Universities and Federal and Federal Institutes of Education, Science and Technology of the parents. During the research, one can observe how the low rates of public institutions in the engagement of TT draw attention, especially when it comes to science and technology institutes and universities in the process of entering into transfer and technology contracts through their NITs. Having a maturity definition tool, be it software, product or internal procedure for the activities of an organization is of fundamental importance for decision making, especially in sectors where there is no maturity in the TT process. However, according to the FORMICT report, most of the public institutions are not yet mature in this process, which may render contracts unfeasible. especially in sectors where there is no maturity in the TT process. However, according to the FORMICT report, most of the public institutions are not yet mature in this process, which may render contracts unfeasible. especially in sectors where there is no maturity in the TT process. However, according to the FORMICT report, the majority of public institutions are not yet mature in this process, which may render contracts unfeasible.
Key words: Innovation, Technology, Contract, Maturity, Transfer.

1. INTRODUCTION

The Innovation concept is directly linked to the act of modernizing, the action of developing something new. In an era in which changes occur rapidly, innovation is presented at the core of several areas, not always with due conceptual care. As an example, a slight search can be cited on the most searched site worldwide, Google, in which when requesting a search for the term "innovation", more than 20 million results were presented. If the search is carried

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out with the term “innovation”, these numbers are even more expressive, with results exceeding 300 million results. (FUCK; VILHA, 2011).

Nowadays, for the same requests on the aforementioned search site, it is noted that the numbers have grown sharply. When performing the search for the word “innovation” alone, the site presents more than 74 million results for the term. By succeeding with the same word in the English language “innovation”, more than 2 billion results for research are shown.

Innovation can be considered as modern associations of new instruments and forces, that is, the development of new products, services or processes or the creation of these same things using different processes. (DALLABRIDA; SIEDENBERG; FERNÁNDEZ, 2002)

Innovation is one of the central reasons for a country to reach another economic level, being essential for the process of evolution and gaining competitive advantages. The ability to innovate is intrinsically linked to the capacity of individuals, organizations, regions or countries. The dissemination of new technologies is essential for the progress of results and increased productivity. (PINSKY; KRUGLIANSKAS, 2017).

For this to happen, organizations such as government, university and industry need to be united to develop innovation strategies that achieve success. The union of these entities, which allows them to examine their strengths and weaknesses, allowing them to improve their interactions is known as the Triple Helix (ETZKOWITZ; ZHOU, 2017).

In order to improve the promotion of innovation, technological and scientific research in the Brazilian production environment, in December 2004 the Technological Innovation Law was launched. The government through public policies, more precisely by the Law of Innovation (10.972 / 2004), made the university stop having a secondary role, focused only on higher education, to be a provider of entrepreneurship and innovation through its Technological Innovation Centers.

Such legislation allowed the nuclei not only to work as a source of intellectual property registration (notary offices), but with the exchange of knowledge and skills, signing technology transfer agreements (TT), ensuring the operation of the triple propeller. This law aimed to promote scientific progress, research and technological qualification in order to enable the development of Brazil, according to articles 218 and 219 of the Federal Constitution. The incentive to this area, through incubators, enables the emergence of more attractive products and services on the market, providing jobs and development. (MATIAS-PEREIRA; KRUGLIANSKAS, 2005).

The Technological Innovation Law is arranged in the following axes: the formalization of an appropriate environment for strategic collaborations between universities and companies;

encouraging the presence of science and technology institutions in the innovation process; and fostering innovation in the company. The law also provides for the consent for the incubation of private companies in the public sector and the chance to share infrastructure. (MATIAS-PEREIRA; KRUGLIANSKAS, 2005).

To strengthen what the law provides, the federal government created the Brazilian Agency for Industrial Development (ABDI), which is responsible for the execution and supervision of industrial, technological and foreign trade policies in Brazil. ABDI aims to associate actions and tactics for industrial policy by encouraging the development of the innovation process to the competitiveness of the production sector. (MATIAS-PEREIRA; KRUGLIANSKAS, 2005).

Although the Innovation Law offers subsidies for TT, this process is not a simple task in the innovation centers, requiring regulations, knowledge, human and financial resources, disclosure of activities and the capacity to enter into public-private agreements. With these difficulties in mind, this work presents a proposal for a Maturity Model for Technology Transfer, allowing the innovation centers to follow processes to achieve success in this matter.

Thus, for the development of the proposal, this article presents in the section on the situation of NITs in Brazil, of statistical data provided by the Ministry of Science and Technology collected directly from the ICTS in the annual report of FORMICT.

In the following sections, technological maturity models are presented, such as TRL developed by NASA, as well as CMM and CMMI, which were maturity models designed for the software development process, based on ISO standards and MPS.BR, which is a model adapted from CMMI for the Improvement of the Brazilian Software Process, guaranteeing the quality of services offered by companies with low cost technologies and standardization of processes.

The section with the proposal for a maturity in technology transfer (MMTT), was guided by the aforementioned models and based on some criteria of the Innovation Law. Finally, the section on completion and future work is presented.

2 NITS SITUATION IN BRAZIL

In compliance with Article 17 of Law 10.973 / 2004, the Ministry of Science, Technology, Innovation and Communications (MCTIC), makes availablean electronic form for Scientific, Technological and Innovation Institutions to provide annual information on intellectual property management. The purpose of the information is to provide an annual report on Intellectual Property policies of ICTs in the country, called FORMIT (ACUNHA, 2016).

The report is mandatory for ICTs publicand private, and in the last report with base year 2017, the form was filled out by 297 institutions. Of these institutions, 212 presented themselves as public and 85 as private institutions, with a greater concentration in the southeast and south of the country (FORMICT / MCTIC, 2018).

ConsidersSince it is mandatory to complete the report, FOMICT is the most reliable source on the situation of the Technological Innovation Centers in Brazil, being updated since 2010. Governed by article 16 of the Innovation Law, the ICT must have its own innovation center or associated with another ICT.

Based on the data provided by the report, 168 public institutions reported having implemented NIT, 13 of which reported not having implemented NIT and 31 public institutions are implementing it (FORMICT / MCTIC, 2018).

Article 16 of the Innovation Law, in item I, determines that “it is incumbent upon ICT to ensure the maintenance of the institutional policy of encouraging the protection of creations, licensing, innovation and other forms of technology transfer”. Item X, on the other hand, “must negotiate and manage technology transfer agreements from ICT” (BRASIL, 2004).

Based on article 16, the FOMICT / MCTIC (2018) report presented data about the existence of innovation policies, that is, documents / regulations with general guidelines for innovation, protection of intellectual property and technology transfer (TT). Theresults are: 153 companies publichave implemented innovation policy; 59 They do not have an implemented innovation policy.

Regarding institutions with technology contracts, the vast majority of institutions do not have or sign technology transfer contracts. In 2017, only 39 public institutions claimed to have contracts, compared to 173 without any type of contract.

With the results presented by FORMICT added to the set of obligations imposed by the Innovation Law, it is clear that ICTs and NITs have little impact on TT aspects. There are many factors that can directly affect the lack of agreements, such as lack of personnel, turnover in the public service and even the lack of knowledge management.

In order to have an idea of the dimension of the demand for Intellectual Property, the National Confederation of Industry (CNI) announced that the number of patents issued only in 2017 granted by the INPI was 6,250, 30% higher than that registered in the year 2016 (CNI, 2017). Most deposits originate from 84 countries, with the USA being the country with the highest demand, representing (31%), while Brazil is second with only (21%).

The graph in Figure 1 clearly shows the reality of public and private institutions, which suggests that there are many flaws in the innovation management process and much to be improved, since the number of public institutions is greater than that of with a proximity to the number of existing contracts.

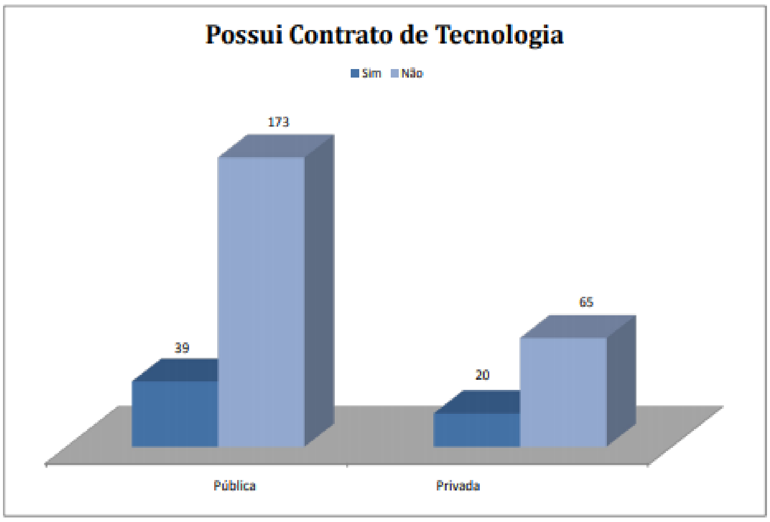

Figure 1 - Number of institutions that have TT contracts.

Source: FORMICT / MCTIC

Another interesting fact is that the report points out that of the 59 public / private companies that have TT contracts, only 4 are Institutes of Professional and Technological Education, against 33 Higher Education Institutions. Research Institutes, only 15 and 7 categorized as others. In other words, the FORMICT numbers reinforce that there is a need to improve processes for managing innovation with a focus on TT.

The organization of NITs and their internal guidelines must be documented, with defined tasks and flows so that in case of staff turnover, it can beaccomplished what determines the Innovation Law, with minimum knowledge about the activities is available to those involved, allowing the ICT NIT to acquire maturity in its processes over time.

3 TECHNOLOGICAL MATURITY AND INTELLECTUAL PROPERTY

New technologies are created all the time, however, before reaching the market it must pass through phases until it is sufficiently mature for the products or processes created to reach the market. In the intellectual property domain, one of the tools used for prospective support is the Technology Readness Level (TRL).

Created by NASA in the 1970s, the tool aims to measure or estimate the level of maturity or readiness of a given technology. Its standardization occurs through ISSO 16290: 2013, entitled (Space System - Definition of the Thechnology Readness Level and its criteria of assessment) (ANDRADE et al., 2018).

The tool can be applied in academia and industry. ANDn 1995 after NASA improvements, the measurement system was updated to have nine framing levels, being stylized in the form of a thermometer (RIBEIRO, 2019).

When used in technological prospecting, TLR allows the creation of an information framework for business intelligence, facilitating analysis of current technologies through the creation of Roadmaps, identifying ideal moments or predictions for technology transfer.

For a better understanding of TLR and its levels, chart 1 shows the maturity levels defined by the NSA.

Table 1. Technology Readness Level Maturity Levels

Levels	description
1 - Basic principles observed and reported.	At this point, one has the basic research of technology.
2 - Concept of formulated technology and / or application.	With the basic principles observed, practical applications begin. (Level still speculative).
3 - Critical analytical and experimental function and / or proof characteristic of the concept.	Analytical laboratory studies to verify the feasibility of the technology and proceed to development.
4 - Validation of components and / or prototype in a laboratory environment.	In this phase the components are tested with each other.
5 - Validation of components and / or prototype in a relevant environment.	It is a continuation of TRL 4, however, it is subjected to more rigorous tests, and the simulation should be performed in an environment as close as possible to the real one.
6 - Model / subsystem system or prototype demonstration in a relevant environment.	Presentation of a fully functional prototype.
7 - Demonstration of the system prototype in a space environment.	Requirement of a prototype with real demonstration in a space environment.
8 - Real system completed and “qualified flight” through testing and demonstration (ground or space).	The technology has already been tested and “qualified for flight” and is ready to be deployed in existing technology or system.
9 - Real “proven flight” system through successful mission operations	Successful on a “proven flight” mission technology achieves TRL 9

Source: NASA (2019).

Like TRL, there are many other tools for maturing processes and products on the market. Most maturity models are applied to software development and usually evolve in processes and / or generate derived models. The next subsection presents maturity models applied to software development and its derivations.

3.1 Other Maturity Model

A maturity model aims to continuously improve the processes of organizations in certain areas. In the software development area, there are several models, the CMM (Capability Maturity Model) being the basis for models such as CMMI (Capability Maturity Model Integration), MPS.Br (Brazilian Software Process Improvement) and others described below (GAMA; ALVARO; PEIXOTO, 2012).

3.2 The Capability Maturity Model

The CMM is a maturity model developed by the Software Engineering Institute (SEI), registered and patented by the US Patent and Trademark Office that describes stages of maturity as an organization goes through its software development cycle through continuous, focused assessments identifying problems, as well as corrective actions (PAULK, 2001).

SEI provides consulting and certification services for the CMM software development process. The issued certification guarantees the company prestige and international visibility since the level of maturity reflects the quality of the development process and the software. The website (www.isdbrasil.com.br) ranks Brazilian companies that have achieved some level of maturity such as CMM or CMMI, such as SERPRO, CESAR, Itaú, Embraer with Level 2 CMM and IBM, CPM Braxis and Instituto Atlântico with CMMI.

The CMM defines 5 Maturity Levels that represent a collection of elements that describe aspects of an organization. According to (MENZOMO; DARONCO, 2012) the levels are:

- **Level 1 - Started**: Disorganized software process (ad hoc), with poorly defined processes;
- **Level 2 - Repetitive**: Basic project management processes with cost, time and functionality control;
- **Level 3 - Defined:** Project and development management processes are now documented and standardized in the organization;
- **Level 4 - Managed**: Metrics are defined and applied in measuring product quality;
- **Level 5 - Optimized**: Quantitative feedback from processes allows understanding of common causes and variations of processes by introducing improvements in technological and incremental innovation.

3.3 Capability Maturity Model Integration

Like CMM, CMMI was also developed by SEI, its most recent maturity model, overcoming the limitations of CMM. It is a model of mature and consolidated practices, arising from the perception that basic software and applications have an integrated context that covers from development to maintenance (design and deliveries) (SILVA; SANTOS; SHIBAO, 2017).

Companies are increasingly looking to improve their internal processes, through their business rules. These rules are the way the company has to express its organizational knowledge, determining how the business works, maintaining a control structure. The adoption of the practices recommended by this maturity model directly implies the implantation, implicit orexplicit new business rules (MORGADO et al., 2007)

The CMMI is organized in levels of maturity with related areas grouped by activities. The levels represent the managerial effectiveness presented in an evolutionary way to improve the software development process and its maintenance (MORGADO et al., 2007). An organization that implements this model must also pass a certification carried out by the SEI to certify that it has implemented and reached a certain level.

Certification takes time and pain, as companies must be well structured. The model, in addition to serving as a guide for the improvement of the development process, assists professional skills in the management of acquisitions, product maintenance and software services that are of paramount importance, since the complexity of project management increases with its size . (VASCONCELOS; MORAIS, 2009)

The CMMI maturity levels are similar to those presented in the CMM ranging from level 1 (initial), level 2 (managed), level 3 (defined), level 4 (quantitatively managed) and level 5 (optimized). These levels are due in Process Areas (PAs). Each level has a set of APs and each AP has objectives, generic and specific practices that must be followed to reach the next level, such as: Level 2 APs - requirements management; project planning; monitoring and control of projects; configuration management; quality assurance process; provision of services and etc. (MARÇAL et al., 2008).

The CMMI has two representations that allow organizations to choose how they intend to have their processes evaluated. The areas are: Dams by Internships offer a systematic and structured approach to level progression. Continuous representation, on the other hand, allows for the incremental improvement of processes. The most common representation of CMMI is by stage, represented in Figure 2.

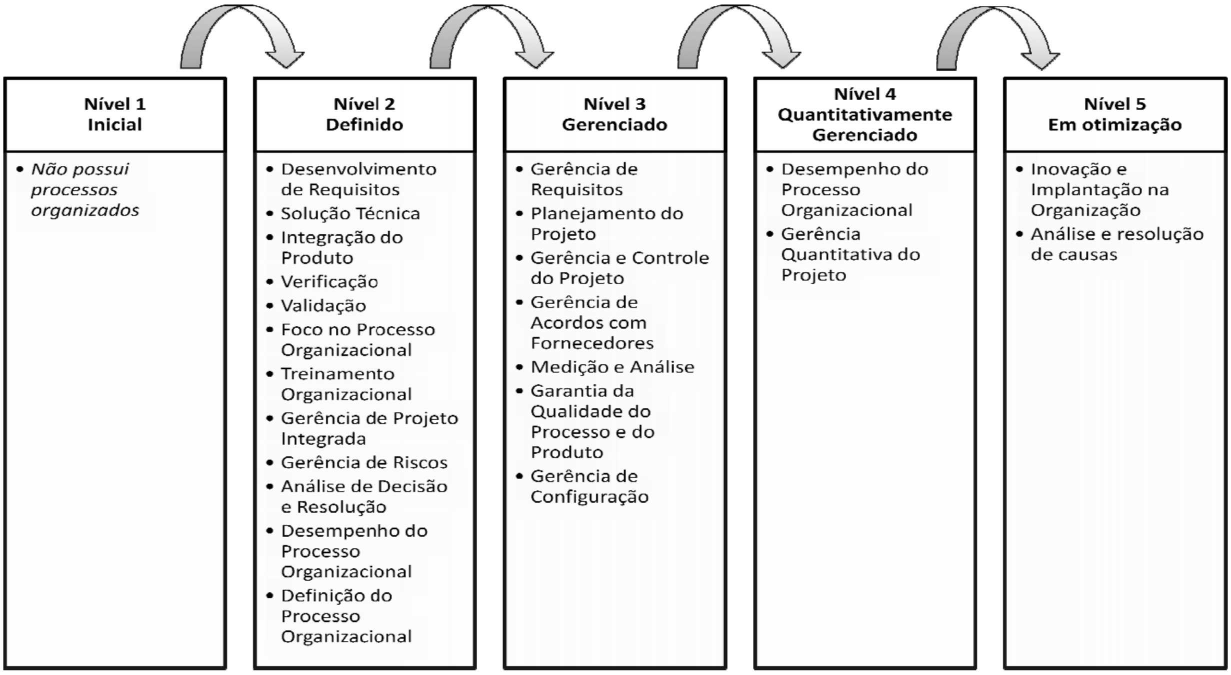

Figure 2. Key CMMI Process Areas in stages.

Source: (VASCONCELOS; MORAIS, 2009).

According to Franciscani and Pestili (2012), in case of certification, the main disadvantage of the maturity model is its high cost, between two hundred thousand reais and one million. This value varies according to the complexity of the assessed organization's processes. Another impact factor is the evaluation and evolution time, where it is estimated between 4 and 8 years to reach the highest levels.

For these authors, most companies do not treat CMM as a model, but as a process, reporting that not all practices contained in the guide are necessary. The agile line of thought considers that for small projects, the model blocks the process, without adding much value to the organization. It is worth mentioning that the model was created and designed for projects in companies with large organizational structures and multidisciplinary teams, which in fact may make its use by small companies unfeasible.

However, when considering the main aspects of CMMI, its levels and key areas in Figure 2, the model brings numerous advantages to the organization with a focus on continuous improvement through process optimization, making it more competitive at each level. It is worth mentioning that most of the existing maturity models have derivations from CMM and CMMI.

3.4 MPS.BR

Created in 2003, the Brazilian Software Process Improvement model (MPS.Br), coordinated by the Association for the Promotion of Brazilian Software Excellence (SOFTEX), supported by the Ministry of Science and Technology and Innovation (MCTI), SEBRAE, FINEP and IDB , aims to increase the competitiveness of organizations to improve the competitiveness of micro, small and business, as well as government companies (SOFTEX, 2016).

The MPS describes models by means of documents in the form of guides that can be found at www.softex.br. These models are divided into: general MPS software guide; services; people management; evaluation; implementation in organizations and; the software acquisition guide. MPS.BR is derived from CMMI and ISOs 12207/15504, and like other models it is organized in maturity levels ranging from A (in Optimization) to G (partially managed), with a much lower implementation cost. CMMI.

The result of the low cost is reflected in statistical data on the website www.softex.br/mpsBr, where 69% of maturity assessments in Brazil are from MPS.Br and 31% for CMMI in 2018. Such assessment demonstrates the search for Brazilian companies that are interested in the continuous improvement of their engineering processes, services and HR.

In this model, divided into 7 levels of maturity (or capacity), they are described by process attributes (PA) that are subdivided. Each attribute is assessed and must be achieved in each process to advance to the next level. Franciscani and Pestili (2012) exemplify the attributes of processes such as:

- AP 1.1 - The process is executed;
- AP 2.1 - The process is managed;
- AP 2.2 - Process work products are managed;
- AP 3.1 - The process is defined;
- AP 3.2 - The process is implemented;
- AP 4.1 - The process is measured;
- AP 4.2 - The process is controlled;
- AP 5.1 - The process is an object of innovation;
- AP 5.2 - The process is continuously optimized;

Based on the example above together with Figure 3, we can have a complete view of the levels, processes and process attributes in each stage of MPS.BR.

Nível de maturidade	Processo	Atributos de Processo
A	-	AP 1.1, AP 2.1, AP 2.2, AP 3.1, AP 3.2, AP 4.1, AP 4.2, AP 5.1 e AP 5.2
B	Gerência de Projetos – GPR (evolução)	AP 1.1, AP 2.1, AP 2.2, AP 3.1, AP 3.2, AP 4.1, e AP 4.2
C	Gerência de Riscos – GRI	AP 1.1, AP 2.1, AP 2.2, AP 3.1 e AP 3.2
	Desenvolvimento para Reutilização – DRU	
	Gerência de Decisões – GDE	
D	Verificação – VER	AP 1.1, AP 2.1, AP 2.2, AP 3.1 e AP 3.2
	Validação – VAL	
	Projeto e Construção do Produto – PCP	
	Integração do Produto – ITP	
	Desenvolvimento de Requisitos – DRE	
E	Gerência de Projetos – GPR (evolução)	AP 1.1, AP 2.1, AP 2.2, AP 3.1 e AP 3.2
	Gerência de Reutilização – GRU	
	Gerência de Recursos Humanos – GRH	
	Definição do Processo Organizacional – DFP	
	Avaliação e Melhoria do Processo Organizacional – AMP	
F	Medição – MED	AP 1.1, AP 2.1 e AP 2.2
	Garantia da Qualidade – GQA	
	Gerência de Portfólio de Projetos – GPP	
	Gerência de Configuração – GCO	
	Aquisição – AQU	
G	Gerência de Requisitos – GRE	AP 1.1 e AP 2.1
	Gerência de Projetos – GPR	

Figure 3. MR-MPS-SW maturity levels.

Source: (SOFTEX, 2016).

As seen in Figure 2, the MPS.BR maturity model has attributes that are repeated at each level, similar to what happens with CMMI. Despite the similarity and the higher number of levels, the cost and time of implementation are lower, directly benefiting the target audience described in this chapter.

3.5 The ISO 9001 NBR

According to Walter (2005) ISO 9001 was created as a quality management methodology, focused on the systematization of planning, in the form known today as PDCA (plain / do / check / act). For its implementation, a lot of documentation is required, standardization of actions with accuracy, monitoring of customer satisfaction and knowledge of the team regarding the standard. As with the models presented, implementing the ISO standard requires commitment from the entire team of the organization to ensure the performance of services.

Thus, ISO 9001 defines criteria that must be met by institutions in order to achieve Quality Certification, which aims to standardize and guarantee quality in a service offered in a repetitive and consistent manner, as defined by the company. Certification is not limited to private companies only, public companies can also obtain certification (Quality management, 2019).

The standard represents a set of experiences from the most diverse organizations, which can be applied in any company that wishes to carry out quality management in its services. According to Chaves and Campello (2015) the standard has 8 quality principles, detailed below:

> - **Customer focus:** organizations are dependent on their customers, so they must meet their current and future needs, satisfying their requirements and implementing mechanisms for the perception of the services and products delivered;
> - **Leadership:** leadership is necessary to promote the unity of goals, direction and creation of an environment in which people become engaged to achieve organizational goals;
> - **People's involvement:**they are the foundation of every organization. Their cooperation, commitment, engagement and motivation enable their full potential to be used efficiently and effectively for the benefit of the organization;
> - **Process approach**: resources and activities must be treated as processes, focusing on understanding the feedback of processes affecting the chain;
> - **Systemic approach to management:**the systems are intertwined, forming an information system. This approach is the principle that allows an organization to perceive, understand and manage interrelated processes;
> - **Continuous improvement:** it is the principle that allows an organization to reassess its processes, correct its problems and readapt to continue in the search for excellence for its products and services;
> - **Factual Approach to Decision Making**: effective decisions must be made based on deductive analysis of data and information;
> - **Mutual benefit in supplier relationships:** despite the independence between organization and supplier, a mutually beneficial relationship can only add value for both;

ISO 9001 allowed significant advances on the theme of standardization and quality of products and services for society, promoting a competitive differential between organizations. It is worth mentioning that the quality of products and services directly affects the brand image, which may or may not retain customers. Apple, for example, is the most valuable brand in the world, its products are known for their quality and price. Samsung, despite being a competitor,provides technology to Apple through its screens. Despite competition, such an example demonstrates the 8th principle of ISO, mutual benefit.

In the public administration there are several agencies seeking control and organization of their processes, examples of which are the STF, Federal Senate, City Councils, Attorney General's Office. The operational efficiency of the activities allows these intuitions to be able to process, for example, their processes more quickly, reducing the waiting time of the citizen and, consequently, reducing the waste of public resources.

4 MATURITY MODEL PROPOSAL FOR TECHNOLOGY TRANSFER (MMTT)

The difficulties presented about the reality of NITs by the FORMICT report when it comes to technology transfer, it is observed that most NITs do not succeed or do not execute contracts that make the reach of the final public feasible so that the gears of the Triple Helix work. In order to reach TT maturity in the innovation centers, the process must be gradual, with each step being performed until the next maturity level is reached. The ultimate goal is to reach the level of resource optimization, integrating different solutions used at each level.

The realization of technology transfer is divided into several stages, including the patenting of an invention, its licensing, commercial use by the licensee and the perception of royalties by the university (SANTOS; SOLLEIRO; LAHOGUE, 2004). To compose the model, it is necessary to consider aspects of TT in the Innovation Law, such as:

- Art 1 item VIII: incentive to create spaces favorable to innovation and technology transfer;
- Art 6: The public ICT is allowed to enter into a technology transfer and licensing agreement to grant the right to use or exploit creation developed by it alone or through a partnership;
- Art 6º, §7º: The remuneration of the private ICT for the transfer of technology and for the licensing of for use or exploration of creation referred to in §6º of art. 5, as well as research, development and innovation, does not represent an obstacle to their classification as non-profit entities;
- Art 8, §2: The parties shall provide, in a specific legal instrument, the ownership of intellectual property and participation in the results of the exploitation of creations resulting from partnerships, the signatories being guaranteed the right to exploit, to license technology;
- Art 13: The creator is guaranteed a minimum participation of 5% (five percent) and maximum of 1/3 (one third) in the economic gains, earned by ICT, resulting from technology transfer and licensing contracts for granting rights protected use or exploitation of which he was the inventor, breederor author, applying, as appropriate, the provisions of the sole paragraph of art. 93 of Law 9,279 / 93;
- Art 15-A: The ICT of right The public should institute its innovation policy, providing for the organization and management of processes that guide the transfer of technology and the generation of innovation in the productive environment, in line with the priorities of the national science, technology and innovation policy with the industrial policy and national technological technology;
- Art 15-A, Item V: to promote guidelines and objectives for the management of intellectual property and technology transfer;
- Art 15-A, Item VII: for the orientation of institutional actions for training human resources in entrepreneurship, innovation management, technology transfer and intellectual property;
- Art 16, §1, item I: ensure the maintenance of the institutional policy to encourage the protection of creations, licensing, innovation and other forms of technology transfer;
- Art 16, P1, item X: negotiate and manage technology transfer agreements from ICT;

Considering the aspects of the Innovation Law, the model proposed here as well as in the CMM is divided into 6 levels, described below:

Level 0 (Chaotic)- At this level there are no internal regulations, model documents (forms and contracts), people specialized in IP. ICT is aware of the Innovation Law, but has not yet implemented regulations to start the creation of the Technological Innovation Center, incurring in the deficiency or nullity of intellectual property protection and technology transfer activities.

Level 1 (Started)- Has a resolution that regulates the skills of the Technological Innovation Center. The NIT has already been instituted, but there are no defined processes for carrying out tasks for registering intellectual property. Research projects with potential for PI registration are not yet mapped. The NIT does not yet have legal personality instituted to enter into public-private agreements. Registration activities with the INPI are based on and dependent on the experience (know-how) of any employee in the sector.

Level 2 (Managed)- Task execution process for receiving demands and registration with the INPI are already defined. Research projects resulting in intellectual property objects are planned; there is budget planning with expenditures in IP. Basic contract models (assignment) are already provided for by the NIT; prospecting activities are already carried out; knowledge management already exists;

Level 3 (Defined)- The NIT already has a defined legal personality, allowing to enter into public-private agreements; it has the capacity to value technologies; Models of license contracts, provision of technical / scientific assistance services and Franchise are already part of the portfolio; The NIT service catalog is already structured;

Level 4 (Quantitatively Managed)- At this level, NIT manages its intellectual property registration and technology transfer activities as projects; The institution controls its contracts and resources from them; estimates new projects; at this point it already has non-zero TT indicators from the FOMICT report;

Level 5 (Optimized)- The Quantitatively Managed process is reviewed and adapted; ICT monitors the needs and internal changes (contracts, legislation, resources, portfolio) to carry out its activities that will impact the technology transfer process;

As in MPS.BR, the current proposal determines that for each process listed above, a set of process attributes must be executed in order to ensure that the implementation of the maturity model can gradually evolve, for this model, called Control Activity.

AC 01 - The Process is Executed

Objective: Confirm that the process has achieved its purpose;

Checks if the purpose of the process has been met, if the expected result has been achieved.

AC 02 - The Process is Managed

objective: Evidence responsibilities regarding the execution of the process;

Checks whether the role and authority for executing a process has already been defined;

AC 03 - The Process is Adjusted

objective: Confirm that the executed process needs corrections;

Checks the execution of a process, observing differences to determine the causes of the occurrence and corrects them.

The key activities proposed here are essential for the composition of the technology transfer maturity model, based on the criteria of MPS.Br and the PDCA cycle instituted by ISSO 9001. As can be seen in the description above, the key activities represent a continuous cycle verification and validation of processes (goals). For MMTT to reach maturity level 5, the involvement and commitment of ICT / NIT managers and their operational employees is necessary.

For a better understanding of the proposal presented here, table 2 represents the maturity model on a consolidated basis.

Table 2. Maturity Models for Technology Transfer.

MATURITY LEVEL	PROCESS	CONTROL ACTIVITIES
Level 0 (Chaotic)	Elaborate norms for the institution of competences of the NIT in accordance with the Law of Innovation;	AC 01; AC 02; AC 03
Level 1 (Started)	Develop a flow of activities for registering Intellectual Property objects with the INPI;	AC 01; AC 02; AC 03
	Recruit People for NIT;	AC 01; AC 02; AC 03
	Develop internal mapping mechanisms for projects with potential PI and TT registration.	AC 01; AC 02; AC 03
	Defines models of technology transfer contracts - Assignment;	AC 01; AC 02; AC 03
	Elaborate budget action plan;	AC 01; AC 02; AC 03
Level 2 (Managed)	Develop formal mechanisms for receiving IP demands;	AC 01; AC 02;

	Elaborate Catalog of NIT services;	AC 01; AC 02;
	Search for budget control mechanisms;	AC 01; AC 02;
	Seek to institute NIT as a Legal personality;	AC 01; AC 02;
	Management potentials research projects in PI and TT;	AC 01; AC 02;
Level 3 (Defined)	Develops and matures contract models (Licensing and royalties);	AC 01; AC 02; AC 03
	Monitors notices and external resources to promote innovation and TT;	AC 01; AC 02;
	Incubates companies;	AC 01; AC 02;
	Sign research and development agreements;	AC 01; AC 02; AC 03
Level 4 (Quantitatively Managed)	Feeds the FOMICT form annually;	AC 01; AC 02;
	Manages TT projects and contracts;	AC 01; AC 02; AC 03
	Publishes PI and TT management indicators;	AC 01; AC 02; AC 03
Level 5 (Optimized)	Monitors internal changes;	AC 03
	Monitors resource;	AC 03
	Monitors legislation;	AC 03

Source: Prepared by the authors.

Table 2 presented the general idea of the MMTT, with the complete definition of the Maturity Levels, activities to be performed and control activities so that there is a guarantee of execution of tasks in the model.

5 FINAL CONSIDERATIONS

A lot must be done so that the Technological Innovation Centers can achieve high volumes of registration of intellectual property and mainly achieve the transfer of technology. The current Brazilian scenario with numerous budget cuts has put at risk the functioning of the units, which are the main agents with institutionalized Innovation Centers, as shown in the section on the situation of NITs in Brazil.

For some institutions that do not yet have the NIT with legal personality, it is practically impossible to promote innovation management throughout its cycle, with the technology transfer stage being limited to assignment contracts or cooperation without financial gains. Another limitation built into the budget constraint is the process of registering intellectual property objects, generating only additional courses for registering and maintaining intangible assets, with no return.

As much as there are public policies to stimulate innovation, such as the Law on Informatics, the Law on Innovation, the triple helix does not work if there is no technology transfer. Some institutions are still afraid to manage resources coming from the private sector, due to a history of financial management (corruption) problems by foundations, with a focus on crimes against public administration.

There are also situations like the fear of standardizing consultancy activities for research and development, as well as standardizing the division of earnings between inventor and ICT.

It is essential that there are people motivated and committed to promoting Innovation and innovation management in ICTs,

The management of human resources trained in intellectual property is fundamental for the proper functioning of the NITs, as well as activities and well-defined execution processes, so that institutions leave level 0 (chaotic) as presented in this MMTT. In the FORMICT report it is possible to observe that the workforce in some NITs is made up of a few public sector employees and in some cases, it is balanced with the use of interns.

Level 1 of this MMTT provided a set of activities necessary for the nucleus to seek the formalization of its activities, search for budgetary resources, human resources, as well as the definition of basic contract models for the assignment of intellectual property rights, even if not looking for financial return to promote other research projects, it is possible to promote some type of technology transfer and improve the MCTIC indicators in the unit.

The proposed level 2 aims to allow the management of demands at the NITs, by means of demand request resources, in the form of forms (systems or documents), as well as a portfolio for knowledge and dissemination of the activities developed at the NIT. The search for legal personality is part of this level, as it is essential for management that the NIT can manage TT resources and agreements;

At level 3 it is assumed that the NIT already has legal personality and can manage any type of TT contract, and already has its service portfolio updated and disclosed to the community. This level is essential because it is the level where the institution is able to carry out the necessary interactions between university and industry.

Levels 4 and 5 represent levels of maintenance of management activities and evolution in the activities of the NIT. Such management is of paramount importance for the innovation management cycle to be fed back, reducing the risks on the management of the signed TT contracts.

Putting this conceptual model into practice is not easy, validating this idea may require organizational cultural changes, impacting the work processes and methodology in some NITs. The creation of the model also required a mixture of concepts from TRL, CMMI, MPS.BR and ISSO 9001, such processes were fundamental to understand how to assemble a model in a structured way. It is expected in future works to validate this study in ICTs that do not fit in any level and to obtain feedback for the improvement of MMTT.

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