Perception Model for Selecting Patentable Technologies

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Abstract

With the development of new technologies, it is necessary to develop new tools for verification and assessment for their protection by the institutions. Therefore, this study aims to build and validate the perception model for selecting patentable technologies. In relation to the methodology, a structured questionnaire was applied with the members of the National Institutes of Science and Technology (INCT), and structural equation modeling was used to examine the relationships between latent variables. The results show that five hypotheses were tested, all of which were tested and validated. Two complementary models were developed, the first being, to better adjust the model, the market construct was removed. The second model analyzed the four constructs, but it was noticed that, without the market construct, the adjustment indices are more adequate, according to what is presented in the literature as recommended indices. Thus, it is noted that the proposed model can contribute to improving the process of appreciating the technologies produced by Universities.

Keywords: assessment of technologies; structural equation modeling; technologies; patents.

1. Introduction

A country's innovation and technological development depends, both on trained human resources and on consistent investments. Brazil has adopted the strategy that academic research can generate knowledge that can be transformed into technological innovations, and these innovations can contribute to job creation, resource generation or reduction of production costs, resulting in social and economic gains for a country (FELIPE, 2007; BERNARDI et al., 2010).

In addition, to analyze the technology management process, which allows the best use of new technologies for organizations that develop and apply this new knowledge, there are two perspectives: one that seeks the development of new products, but focused on the context of the firm ; and another that involves technologies generated in institutions that do R&D, but do not implement, in a primordial way,

new technologies in the form of products, these being universities and research institutions (GARNICA; TORKOMIAN, 2009).

In the process of analyzing patents or developed technology, it may happen that the technology is not adequate or is inopportune, that is, it appeared late or long before the market maturity (ADRIANO; ANTUNES, 2017).

Assessing the technological potential, patentability and also the commercial potential of inventions developed at universities corresponds to a difficult process, which is often subject to evaluation errors, which can be detrimental when sorting or selecting products and processes built through research in universities (GAMA et al., 2013).

This research is justified by the search for the construction of a model that helps to understand how the process of assessment for protection of technologies can be carried out. Therefore, this research aims to build and validate the perception model for selecting patentable technologies.

2. Technology Selection

Building and managing an IP portfolio is an important means for a successful innovation and TT program. TT offices assist in the creation of strategic processes and the development of tools that assist in the commercialization, protection and management of technologies. However, the newly created offices at Universities, as they have small technology portfolios, do not allow them to develop tools and strategies to assist in the commercialization of the technologies created, which are often at an incipient stage of development (GAMA et al., 2013).

It is important to emphasize that the concern with technological management aimed at the academic environment is related to research activities that result in new knowledge that is likely to be transformed into technologies that can be commercialized in the market (GARNICA; TORKOMIAN, 2009).

For this reason, to assess the chances of implementing technologies in the market, it is necessary to check the following factors: the stage of development, the feasibility of protecting the invention and the nature and complexity of the market. These factors may or may not be complementary. Patentability indicators can guide decisions opposed to those arising from market indicators, and vice versa. An invention may be suitable for patent protection, but have no market potential. On the other hand, it may be commercially viable, but not be able to protect it due to the state of the art (GAMA et al., 2013).

The improvement of the impact assessment processes of new technologies can bring benefits to companies, as well as to public research institutions, by increasing the quality of their products (technologies) and services, and decreasing efforts for their production. But the effective participation of the potential of human resources is necessary to contribute to the generation of patentable products and processes with high added value (BERNARDI et al., 2010; FELIPE, 2007).

A patent is only valuable when used, it is an intangible product that produces tangible products, and its life cycle in the market is geared to the life cycle of the products that are generated by this patent, but there is a moment that it must be obsolete, therefore, the need to evaluate the commercialization potential of technologies developed by companies and universities (ADRIANO; ANTUNES, 2017).

However, it is understood that one of the main problems faced by academic NITs corresponds to the very

incipient stage of technologies that are developed in universities, as these are usually closer to the level of a discovery than to a finished product. In addition, it showed that American NITs have been developing tools over the years that facilitate and bring a little more precision to the evaluation process (GAMA et al .; 2013).

Still, Gama et al. (2013) highlight that there are relevant factors to carry out the selection process (screening) or prioritization of technologies, which are: title, inventors, stage of development, ease of protection and market.

2.1 Market

With regard to the market, this factor allows to verify the market needs to analyze whether the technologies developed surpass those already existing in this, in addition to seeking to evaluate the products already existing on the market and to analyze how innovation surpasses these products or competes with them (GAMA et al., 2013).

However, for Kotler (2000), companies that plan to promote their new products must decide when is the best time to enter the market, since it is necessary to identify their needs and gather information to develop or insert new products in it.

In addition, the insertion of a technology in the market can occur through the transfer of technology, which has the characteristic of transmitting knowledge, designed by a party that owns the technology, to third parties, such as private or public companies, educational institutions and research groups (SILVA; VIEIRA JÚNIOR; LUCATO, 2013).

In view of this, the following hypothesis can be evidenced for the market analysis:

H1: The market has a positive influence on the development stage.

2.2 Protection Facility

The ease of protection emphasizes the analysis of the geographic location of the market and whether patent protection worldwide is necessary and/or can be obtained, as this will allow to verify the protection costs of a single technology in different markets (GAMA et al ., 2013).

Still, the protection granted by the patent is not eternal, organizations that do not innovate continuously can be overtaken by companies that innovate with new products and processes. In turn, the granting of the patent allows the author to have exclusive exploitation, making it impossible for third parties to produce or use the products and processes resulting from this patent during a certain period (PORTER, 1986; TEH; KAYO; KIMURA, 2008).

Based on the information above, the following hypothesis arises:

H2: The ease of protection positively influences the market.

H3: The ease of protection positively influences ownership and inventors.

2.3 Development Stage

The development stage makes it possible to verify whether the researcher already has results that show the viability of the technology and the capacity of this technology for commercial purposes (GAMA et al., 2013).

In addition, it is understood that in the process of developing a new product there is the generation and selection of ideas, in which the product is developed and marketed, with the purpose of deciding whether those selected ideas should be developed or abandoned (DUTRA; GARCIA , 2011).

In turn, Gama et al. (2014) explain that this stage of development also involves the risk that an organization may suffer if it carries out the licensing of the technology produced, making it possible to analyze the decision to protect or not this technology.

Based on the presented theory, the following hypothesis is analyzed:

H4: The stage of development positively influences the ease of protection.

2.4 Ownership and Inventors

Ownership allows you to know if there is dependence on any other patented technology, and there may be restrictions on the office's ability to license it. Besides that there may be other inventors external to the institution and financial obligations or not of the Institutions of Science and Technology (ICT) with the institution that financed (or co-financed) the research, which can decrease the financial return to ICT and make the less attractive licensing (GAMA et al., 2013).

Still, patent ownership is a subject that must be considered in the context in which the development of new relationships between universities and companies occurs within the scope of their cooperation and possible emergence of inventions (GARNICA; OLIVEIRA; TORKOMIAN, 2006).

Regarding the inventors, Gama et al. (2013) explain that these are related to ownership, as it is related to the employment relationship of the inventor (s). This factor allows to verify if there is fragmentation of the know-how associated with the technology between several people, as this can make it difficult to transfer this know-how to the licensed company, which makes the chances of licensing less.

In turn, ownership is also important for the management of intellectual property, as it determines the rights and obligations of co-owners in matters related to the exploitation of results that involve research carried out jointly between two or more institutions (MACEDO; BARBOSA, 2000).

H5: Ownership and inventors positively influence the stage of development.

3. Methodology

The study is characterized as quantitative exploratory, with the population of researchers from the National Institutes of Science and Technology (INCT). The analysis was carried out through the application of a structured questionnaire (Appendix 1).

This questionnaire, contained in the appendix, was approved by the Research Ethics Committee (CEP), with opinion number 2.412.977 and the Certificate of Presentation for Ethical Appreciation - CAAE No.: 79910617.8.0000.5546 was assigned.

Data were collected between May 2019 and March 2020, through the application of the questionnaire, with 258 questionnaires being collected, a result that exceeds the value of a 95% CI and an error of 6%, which corresponds to 255.

In addition, the model studied for the selection of technologies involves four variables, as described in Table 1. The structural equation model (SEM) and factor analysis were used to test the hypothesis

relationships and the AMOS software to analyze the hypothetical models. In addition, the relationships of the constructs were tested separately, to then analyze the relationship between them.

Table 1. Proposed Structural Model

Observable Variables		Theoretical Reference	Latent Variables
TI01	There are other inventors and owners outside the institution	Gama et al., 2013; Garnica; Oliveira; Torkomian, 2006	Ownership and Inventors
TI02	Dependence on some other patented technology granted or required		
TI03	There are financial and copyright obligations of the Science and Technology Institutions (ICTs) with the institution that financed (or co-financed) the research		
TI04	There is an internal technology sponsor		
TI05	There is fragmentation of know-how associated with technology among several people		
ED01	There is a technology differential in relation to the State of the Art	Gama et al., 2013; Dutra; Garcia, 2011; Gama et al., 2014	Development Stage
ED02	The potential of technology for industry		
ED03	Technical and functional data (access to data, information, expertise and know how) are available		
ED04	The information shows that the product/process/service has a novelty, inventive act or activity and industrial application, in the form of LPI		
ED05	The technology presents technological, economic, social or environmental risks of production		
FP01	Assess current and public domain patent portfolio of potential competitors	Gama et al., 2013; Porter, 1986; Teh; Kayo; Kimura, 2008	Protection Facility
FP02	Measure technological prospecting from the perspective of the state of the art		
FP03	Claims to verify whether they facilitate or hinder technology protection		
FP04	There was a search for anteriority from the perspective of the unionist priority (novelty requirement)		
FP05	The product/process has distribution channels for dissemination and commercialization		
M01	Houve levantamento das necessidades de mercado	Gama et al., 2013; Kotler, 2000; Silva; Vieira Júnior; Lucato, 2013	Market
M02	The technology presents strategies for marketing the product / process		
M03	The technology has the potential to be inserted in the market		
M04	The technology was developed / licensed through direct and / or assisted negotiation with technology transfer companies		
M05	The technological solution was implemented by a technological order contract for a specific case		
The scale used was the Likert agreement of 5 points: 1 - Totally disagree; 2 - Disagree; 3 - Indifferent; 4 - I agree; 5 - I totally agree.			

Source: Elaborated by the authors (2020)

The univariate procedures for outliers were performed, and this analysis is carried out by identifying cases that are far from the average. Atypical observations can be excluded when scores are repeated in more than two variables and also when there is repetition in atypical multivariate observations (HAIR Jr. et al., 2009).

In the case of univariate analysis, there was no outlier, but in multivariate analysis, questionnaires 105, 132 and 207 were considered outliers; therefore, they were disregarded in the analysis, and the sample analyzed in the models became 255 respondents.

In addition, the normality test was applied using asymmetry and kurtosis measures (KLINE, 2005), as highlighted in Table 2. Regarding asymmetry measures, it is understood that if it is unbalanced or is detached to one side, it is recommended that values above | 3 | indicate an asymmetric distribution, that is, they are not accepted. In kurtosis measures, score values up to 10 are accepted, since they guarantee normality (HAIR Jr. et al., 2009; KLINE, 2005). It can be seen that the assumption of normality of asymmetry was achieved, since the values varied between -0.285 and -1.223. Regarding kurtosis values, these ranged between -1.168 and 1.766.

Table 2. Normality test for skewness and kurtosis

Variables	Skewness		Kurtosis	
	Statistic	Standard Error	Statistic	Standard Error
TI01	-0.958	0.152	-0.178	0.302
TI02	-0.523	0.152	-0.886	0.302
TI03	-0.758	0.152	-0.425	0.302
TI04	-0.323	0.152	-1.075	0.302
TI05	-0.674	0.152	-0.563	0.302
ED01	-1.212	0.152	1.265	0.302
ED02	-1.223	0.152	1.749	0.302
ED03	-1.007	0.152	0.625	0.302
ED04	-1.359	0.152	1.766	0.302
ED05	-0.577	0.152	-0.988	0.302
FP01	-0.901	0.152	0.417	0.302
FP02	-1.057	0.152	1.112	0.302
FP03	-0.729	0.152	0.061	0.302
FP04	-1.013	0.152	0.715	0.302
FP05	-0.379	0.152	-0.706	0.302
M01	-0.647	0.152	-0.442	0.302
M02	-0.488	0.152	-0.728	0.302
M03	-1.047	0.152	0.853	0.302
M04	-0.285	0.152	-0.924	0.302
M05	-0.114	0.152	-1.168	0.302

Source: Elaborated by the authors, based on the results of SPSS (2020).

In the analysis of linearity, scores between 0.0 and 0.4 show a bad correlation, 0.4 and 0.6 highlight low correlation, between 0.6 and 0.8 suggest medium correlation, from 0.8 to 0.9 indicate good correlation and between 0.9 to 1.0 show high or excellent correlation (HAIR Jr. et al., 2009). With regard to the correlation analysis shown in Table 3, it is understood that high correlation values were not obtained, with the highest value being 0.567.

Table 3. Pearson correlation for linearity analysis

Constructs	TI	ED	FP	M
Ownership and Inventors	1			
Development Stage	0.420**	1		
Protection Facility	0.333**	0.567**	1	
Market	0.275**	0.369**	0.512**	1

Source: Elaborated by the authors, based on the results of SPSS (2020).

Note: (**) The correlation is significant at the 0.01 level (2 ends).

Regarding the multicollinearity test, it can be seen in Table 4 that multicollinearity problems were not detected, since for Hair Jr. et al. (2009) the tolerance varies between 0 and 1; therefore, these values should be between 0.1 and 1, showing a small degree of multicollinearity.

Table 4. Multicollinearity test

Constructs	Variables	Tolerance Value	VIF*
Ownership and Inventors	TI02	0.676	1.480
	TI03	0.584	1.712
	TI04	0.626	1.597
	TI05	0.651	1.535
Development Stage	ED01	0.589	1.697
	ED02	0.484	2.067
	ED03	0.595	1.681
	ED04	0.546	1.831
	ED05	0.610	1.641
Protection Facility	FP01	0.406	2.464
	FP02	0.472	2.121
	FP03	0.684	1.463
	FP04	0.636	1.573
	FP05	0.625	1.600
Market	M01	0.399	2.504
	M02	0.411	2.436
	M03	0.620	1.613
	M04	0.387	2.583
	M05	0.385	2.595

Source: Elaborated by the authors, based on the results of SPSS (2020).

Note: (*) Variance Inflation Factor.

Table 5 highlights the results of the KMO statistic and the Barlett sphericity test, which showed that they are suitable for application, since, according to the KMO interpretation scale used by Hair Jr. et al. (2009), for a KMO interval equal to or greater than 0.8, the adequacy of the sample is admirable.

Table 5. KMO and Bartlett test

Kaiser-Meyer-Olkin measure of sampling adequacy		0.816
Bartlett's sphericity test	Approx. Chi-square	1896.204
	GL	190
	Sig.	0.000

Source: Elaborated by the authors, based on the results of SPSS (2020).

In addition, there are adjustment quality indices that must be observed when modeling structural equations, these being the CMIN/DF (chi-square on degrees of freedom), CFI (comparativefit index), GFI (goodnessof it index), TLI (Tucker-Lewis index) and RMSEA (root mean error of approximation) (MARÔCO, 2010). Table 6 shows the following comparative adjustment measures.

Table 6. Adjustment index

	Measures	**Recommended values**
Absolute	Degrees of Freedom Chi-square (χ2/ GL)	χ2/GL < 5 Kline (2005)
	Goodnessof Fit (GFI)	GFI > 0,9 Hair Jr. et al. (2009)
	Root Mean Square Error of Approximation (RMSEA)	RMSEA < 0.08 Hair Jr. et al. (2009)
	Standardized Root Mean Square Residual (SRMR)	SRMR < 0,1 Kline (2005)
	Adjusted Goodness of Fit (AGFI)	AGFI > 0.8 Hair Jr. et al. (2009)
Incremental	Tucker-Lewis Index (TLI)	TLI > 0.95 Bagozzi e Yi (2012)
	Normed Fit Index (NFI)	NFI > 0,9 Byrne (2010)

Source: Elaborated by the authors (2020)

4. Results

With regard to the results found, questionnaires were applied with the members of the INCT, with 258 questionnaires being collected, a result that exceeds the value of a 95% CI and an error of 6%, which corresponds to 255. Regarding the profile of the researchers, the information that is described below was collected.

Table 7. Gender of researchers

Genre	Research	%
Male	177	68,6
Feminine	80	31
Other	1	0,4
Total	258	100

Source: Elaborated by the authors (2020)

Table 7 shows that the majority of researchers who answered the survey questionnaire are male, 68.6% (177), followed by female with 31% and only one researcher as gender another 0.4% (1).

Table 8. Researchers' education

Education	Researchers	%
Doctorate degree	245	95
Master's	11	4,2
Specialization (lato sensu)	1	0,4
University graduate	1	0,4
Total	258	100

Source: Elaborated by the authors (2020)

Regarding the education of the researchers, it can be seen in Table 8 that the majority of researchers have a PhD, 95% (245), 4.2% (11) have a Master's degree, 0.4% (1) have a Specialization and 0 , 4% (1) have an undergraduate degree.

Table 9. 10 Institutions affiliated to Researchers

Institution	Researchers
University of São Paulo (USP)	34
Federal University of Rio de Janeiro (UFRJ)	24
Oswaldo Cruz Foundation (FIOCRUZ)	14
Brazilian Agricultural Research Corporation (Embrapa)	9
Federal University of Ceará (UFC)	8
Federal University of Sergipe (UFS)	6
University of Brasilia (UnB)	6
National Institute of Industrial Property (INPI)	5
Fluminense Federal University (UFF)	5
Federal University of Paraíba (UFPB)	5
Total	116

Source: Elaborated by the authors (2020)

Regarding the institution to which the researcher is linked, Table 9 shows the 10 institutions that

presented more than 4 researchers. It was noticed that most researchers are linked to the University of São Paulo (USP), 34. In addition to USP, 22 researchers are linked to the Federal University of Rio de Janeiro (UFRJ), 14 to the Oswaldo Cruz Foundation (FIOCRUZ), 9 to the Brazilian Agricultural Research Corporation (Embrapa) and 8 to the Federal University of Ceará (UFC).

Table 10. INCT Area

INCT	Researchers	%
Health	79	31
Exact and Natural	54	21
Engineering and Information Technology	39	15
Agrarian	24	9
Ecology and Environment	20	8
Nanotechnology	17	7
Human and Social	16	6
Energy	9	3
Total	258	100

Source: Elaborated by the authors (2020)

In turn, Table 10 shows that 31% (79) of the researchers are from the Health area, 21% (54) are Exact and Natural, 15% (39) are from Engineering and Information Technology, 9% (24) are from Agrarian, 8% (24) from Ecology and Environment, 7% (17) are from Nanotechnology, 6% (16) are from Human and Social and only 3% (9) from Energy. The Health area had the highest number of respondents to the questionnaire, and this can be explained due to the fact that this health INCT has the largest number of institutes and the largest number of researchers (INCT, 2008).

Table 11. Category in the Research Project

Category	Researchers	%
Member	104	40
Coordinator	86	33
collaborator	68	27
Total	258	100

Source: Elaborated by the authors (2020)

Table 11 highlights the category in which the researchers participated in the research project, with the majority participating as a member, 40% (104), followed by 33% (86) who participated as coordinator and 27% (68) who participated as collaborator.

4.1 Model Validation

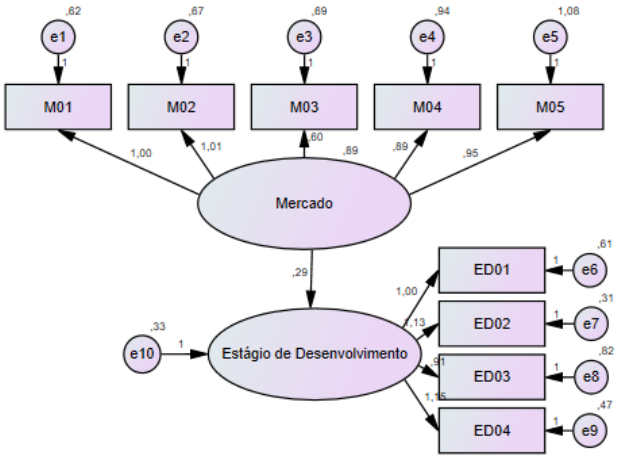
To understand the effects of the research variables and their relationship to the selection of patentable technologies, some models of structural equations (SEM) were used to test the hypothesis relationships.

Therefore, the relationship of each construct was tested separately, to then analyze the joint relationship of these constructs.

4.2 Model H1 - There is market influence on the stage of development

The first tested model sought to analyze the relationship between the market and the development stage, the result of which shows that these constructs have a positive and significant relationship (β = 0.29; p = 0.000), as can be seen in Figure 1.

Figure 1. Model H1: Market and Stage and Development



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 12 showed the adjustment indexes obtained, which show the values that demonstrate the model's validity. It is noticed that the adjustment measures are slightly below the expected indexes, as highlighted in this table.

Table 12. H1 adjustment indexes

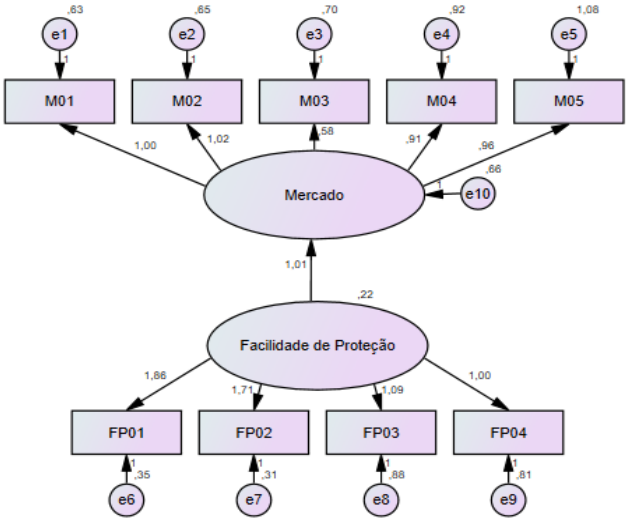
Model	Absolute				Incremental	
	χ2/GL < 5	GFI > 0.9	RMSEA < 0.08	AGFI > 0.8	NFI > 0.9	CFI > 0.9
	7.078	0.866	0.154	0.769	0.786	0.809

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.3 Model H2 - The influence of ease of protection on the market

In the second model, the relationship between the construct of easy protection and the market was verified. It can be seen, in Figure 2, that there is a positive and significant relationship (β = 1.01; p = 0.000).

Figure 2. Model H2: Ease of Protection and Market



Source: Elaborated by the authors, based on the results of SPSS (2020).

The indices indicate that they are not very suitable for the parameters proposed in the literature, which are highlighted in Table 6.

Table 13. H2 adjustment indexes

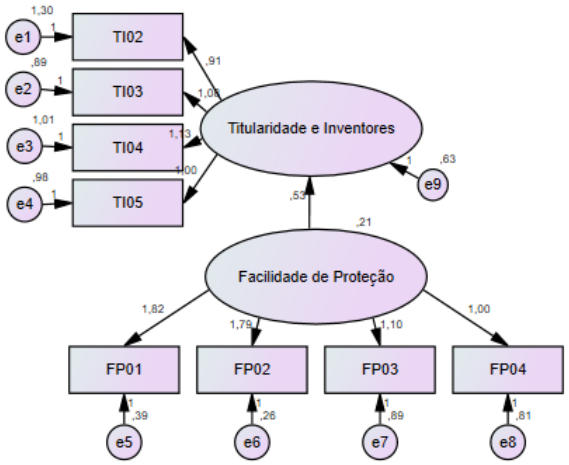
Model	Absolute				Incremental	
	χ2/GL <5	GFI > 0.9	RMSEA < 0.08	AGFI > 0.8	NFI > 0.9	CFI > 0.9
	7.162	0.865	0.155	0.766	0.788	0.809

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.4 Model H3 - The influence of ease of protection on ownership and inventors

Regarding the ease of protection and ownership and inventors constructs, it was found that there is a positive and significant influence (β = 0.53; p = 0.002), as highlighted in Figure 3.

Figure 3. Model H3: Protection Facility, Ownership and Inventors



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 14 shows that the adjustment measures are adequate for most indexes.

Table 14. H3 adjustment indexes

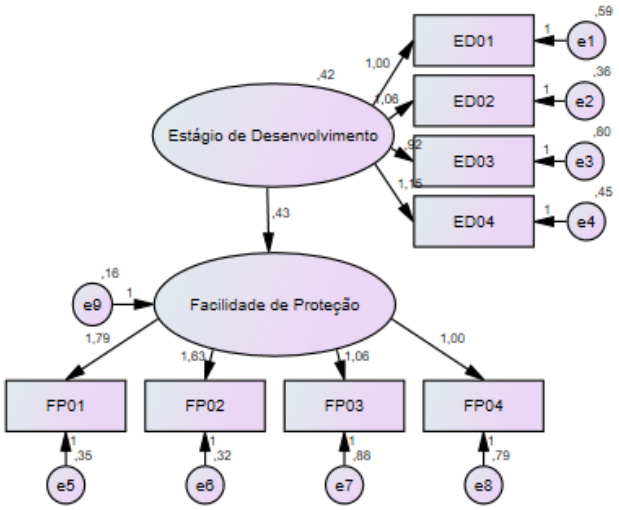
Modelo	Absoluto				Incremental	
	χ2/GL < 5	GFI > 0.9	RMSEA < 0.08	AGFI > 0.8	NFI > 0.9	CFI > 0.9
	2.184	0.961	0.068	0.927	0.920	0.954

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.5 Model H4 - The influence of the development stage on the ease of protection

The analysis regarding the development stage and ease of protection confirmed that it has a positive and significant influence (β = 0.43; p = 0.000), as can be seen in Figure 4.

Figure 4. Model H4: Development Stage and Ease of Protection



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 15 showed that the adjustment indices, which indicate the quality of the model, are mostly adequate.

Table 15. H4 adjustment indexes

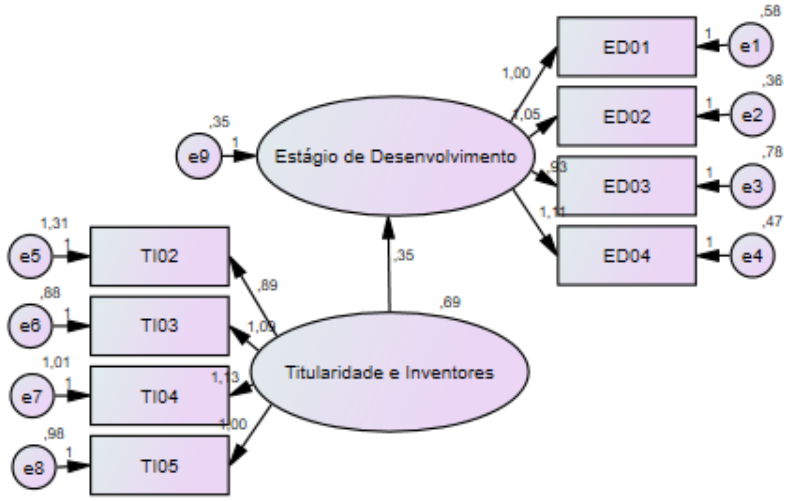
Model	Absolute				Incremental	
	χ2/GL < 5	GFI > 0.9	RMSEA < 0.08	AGFI > 0.8	NFI > 0.9	CFI > 0.9
	2.725	0.945	0.082	0.913	0.918	0.946

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.6 Model H5 - The influence of ownership and inventors on the stage of development

Figure 5 showed that there is a positive relationship between the constructs ownership and inventors, and the stage of development (β = 0.35; p = 0.001).

Figure 5. Model H5: Ownership and Inventors, Development Stage



Source: Elaborated by the authors, based on the results of SPSS (2020).

The adjustment measures of the H5 model are adequate to the indices, as seen in the results highlighted in Table 16.

Table 16. H5 adjustment indexes

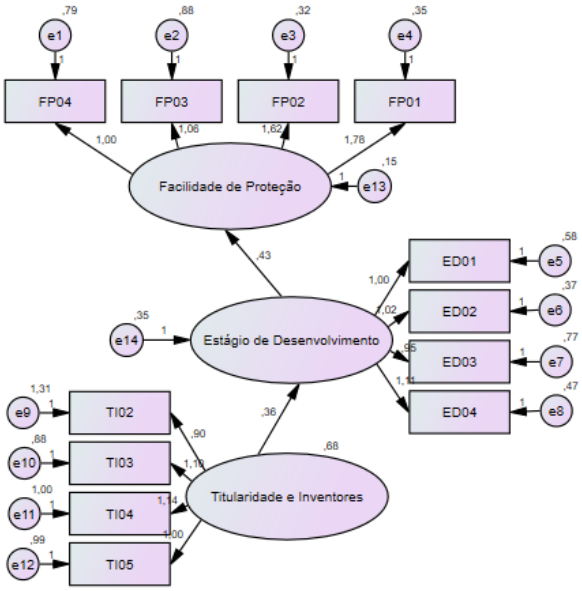
Model	Absolute				Incremental	
	χ2/GL <5	GFI > 0,9	RMSEA < 0,08	AGFI > 0,8	NFI > 0,9	CFI > 0,9
	2,383	0,961	0,073	0,927	0,916	0,949

Source: Elaborated by the authors, based on the results of SPSS (2020).

4.7 Complete Models

In complete model 1, shown in Figure 6, the three constructs were analyzed together; only the market construct was withdrawn.

Figure 6. Complete Model 1



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 17 showed the adjustment indexes for this model, verifying that the values are mostly adequate for a good adjustment of the model.

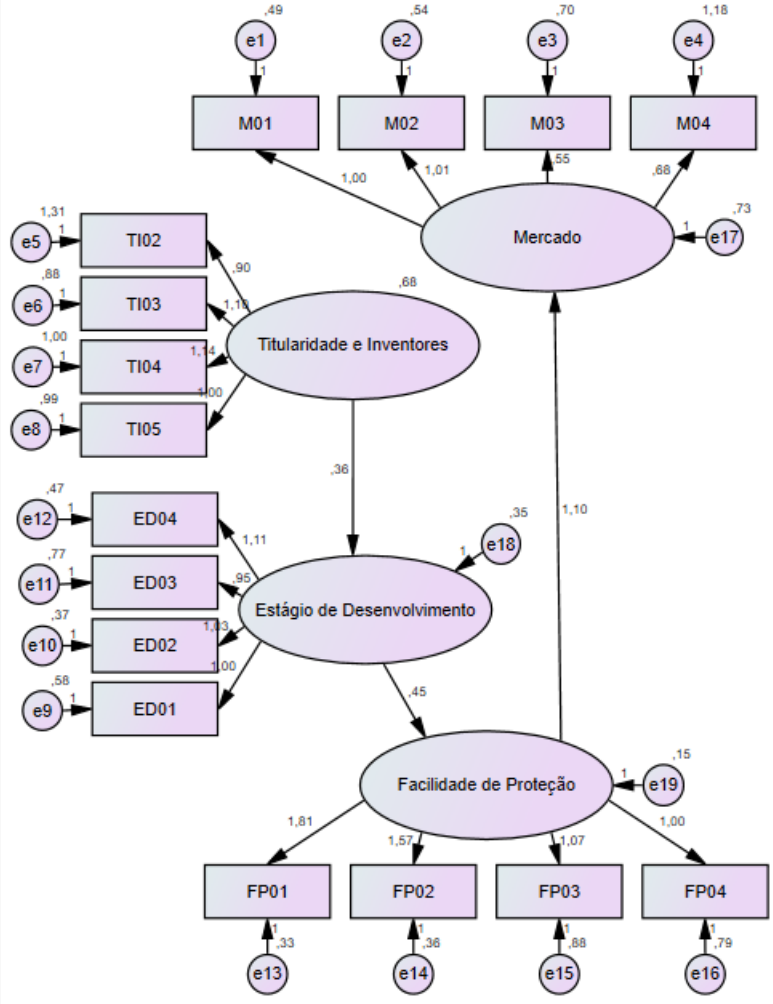
Table 17. Adjustment indexes of the complete model 1

Model	Absolute				Incremental	
	χ2/GL < 5	GFI > 0,9	RMSEA < 0,08	AGFI > 0,8	NFI > 0,9	CFI > 0,9
	2,205	0,934	0,068	0,901	0,877	0,928

Source: Elaborated by the authors, based on the results of SPSS (2020).

In addition, the complete model 2 was created, shown in Figure 7, which jointly analyzes the four constructs.

Figure 7. Complete Model 2



Source: Elaborated by the authors, based on the results of SPSS (2020).

Table 18 shows the adjustment indexes for this model, verifying that some values are slightly below the stipulated for a good adjustment of the model.

Table 18. Adjustment indexes of the complete model 2

Model	Absolute				Incremental	
	χ2/GL < 5	GFI > 0,9	RMSEA < 0,08	AGFI > 0,8	NFI > 0,9	CFI > 0,9
	2,482	0,893	0,076	0,855	0,822	0,884

Source: Elaborated by the authors, based on the results of SPSS (2020).

5. Conclusion

It was noticed, throughout this study, with the application of the questionnaire that most of the respondents are doctors and it was evidenced that some of these are linked to the University of São Paulo (USP) and are members of the INCT in the Health area, showing the growth in health-related research.

Regarding the model, the four constructs were analyzed and adjustments were made to obtain an adequate model of perception for the selection of patentable technologies. In view of this, it can be verified which variables influence the assessment process to protect technologies.

The structural equation model, through which three constructs were analyzed together, showed that the construct stage of development influences the ease of protection and the construct ownership and inventors influences the stage of development.

However, a new model was created analyzing the four constructs, highlighting that the construct of protection eases the market. However, it was noted that even though the model had a positive and significant influence, the adjustment indices showed a value slightly lower than that of the literature, different from the indices analyzed in the three-construct model that presented the most adequate values.

This model shows how much it is necessary to pay attention to ownership and stage of development so that this favors the ease of protection of what is being developed, since it is necessary to check if there is any pending of some other patented technology, if the researcher already has results that evidence the viability of the technology created.

In addition, it was noted that the market construct was not considered important in the adjustment of the model, since it presented adjustment rates slightly lower than recommended in the literature; in addition, it is understood that the insertion of technologies in the market can and must come through the technology transfer process, that is, it comes after the process of protecting this technology.

Thus, it was understood that the model built with the four constructs allows the variables that influence the assessment process to protect technologies to be verified, in order to facilitate the selection of technologies that can be patented and later marketed on the market.

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7. References

[1] Adriano, E., & Antunes, M. T. P. (2017). Proposta para Mensuração de Patentes. *Revista de Administração Contemporânea*, 21(1), pp.125-141.

[2] Bagozzi, R. P., Y. Yi. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the Academy of Marketing Science,* 40, pp. 8-34.

[3] Bernardi, A. C. C., Rodrigues, A. A., Mendonça, F. C., Tupy, O., Barioni Junior, W, & Primavesi, O. (2010). Analysis and improvement of the process of economic, social, and environmental impact assessment of technologies from Embrapa Pecuária Sudeste. *Gestão & Produção*, 17(2), p. 297-316, 2010.

[4] Byrne, B. M. (2010). *Structural equation modeling with AMOS:* Basic concepts, applications, and programming. 2. ed. Routledge Taylor & Francis Group.

[5] Dutra, A. C.; Lopes, C. S.; Garcia, M. H. (2011). Marketing de novos produtos lançamento e inovação. *In:* Encontro Científico e Simpósio de Educação Unisalesiano, Disponível em: <http://www.unisalesiano.edu.br/simposio2011/publicado/artigo0137.pdf>. Acesso: 25 mar. 2020.

[6] Felipe, M. S. S. (2007). Desenvolvimento tecnológico e inovação no Brasil: desafios na área de biotecnologia. *Novos Estudos - CEBRAP*, 78, pp. 11-14.

[7] Gama, G. J., Toledo, P. T. M., Eberhart, D. E., & Widener, R. M. (2014). Métodos e ferramentas para avaliação de tecnologias em estágio embrionário. *In:* Silva, G. F.; Russo, S. L. Capacite: os caminhos para a inovação tecnológica. São Cristóvão: Editora UFS.

[8] Gama, G. J., Toledo, P. T. M., Eberhart, D. E., & Widener, R. M. (2013). Triagem de Tecnologias – ferramenta para a construção e gestão de um portfólio tecnológico robusto em inovação e transferência de tecnologia. *Revista GEINTEC*, 3(2), pp.239-258.

[9] Garnica, L. A., Oliveira, R. M., & Torkomian A. L. V. (2006). Propriedade intelectual e titularidade de patentes universitárias: um estudo piloto na Universidade Federal de São Carlos – UFSCar. *In:* XXIV Simpósio de Gestão da Inovação Tecnológica, 2006. Disponível em: <http://www.anpad.org.br/admin/pdf/DCT456.pdf>. Acesso: 25 mar. 2020.

[10] Garnica, L. A, & Torkomian, A. L. (2009). Gestão de tecnologia em universidades: uma análise do patenteamento e dos fatores de dificuldade e de apoio à transferência de tecnologia no Estado de São Paulo. *Gestão & Produção,* 16(4), pp. 624-638.

[11] Hair, Joseph. F., Black, W. C., Babin, B. J., Anderson, E., & Tathan, R. L. (2009). *Análise Multivariada de Dados.* 6. ed. Porto Alegre: Bookman.

[12] Kline, R. B. (2005). *Principles and practice of structural equation modeling.* 2. ed. New York, Estados Unidos: Guilford Press.

[13] Kotler, P. (2000). *Administração de Marketing.* 10ª Ed. 7ª reimpressão. São Paulo: Prentice Hall.

[14] Macedo, M. F. G., & Barbosa, A. L. F. (2000). *Patentes, pesquisa e desenvolvimento.* 20. ed. Rio de Janeiro, Fiocruz.

[15] Marôco, J. (2010). *Análise de equações estruturais:* Fundamentos teóricos, software aplicações. 2. ed. Lisboa: ReportNumber.

[16] Portal INCT. (2018). *Institutos*. Disponível em: <http://inct.cnpq.br/institutos/>. Acesso em: 05 mar. 2018.

[17] Porter, M. E. (1986). *Estratégia competitiva: técnicas para análise de indústrias e da concorrência.* Rio de Janeiro: Campus.

[18] Silva, R. C., Vieira Júnior, M, & Lucato, W. C. (2013). Proposta de procedimento de transferência de tecnologia. *Exacta – EP,* 11(1), pp. 115-122.

[19] Teh, C. C., Kayo, E. K., & Kimura, H. (2008). Marcas, patentes e criação de valor. *RAM, Rev. Adm. Mackenzi*e, 9(1), pp. 86-106.

Appendix

Appendix 1.

Dear Researcher

I am Cleide Ane Barbosa da Cruz, student of the PhD in Intellectual Property Science at the Federal University of Sergipe, I am under the guidance of Professor Dra. Ana Eleonora Almeida Paixão. I would like to request that you participate in a survey by filling in some questions. The data collected will be used in my thesis research, entitled “Perception Model for the Selection of Patentable Technologies”. This study will enable the development of a tool for screening patentable technologies. Participation in this study is voluntary and you are free to withdraw your consent at any time and thus no longer participate in the study, without causing any harm to you. Your identity and privacy will be preserved. The information in this research will be disclosed only in scientific events or publications, with no identification of the volunteers.

It is important to note that the project was approved by the Human Research Ethics Committee, process number: 2,412,977.

If you have any questions, please contact me by e-mail: cleideane.barbosa@bol.com.br.

Identificação do(a) Pesquisador(a):

1. Gender:
( ) Male
( ) Feminine
( ) Other

2. Degree of Education:
( ) University graduate
( ) Specialization (lato sensu)
( ) Master's
( ) Doctorate degree

3. The institution to which the researcher is linked?

_____

4. What area of the INCT did you participate or participate as a member?
( ) Agrarian
( ) Energy
( ) Engineering and Information Technology
( ) Exact and Natural
( ) Human and Social
( ) Ecology and Environment
( ) Nanotechnology
( ) Health

5. Which category did you participate in the research project?
( ) Coordinator
( ) Member
( ) Collaborator

Instructions: Regarding the following items, rate disagreeing or agreeing with what you consider important to be analyzed in the technology screening process at Universities.
1 - Strongly Disagree
2 - Disagree
3 - Indifferent
4 - Agree
5 - Strongly Agree

ITEM: Ownership and Inventors (GAMA et al., 2013; GARNICA; OLIVEIRA; TORKOMIAN, 2006)

Items	Classification
There are other inventors and owners outside the institution	1 2 3 4 5
Dependence on some other patented technology granted or required	1 2 3 4 5
There are financial and copyright obligations of the Science and Technology Institutions (ICT) with the institution that financed (or co-financed) the research	1 2 3 4 5
There is an internal technology sponsor	1 2 3 4 5
There is fragmentation of know-how associated with technology among several people	1 2 3 4 5

ITEM: Development Stage (GAMA et al., 2013; DUTRA; GARCIA, 2011; GAMA et al., 2014)

Items	Classification
There is a technology differential in relation to the State of the Art	1 2 3 4 5
The potential of technology for industry	1 2 3 4 5
Technical and functional data (access to data, information, expertise and know how) are available	1 2 3 4 5
The information shows that the product / process / service has a novelty, inventive act or activity and industrial application, in the form of LPI	1 2 3 4 5
The technology presents technological, economic, social or environmental risks of production	1 2 3 4 5

ITEM: Protection Facility (GAMA et al., 2013; PORTER, 1986; TEH; KAYO; KIMURA, 2008)

Items	Classification
Assess current and public domain patent portfolio of potential competitors	1 2 3 4 5
Measure technological prospecting from the perspective of the state of the art	1 2 3 4 5
Claims to verify whether they facilitate or hinder technology protection	1 2 3 4 5
There was a search for anteriority from the perspective of the unionist priority (novelty requirement)	1 2 3 4 5
The product / process has distribution channels for dissemination and commercialization	1 2 3 4 5

ITEM: Market (GAMA et al., 2013; KOTLER, 2000; SILVA; VIEIRA JÚNIOR; LUCATO, 2013)

Items	Classification				
There was a survey of market needs	1	2	3	4	5
The technology presents strategies for marketing the product/ process	1	2	3	4	5
The technology has the potential to be inserted in the market	1	2	3	4	5
The technology was developed/licensed through direct and/or assisted negotiation with technology transfer companies	1	2	3	4	5
The technological solution was implemented by a technological order contract for a specific case	1	2	3	4	5