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PERCEPTIONS BETWEEN INDUSTRY-UNIVERSITY CONNECTIONS

PERCEPÇÕES ENTRE AS LIGAÇÕES INDÚSTRIA-UNIVERSIDADE

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ABSTRACT: One of the best ways to ensure the competitiveness of a company is through innovation, which can be derived from studies developed within universities. It is still incipient the use by the companies of the knowledge available in the universities to launch innovative products in the market. Those responsible for the planning and development of new companies should be aware of the new technological processes in the area in which they work, planning actions in the field of scientific and technological research, to generate knowledge and technologies that can be incorporated into the production system. They must know the mechanisms of technology transfer, as well as those that are directly linked to the diffusion of knowledge. In this context, university research plays an important role in the knowledge and development of new technologies applied to companies. Cooperation between companies and universities depends on the relationship between those involved and the resources that are allocated. These relationships involve mechanisms such as research support, cooperative research, knowledge transfer, and technology transfer. Thus, the connections between companies and universities follow a model of partnership existing between organizations of different nature, which may have different purposes, but collaborate unilaterally towards the same objectives. This article aimed to build and validate a structural model that demonstrates how and why Enterprise-University Connections occur. The population was formed by Brazilian researchers, who have patent registration. Through exploratory and confirmatory factor analysis, a valid measurement model was found at a significance level of 5%, formed by the following constructs: Types of Cooperation; Motivations of the Cooperation Process; Barriers to the Cooperation Process; Facilitators of the Process of Cooperation and Satisfaction of the Cooperation Process.

Keywords: Technology Transfer; Industry-University Connections; Motivations; Barriers; Facilitators and Satisfaction.

RESUMO: *A inovação vinda dos estudos acadêmicos é vista como a melhor forma para garantir a continuidade de uma empresa. Mas, de modo geral, as empresas não se utilizam do conhecimento disponível nas universidades para colocar produtos inovadores no mercado. O gestor de empresa deve estar atento aos novos processos tecnológicos na área em que atua, deve planejar ações no campo da pesquisa científica e tecnológica, como forma de gerar conhecimentos e tecnologias que possam ser incorporadas ao sistema produtivo. Deve conhecer os mecanismos de transferência de tecnologia e os que afetam a difusão do conhecimento. Assim, as pesquisas realizadas em universidades vêm desempenhando um papel importante no âmbito do conhecimento e do desenvolvimento de novas tecnologias aplicadas à indústria. As relações de cooperação entre empresas e universidades dependem da relação entre os envolvidos, dos recursos comprometidos, e essas relações envolvem mecanismos, tais como suporte à pesquisa, pesquisa cooperativa, transferência de conhecimento e transferência de tecnologia. Essas conexões, entre empresas e universidades, seguem um modelo de parceria existente entre organizações de*

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natureza distintas, que podem ter finalidades diferentes, mas colaboram unilateralmente para os mesmos objetivos. O objetivo principal deste artigo foi construir e validar um modelo para analisar como e porque ocorrem as Conexões Empresa-Universidade. A população foi formada por pesquisadores brasileiros, que possuem registro de patentes. Através da análise fatorial exploratória e confirmatória, foi gerado um modelo de mensuração válido a um nível de significância de 5%, formado pelos seguintes construtos: Tipos de Cooperação; Motivações do Processo de Cooperação; Barreiras do Processo de Cooperação; Facilitadores do Processo de Cooperação e Satisfação do Processo de Cooperação.

Palavras-chaves: *Transferência de Tecnologia; Conexões Empresa-Universidade; Motivações; Barreiras; Facilitadores e Satisfação.*

1 INTRODUCTION

Despite the different efforts of construction and / or conceptual improvement of models for technology transfers in Brazil (after the Innovation Law of December 12, 2004), the results for most public and private universities are still incipient, as ratified by the reports of the FORMITC of 2015, of the 264 Science and Technology Institutions (ICTs) that responded, only 29 ICTs have Intellectual Property Rights Licensing Contracts (FORMICT, 2015; BRASIL 2004).

Many studies on the subject, such as Demain (2001), Mendes and Sbragia, (2002), Cruz and Segatto (2009), Tecchio et al. (2013); Russo et al (2012) study the concepts of technology transfer through the Technological Innovation Centers point of view, without dwelling on the perception of the researcher, who is often responsible for the partnership between the Industry and the University. In this perspective, this study becomes important for the public institutions of science and technology when constructing an instrument that measures the perception of the researcher for the construction of the connection between Industry and university, proposing a convergence of models and carrying out a critical analysis, including of the Legislation in order to make them effective and effective in understanding and operating on the

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actions of the partnerships. Thus, a model is proposed for the perception of researchers about the Connections between Industry-University (CIU), in order to make effective and effective to understand and operate on the actions of NITs.

2 CONNECTIONS BETWEEN INDUSTRIES AND UNIVERSITIES (CIU)

The concept of enterprise-university cooperation links refers to the realization of training, research and development and other activities in a collaborative way, within a system that allows all parties and society to benefit from the available opportunities (knowledge, personnel, financial power, etc.) of universities.

Reasons for which the relations between University-Business-Government, according to Silva and Mazzali (2001), should be studied:

1) research centers, which are formed of producers of patents, prototypes and licenses, play an important role in the process of technology transfer;

2) the relationships developed in the research centers are predecessors of more complex collaborations, usually carried out in the form of consortiums, which involve several universities and industries. Alliances between universities and industries should be understood as a way to better assist in the management of these emerging entities.

3) the national relations carried out in partnerships between universities and industries or research centers that demonstrate a manifestation of the policy of scientific and technological research and development. In general, the federal development agencies or the Foundations of Support to the Research of the states make public notices in forms of financial aid to the research so that there is a proximity between the universities and the industries; thus forming partnerships. The beneficial outcome of these partnerships can increase the profitability and competitiveness of industries.

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The important products resulting from the academic research mentioned by Mowery et al. (p.211, 2004) are: "technological and scientific information; equipment and instrumentation; development of human capital; networking of scientific and technological capacity; process development, prototype products ". The authors emphasize that the connections between Industry-university must be strengthened, as well as other institutions and those involved in the national innovation system, being an important factor for the university to contribute to the technological development.

It can be said that in academia, basic research is developed in general and in the business environment, in general, applied research and Technological Research are developed. And as a consequence, universities train professionals by disseminating their research results, while industries aim for profit; in this way, projects are carefully selected (FABRIS, 2016).

According to Carre et al (2014), Boehm and Hogan (2013), Calderan and Oliveira (2013), Dagnino (2003) and Plonski (1995), for a partnership between universities and industries to be considered the performance of the government, as an actor responsible for funding and coordination of technology policy in general. According to the Triple Propeller, universities provide support for the development of core competencies, while the productive sector must ensure the transformation of innovations into output, and the government, in turn, has the mission of securing infrastructure (CUNHA; NEVES, 2008; LEYDESDORFF; ETZKOWITZ, 1998).

2.1 MOTIVATION OF CONNECTIONS

The technological connections between industries and universities occur when there is interest in collaboration of a technological development. In the first contacts there are usually motivations on both sides that make them continue on the connections. The motivations are different for each institution involved.

Manjarrés-Henríquez et al. (2008) have identified, together with the Spanish Universities, that the researchers, involved in activities of scientific and technological

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research with the industry, seek to capture more public resources than researchers who are exclusively involved in scientific research. In addition, the scientific productivity of these researchers is greater, and allow them to have a higher status within their institutions than the other members of the faculty who focus only on scientific research.

Yeh et al. (2012) reported that the evolution of innovative ideas is influenced by the experience, motivation, emotions of an individual and the environment.

According to Lai and Chang (2010), the antecedent characteristics of the Industry are also the factors that influence the Industry's motivation to participate in research and development (R & D). Some researchers have noted that a Industry's history, business scale, similarity (HARRIGAN, 1988), and the partnership experience (RAMANATHAN et al., 1997) have a significant impact on the performance of R & D connections. Experience in past relationships affects the willingness of the Industry to participate in new connections; if this accumulated experience of cooperation is positive, it can facilitate trust between the partners (MOHR; SPEKMAN, 1994; HAGEDOORN, 2002; LAI AND CHANG, 2010, WEY, 2014).

Within the process of innovation, some industries may decide to cooperate in order to absorb the knowledge and skills that they lack and which is represented by the tacit knowledge of their partner, ie their know-how.

2.2 BARRIERS AND FACILITATORS OF CONNECTIONS

According to Tecchio et al. (2013), many barriers can be identified in the process of enterprise-university cooperation, and these permeate the whole process, hampering its progress or even causing its interruption. These barriers involve difficulties that can generate

They constitute barriers to the process of Industry-university cooperation: extension of the time of the process; absence of legal instruments regulating research activities involving universities and industries, concomitantly; institutional philosophies of institutions; degree of project uncertainty; lack of communication between the

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parties; instability of public universities; lack of confidence in the capacity of human resources on the part of both institutions; and the view that the government should be the sole financier of university research activities, and that the business segment is a detriment to the university's larger goals and mission (MENDES, SBRAGIA, 2002).

2.3 SATISFACTION WITH CONNECTIONS

The development and results of the connections between industries and universities can influence the decisions of future partnerships.

According to Bohem et Hogan (2013) business relations embrace both economic and personal satisfaction. The logic, behind the satisfaction of the Industry-university connections, is to form relationships in order to achieve the common goal of transfer and exploitation of scientific and technological knowledge. Inherent in this common goal is the fact that all parties will make investments in the relationship, these investments will create social bonds of trust, commitment, interdependence or structural obligations in the form of information sharing and shared scientific knowledge, provisions contractual agreements, joint investments in equipment and machinery.

Bohem and Hogan (2013) have identified that differences in industry motivations and university partners have an influence on expectations of partnership outcomes, which will ultimately result in the satisfaction of each employee.

2.4 PROPOSED THEORETICAL MODEL

Four hypotheses were used to construct the model: H1: The types of cooperation have a positive impact on the connections between Industry and University. H2: The motivations have a positive impact on the connections between Industry and University. H3: Barriers have a negative impact on the connections between Industry and University. H4: Facilitators have a positive impact on the

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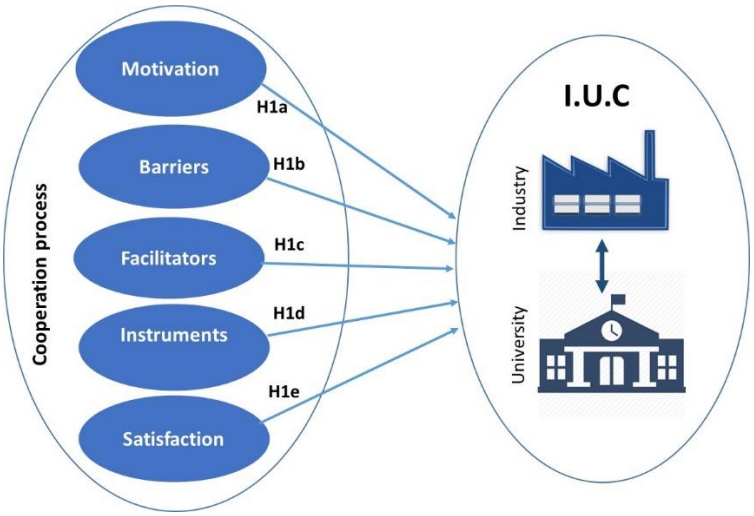
Industry-University connections. H5: Satisfaction has a positive impact on the connections between Industry and University.

Figure 1 shows the schematic representation of the proposed theoretical model. The framework has five constructs that lead to the connections between University and Industry, namely: a) Types of Cooperation; b) Motivations of the Cooperation Process; c) Barriers to the Cooperation Process; d) Facilitators of the Cooperation Process; e) Satisfaction of the Cooperation Process.

Figure 1 - Proposed theoretical model



Source: Prepared by the authors

3 METHODOLOGY

This research has a descriptive approach, because it is a research that seeks to identify and analyze a reality and, for Triviños (1995), the essential focus of these studies lies in the desire to know the community and has the pretension to describe with exactitude the facts and phenomena related to this reality.

Regarding the technical procedures, the present research will use the study of multiple cases, procedure justifiable by the exploratory, quantitative nature of the

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research. Regarding the objectives, this research is classified in the exploratory research group, by the characteristics of the subject in relation to the degree of novelty and the recent exploration of the subject in a scientific way. For the quantitative research, a two-stage questionnaire was developed; the first aims to identify aspects that affect business decision-making to cooperate with universities and the problems faced when cooperation is implemented; the second stage seeks to raise its expectations regarding the Innovation Law for the improvement of mechanisms of technology transfer between universities and industries, using the Likert scale of five points, ie i) 1 = totally disagree; ii) 2 = partially disagree; iii) 3 = I do not agree or disagree (indifferent); iv) 4 = partially agree; v) 5 = fully agree (see Table 1)

The questionnaire was then composed of 5 (five) blocks, in addition to the initial items. In the univariate analysis of the variables of the model, the characteristics of central tendency and variability of each of the variables were analyzed. In the multivariate analysis were used: a) Exploratory Factor Analysis, whose objective was to reduce the number of variables reproducing the structure of correlations of the constructs; b) Modeling of Structural Equations and Confirmatory Factor Analysis, with the objective of evaluating the hypothesized relations for the latent variables of the model, besides verifying the validity of the constructs involved in the theoretical model.

Table 1 - Scale of the instrument for collecting data on constructs

BLOCK	CONSTRUCTION	NUMBER OF ITEMS	SCALE
Block 1	C - Types of Cooperation	7	Likert – 5 points
Block 2	M - Motivations of the Cooperation Process	12	Likert – 5 points
Block 3	B - Barriers to the Cooperation Process	8	Likert – 5 points

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Block 4	F - Facilitators of the Cooperation Process	6	Likert – 5 points
Block 5	S - Satisfaction of the Cooperation Process	6	Likert – 5 points

Source: Prepared by the authors

4 ANALYSIS AND DISCUSSION OF RESULTS

The questionnaires were sent to research professors from 71 higher education institutions in Brazil, public and private, seeking a broad knowledge of the relationship of cooperation between universities and industry in Brazil.

4.1 RESEARCHER IDENTIFICATION

The descriptive analysis of the results showed that 36.11% (26) of the respondents were female and 63.89% (46) were male, 54.17% (39) with a Postdoctoral degree, 37.50% (27) with Doctorate, 6.94% (5) Masters and 1.39% (1) with Graduation. Regarding the type of university that the teacher is affiliated, 8.82% (6) are of private institution with the type of effective bond and 91.18% (66) are from public institutions, with 83.33% (60) with effective membership, 1.47% (1) as a substitute 2.78% (2) voluntary and 4.16% (3) other membership. The number of years the researcher taught at his institution ranged from 0 to 44 years, with an average of 16.57 years. Table 2 shows the research area where 55.56% (40) were from the area of Exact and Technological Sciences.

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Table 2 - Research area

Research area	Researchers	%
Agronomy Sciences	8	11.11
Biological and Health Sciences	19	26.39
Exact and Technological Sciences	40	55.56
Ciências Sociais e Aplicadas	5	6.94
Total	**72**	**100**

Source: Prepared by the authors

All researchers had research projects in the years 2005-2015 and 88.89% (64) reported that the results of their projects had real market potential (commercial applications). Only 11.11% (8) described that their projects had no marketing potential.

4.2 INDUSTRY COOPERATION – UNIVERSITY

Of the 72 researchers, 38 (52.78%) presented joint projects or Industry sponsored projects. Regarding the origin of the interest of the interaction between the university and the industries, it was verified that 28 projects (38.88%) were requested by Industry demand and at the University's initiative. It was found that 3 (4.17%) was on the initiative of the researcher. The other answers were in other types of specifications.

The cooperation between the Industry and the University originated: 164 publications in national journals, 317 publications in international journals, 470 presentations in conferences, 128 seminars, 173 trainings, 184 theses / dissertations, 283 equipment acquired, 97 technical / educational materials and 147 technological developments. example, Prototype, Product, Process, Integrated Circuit, Software, Brand, Cultivars).

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Of the total of 147 technological developments with the cooperation of industries, 100 were registered in the National Institute of Intellectual Property (INPI) or in other organs, being divided into: 74 Patents, 5 Utility Models, 2 Brands, 7 Software and 12 Cultivars. A total of 281 technological developments were carried out without the cooperation of industries and registered with INPI or other bodies: 205 Patent, 19 Utility Models, 3 Industrial Designs, 16 Trademarks, 37 Software and 1 Cultivars.

About the data in the Blocks analyzed, it was verified that the cooperation-business-university interaction is made by demand of the Industry (20.5%) and then by university initiative (17.65%), and of these partnerships, 8% technological development. With these data, we can conclude that Brazilian researchers do not have the concern to protect their research.

According to the individual analysis of the constructs, we find that in Block 1 - Types of Cooperation, the perception of Brazilian researchers (52.94%) considers that informal relations help in the cooperation between the University Industry. While relations to the formal mechanisms, 58.82% of the researchers consider that formal relations are considered as mechanisms to promote this collaboration.

According to the analyzes of Block 2 - Researcher Motivations, (80.55%) researchers consider that financial resources and material resources as a motivator in the Industry-university relationship. 84.72% of the researchers consider that the social function of the university is a motivator of cooperation. Regarding the prestige acquired by the researcher through research, in the academic and business environment, 68.05% consider it a motivator to disseminate the image of the university as a major motivator in the Industry-University relationship. 86.11% of the researchers believe that the results obtained in relation to obtaining practical knowledge about the existing problems are motivators in the Industry-University relationship. The incorporation of new information into university teaching and research processes is considered as a motivator in the Industry-University relationship by 91.66% of the researchers. 88.89% of the researchers believe that access to highly qualified human resources of the university is considered an interaction motivation. Already the reduction of costs and /

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or risks involved in research and development projects is considered by 81.94% of the researchers as a motivation in the relationship of industries with the university. 95.59% of the researchers consider that obtaining practical knowledge about existing problems is a great motivator in the Industry-University relationship.

The identification of students of the institution for future recruitment is considered as an incentive in the relationship of industries with the university by 81.94% of the researchers. It was verified that 91.67% researchers agree that the resolution of the technical problems that generated the necessity of the research in cooperation is an item of motivation in the relation of the industries with the university.

It is concluded from this block that, in general, the items questioned are motivators for the Industry-university cooperation process. Regarding the analyzes of Block 3 - Barriers of the cooperation process, it is observed that in relation to the barriers to university / industry collaboration, it is observed that the distance between the Industry and the University is considered as a barrier by 58.33% of Brazilian researchers. The high degree of uncertainty of the project is considered as a barrier to Industry-University collaboration by 51.39% of researchers. The university bureaucracy is considered a barrier by 81.92% of Brazilian researchers.

Regarding the duration of the project, 50% of Brazilian researchers believe that the very long duration of the project is a barrier to collaboration between Industry and University. Considering the difference in level of knowledge between the people of the university and the Industry involved in the cooperation, this item is considered as a barrier to this relationship by 33.33% of Brazilian researchers indifferent.

IP rights are considered as a barrier to Industry-University collaboration by 48.66% of Brazilian researchers. In relation to Intellectual Property generated, 44.44% of researchers consider it a barrier to Industry-University collaboration. It was observed that in relation to the absence of suitable interlocutor in the industries, 68,03% of the researchers consider as a barrier to the cooperation between Industry-University.

For Block 4 - Facilitators of the cooperation process, the distance between the University and the Industry is considered by 62.50% of the Brazilian researchers as a

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facilitator in relation to the facilitators for university / Industry collaboration. The existing tax incentives are considered by 69.44% of the researchers as a facilitator to the cooperation between Industry-University. It was observed that 52.78% of the Brazilian researchers believe that government research support funds are considered as a facilitator for Industry-University cooperation.

The Intellectual Property generated is considered by 58.34% of the Brazilian researchers as a facilitator to the collaboration between Industry-University. Regarding the presence of an appropriate interlocutor in the University, it was observed that 70.83% of the Brazilian researchers agree that they are a facilitator to the collaboration between Industry-University.

According to the individual analyzes of the constructs, for Block 5 - Satisfaction resulting in the cooperation process, the researchers' perception about satisfaction with university / Industry collaboration is that 70.83% of the Brazilian researchers agree that the satisfaction obtained with the final results of the interaction is one of the items considered in the cooperation between Industry-University.

Regarding the desire to continue with future interaction projects, 84.73% agree that this is a result of satisfaction in the process of cooperation between Industry-University. It was observed that 80.56% of the Brazilian researchers agree that cooperation in the research group is a satisfaction factor in the cooperation process. In, 86.11% of the Brazilian researchers agree that the satisfaction of the members of the research group in cooperating with other researchers is considered important in the cooperation between Industry-University.

It was observed that 83.34% agree that the satisfaction of the members of the research group in cooperating with industries is considered in the cooperation between Industry-University. In relation to the time programmed to carry out the research, it is sufficient for the accomplishment of the same, 50% of the Brazilian researchers agree that this item can be considered a satisfaction in the cooperation between Industry-University.

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4.3 ANALYSIS OF THE PROPOSED MODEL

4.3.1 Exploratory factorial analysis

When selecting the constructs to be used in the estimation of the model, the factors of each construct were established separately, through the following sequence:

a) Intrablock Exploratory Factorial Analysis (EFA), using the Varimax rotation main component method, which was carried out separately for each item of the constructs in order to verify, for the reality in question, whether it makes sense to keep the scale without any type of and to verify if there is correlation between the constructs confirming its explanation.

b) Then, the block analysis was performed in which the constructs were analyzed together.

To validate the adequacy of the two analyzes, the Kaiser-Meyer-Olkin Test (KMO), the Bartlett Test, was used to verify if the items were adequate to perform the AF and Cronbach's Alpha, to analyze the internal consistency of the items of the questionnaire.

4.3.2 Intrablocks exploratory factorial analysis

The values of the Kaiser-Meyer-Olkin (KMO) statistic (because they were greater than 0.5, reference value) and the Bartlett Test results (with significance p <0.5) for each construct, separately, revealed the adequacy of the factorial analysis (Table 3) (HAIR et al., 2005).

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Table 3 - KMO and Bartlett Test

BLOCK	KMO	BARTLETT TEST***
C - Types of Cooperation	0.815	149.667
M - Motivations of the Cooperation Process	0.805	473.870
B - Barriers to the Cooperation Process	0.632	113.927
F - Facilitators of the Cooperation Process	0.734	87.524
S - Satisfaction of the Cooperation Process	0.798	130.581

*** Statistically significant at 1%.

Source: Prepared by the author

Most of the indicators achieved a high power of explanation, considering all the factors obtained (commonalities). Some factors (three) obtained reasonable explanations (below 0.40). The reliability measure given by Cronbach's alpha index was greater than 0.6, a critical value, according to Malhotra (2006), showing the validity of the factors formed.

The closer its value is to the unit, the better the internal consistency of the construct; if the value found for Cronbach's alpha is less than 0.6, the scale is considered to have no internal validity. Three were the factors extracted, because they presented commonalities below 0.4. Although some items have little relation with the constructs, many achieved a high explanatory power (values greater than 0.7), the greatest value found was 0.943 for construct M - Motivations of the Cooperation Process.

The degree of explanation reached by the factors was calculated by the FA; despite a weak relation between the factors, the model can explain in 70,908% of the

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variance of the original data for the construct S - Satisfaction of the cooperation process.

Regarding this indicative, the intrablock model can explain the variance of the original data for each construct (Table 4)

Table 4 - Total Explained Variance

	INITIAL EIGENVALUES			EXTRACTED SUM OF SQUARES			ROTATION SUM OF SQUARES		
	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
C - Types of Cooperation									
C1	3.147	62.936	62.936	3.147	62.936	62.936			
C2	0.750	15.009	77.945						
C3	0.425	8.493	86.438						
C4	0.392	7.838	94.277						
C5	0.286	5.723	100.000						
M - Motivations of the Cooperation Process									
M1	5.180	43.166	43.166	5.180	43.166	43.166	3.337	27.806	27.806
M2	1.735	14.462	57.628	1.735	14.462	57.628	2.734	22.785	50.592
M3	1.267	10.562	68.190	1.267	10.562	68.190	2.112	17.599	68.190
M4	0.707	5.893	74.083						

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M5	0.658	5.479	79.563						
M6	0.582	4.852	84.415						
M7	0.483	4.028	88.443						
M8	0.421	3.504	91.947						
M9	0.392	3.265	95.212						
M10	0.273	2.276	97.488						
M11	0.256	2.136	99.624						
M12	0.045	0.376	100.000						
B - Barriers to the Cooperation Process									
B1	2.338	38.971	38.971	2.338	38.971	38.971	2.338	38.963	38.963
B2	1.696	28.265	67.236	1.696	28.265	67.236	1.696	28.273	67.236
B3	0.683	11.387	78.623						
B5	0.605	10.079	88.702						
B4	0.351	5.846	94.548						
B6	0.327	5.452	100.000						
F - Facilitators of the Cooperation Process									
F1	2.587	43.112	43.112	2.587	43.112	43.112	1.884	31.395	31.395
F2	1.139	18.988	62.100	1.139	18.988	62.100	1.842	30.704	62.100

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F3	0.771	12.847	74.947						
F4	0.589	9.812	84.759						
F5	0.502	8.363	93.122						
F6	0.413	6.878	100.000						
S - Satisfaction of the Cooperation Process									
S1	2.836	70.908	70.908	2.836	70.908	70.908			
S2	0.520	13.012	83.919						
S3	0.364	9.106	93.025						
S4	0.279	6.975	100.000						

Source: Prepared by the authors

4.3.3 Factorial analysis between blocks

For the factorial analysis (AF) between the blocks, all items of the constructs were used together. Table 5 shows the Comunalities.

Table 5 - Communalities

CONSTRUCT AND INDICATORS	INITIAL	EXTRACTED
C1. Informal personal relationships	1.000	0.910
C2. Formal personal relationships	1.000	0.924
C3. Involvement of another Institution	1.000	0.659
C4. Formal agreements with defined objectives	1.000	0.794
C5. Formal agreements without defined objectives	1.000	0.704
C6. Creation of Focused Structures	1.000	0.697
M1. Additional financial resources to be provided by companies for research	1.000	0.751

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M2. The additional material resources (equipment. materials. etc ...) to be provided by companies for research	1.000	0.742
M3. The realization of the social function of the university through the transformation of the acquired knowledge into products / processes that will promote the improvement of the quality of life of the population.	1.000	0.685
M4. The prestige that will be obtained by the researcher. through research. in the academic and business environment.	1.000	0.741
M5. Disclosure of university image.	1.000	0.627
M6. Obtaining practical knowledge about existing problems.	1.000	0.710
M7. Incorporation of new information into university teaching and research processes.	1.000	0.673
M8. Access to highly qualified human resources from the university.	1.000	0.837
M9. Reduced costs and / or risks involved in R & D projects.	1.000	0.755
M10. Access to the newest knowledge developed in the academic environment.	1.000	0.650
M11. Identification of students of the educational institution for future recruitment.	1.000	0.554
M12. Solving the technical problems that generated the need for cooperation research.	1.000	0.797
B1. The distance between the University and the Industry.	1.000	0.759
B2. The degree of high project uncertainty.	1.000	0.518
B3. The university bureaucracy.	1.000	0.702
B4. The very long duration of the Project.	1.000	0.782
B5. The difference in level of knowledge between the people of the university and the industry involved in the cooperation.	1.000	0.732
B6. The rights of IP	1.000	0.725
B7. The Intellectual Property generated (Books. Patents. Softwares. Cultivars. ...).	1.000	0.645
B8. Absence of suitable interlocutor in the industries.	1.000	0.782
F1. The distance between the University and the Industry.	1.000	0.816
F2. Existing tax incentives.	1.000	0.750
F3. Government funds to support research (FINEP. CNPq. BNDES. etc.).	1.000	0.815
F4. The university's financial benefit distribution system.	1.000	0.689

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F5. The Intellectual Property (Books. Patents. Softwares. Cultivars. ...) generated is a facilitator.	1.000	0.707
F6. Presence of an appropriate interlocutor in the University (Example: Intellectual Property Offices)	1.000	0.763
S1. Satisfaction obtained with the final results of the interaction.	1.000	0.729
S2. Desire to continue with projects of interaction in the future.	1.000	0.706
S3. Cooperation in my research group is a satisfaction factor.	1.000	0.762
S4. The members of the research group consider themselves satisfied to cooperate with other researchers.	1.000	0.757
S5. The members of the research group consider themselves satisfied to cooperate with the companies interested in research.	1.000	0.673
S6. Has the time scheduled for the research been sufficient?	1.000	0.642

Source: Prepared by the authors

Table 5 shows that the model presented a good adjustment, with the weights of each item included in the analysis being presented. Most of the indicators achieved a high explanatory power (above 0.7), considering all factors obtained (commonalities). The highest value found was 0.924 for item C2 - Informal personal relationships, value marked in blue in Table 5.

Table 6 shows the degree of explanation reached by the factors of each construct that was calculated by FA.

Table 6 - Total Explained Variance

	INITIAL EIGENVALUES			EXTRACTED SUM OF SQUARES			ROTATION SUM OF SQUARES		
	Total	**Variance %**	**Cumulative %**	**Total**	**Variance %**	**Cumulative %**	**Total**	**Variance %**	**Cumulative %**
	7.853	20.667	20.667	7.853	20.667	20.667	4.046	10.649	10.649
	3.835	10.091	30.758	3.835	10.091	30.758	3.824	10.063	20.712
	2.960	7.789	38.547	2.960	7.789	38.547	3.352	8.821	29.533
	2.754	7.248	45.794	2.754	7.248	45.794	3.265	8.593	38.126
	2.551	6.714	52.509	2.551	6.714	52.509	2.499	6.576	44.702

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	2.178	5.733	58.241	2.178	5.733	58.241	2.422	6.373	51.075
	1.820	4.789	63.030	1.820	4.789	63.030	2.309	6.075	57.150
	1.379	3.628	66.658	1.379	3.628	66.658	2.276	5.989	63.139
	1.263	3.325	69.983	1.263	3.325	69.983	2.112	5.557	68.696
	1.071	2.818	72.801	1.071	2.818	72.801	1.560	4.106	72.801
	0.984	2.589	75.390						
	0.920	2.422	77.812						
	0.844	2.220	80.032						
	0.725	1.908	81.939						
	0.651	1.712	83.652						
	0.603	1.587	85.239						
	0.581	1.529	86.768						
	0.548	1.442	88.209						
	0.525	1.383	89.592						
	0.468	1.231	90.823						
	0.420	1.104	91.927						
	0.406	1.069	92.996						
	0.340	0.894	93.890						
	0.327	0.861	94.751						
	0.301	0.792	95.543						
	0.282	0.741	96.284						
	0.225	0.593	96.877						
	0.212	0.557	97.434						
	0.172	0.451	97.886						
	0.157	0.413	98.299						
	0.145	0.383	98.682						
	0.118	0.310	98.993						
	0.111	0.292	99.285						

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	0.078	0.206	99.490						
	0.064	0.169	99.659						
	0.060	0.158	99.817						
	0.044	0.117	99.934						
	0.025	0.066	100.000						

Source: Prepared by the author

With respect to this indicative, the model between the blocks can explain the variance of the original data. The model presented a better fit (72.80%) than intrabloc analysis (Table 6). After rotating two factors were suppressed because they had loads below 0.5 (Table 7).

Table 7 - Matrix of rotated components for up to ten factors

BLOCKS	INDICATORS	FACTORS									
		1	2	3	4	5	6	7	8	9	10
C - Types of Cooperation	C1										0.850
	C2			0.674							
	C3			0.833							
	C4			0.683							
	C5			0.677							
	C6			0.818							
M - Motivations of the Cooperation Process	M1						0.895				
	M2						0.901				
	M3					0.598					
	M4					0.638			0.504		
	M5					0.618					
	M6					0.642					
	M7										
	M8	0.795									
	M9	0.756									
	M10	0.746									
	M11	0.708									
	M12	0.743									
B - Barriers to the	B1				0.757						
	B2				0.710						

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Cooperation Process	B3				0.733						
	B4				0.705						
	B5										
	B6									0.854	
	B7									0.799	
	B8				0.522						
F - Facilitators of the Cooperation Process	F1				0.644						
	F2								0.813		
	F3								0.690		
	F4							0.756			
	F5							0.721			
	F6							0.603			
S - Satisfaction of the Cooperation Process	S1		0.524								
	S2		0.703								
	S3		0.764								
	S4		0.825								
	S5		0.729								
	S6		0.702								

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser normalization
Source: Prepared by the authors

Table 7 shows the indicators that are part of one of the factors (Matrix Component), which allows to more accurately verify which of the factors explains each of the indicators considered,

The items of the C-Types of cooperation construct are found in Factor 3 and Factor 10; the items of construct M - Motivations of the cooperation process are divided into factors Factor 1, Factor 5; Factor 6 and Factor 8. The items in construct B - Barriers of the cooperation process are in Factor 4 and Factor 9. In construct F - Facilitators of the cooperation process, the items are divided into Factor 4, Factor 7 and Factor 8

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factors. And, the items in construct S - Satisfaction of the cooperation process are all in Factor 2.

After analyzing the quality of the adjustment, the proposed structural model was estimated, in order to verify whether the research hypotheses would be confirmed or not. It is concluded from Table 7 that the constructs B - Barriers of the cooperation process are not supported in the model.

4.3.4 Confirmatory Factor Analysis

Based on the analysis performed, it was concluded that most of the constructs present adequate properties. Then, after evaluating the validity and reliability of the measurement model, the next step consisted of the evaluation of the structural model.

The items of the constructs were submitted to AMOS® software, to obtain the standardized regression coefficients. Subsequently, the squared and error estimates were calculated based on the estimates for the composite reliability (CC) and the extracted variance (VE) for each construct / factor. The theory suggests that the standards stipulated as ideal are $CC > 0{,}7$ and $VE > 0{,}50$, Table 8.

For the effectiveness of the Discriminant Validity tests (Fornell and Larcker, 1981) and Bagozzi and Phillips (1982), the criterion to which the model was submitted highlights the possible relations with all items within the constructs, which can be observed in the Table 8, column 5 (Factorial Loads).

Table 8 - Confirmatory factor analysis statistics

BLOCKS	INDICATORS	VE	CC	FACTORIAL LOAD
C - Types of Cooperation	C1	0.7495	0.8290	-
	C2			0.737
	C3			0.573
	C4			0.600
	C5			

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	C6			
M - Motivations of the Cooperation Process	M1	0.8052	0.8720	0.792
	M2			0.813
	M3			0.606
	M4			0.575
	M5			0.561
	M6			0.523
	M7			0.564
	M8			0.801
	M9			0.703
	M10			0.690
	M11			0.723
	M12			0.793
B - Barriers to the Cooperation Process	B1	0.9031	0.7020	0.766
	B2			0.774
	B3			0.663
	B4			0.708
	B5			-
	B6			0.779
	B7			0.861
	B8			-
F - Facilitators of the Cooperation Process	F1	0.8277	0.7100	0.747
	F2			0.756
	F3			0.702
	F4			0.654
	F5			0.591
	F6			-
S - Satisfaction of the Cooperation Process	S1	0.8438	0.8470	0.571
	S2			0.720
	S3			0.771
	S4			0.766
	S5			0.693
	S6			-

Source: Prepared by the author

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After this step, the adjustment of the model was analyzed, which is presented in the following item.

4.3.5 Analysis of model fit

Having verified the quality of the absolute fit of the model, the proposed structural model was estimated, with the objective of analyzing the proposed hypotheses. The literature shows that the chi-square test is influenced by sample size and suggests a correction for the degrees of freedom (HAIR et al., 2005; KLINE, 1998, MARÔCO, 2010). Kline (1998) says that a ratio of less than three is considered acceptable. Thus, for the model adjustment (Table 9), the final model presented a satisfactory level for the Chi-square test (X^2) divided by degrees of freedom (DF), the value found was 4.548. The GFI indicator (0.91) met the minimum stipulated, which should be higher than 0.9.

Table 9 - Results of adjustment indexes

FIT INDEX	CONSTRUCTS				
	Types of Cooperation	**Motivations of the Cooperation Process**	**Barriers to the Cooperation Process**	**Facilitators of the Cooperation Process**	**Satisfaction of the Cooperation Process**
Estimative	0.849	0.828	0.033	0.964	0.980
P	0.000	0.000	0.777	0.000	0.000
Confirmation of hypotheses	Confirmed	Confirmed	Not Confirmed	Confirmed	Confirmed
ABSOLUTE FIT INDEX					
X^2	1036.931				
X^2/GL	4.548				
GFI	0.91				
RMSEA (Root mean square error of approximation)	0.08				
RMSR (Root-mean-square residuals)	0.07				
Alpha of Combrach of the whole instrument	0.7938				

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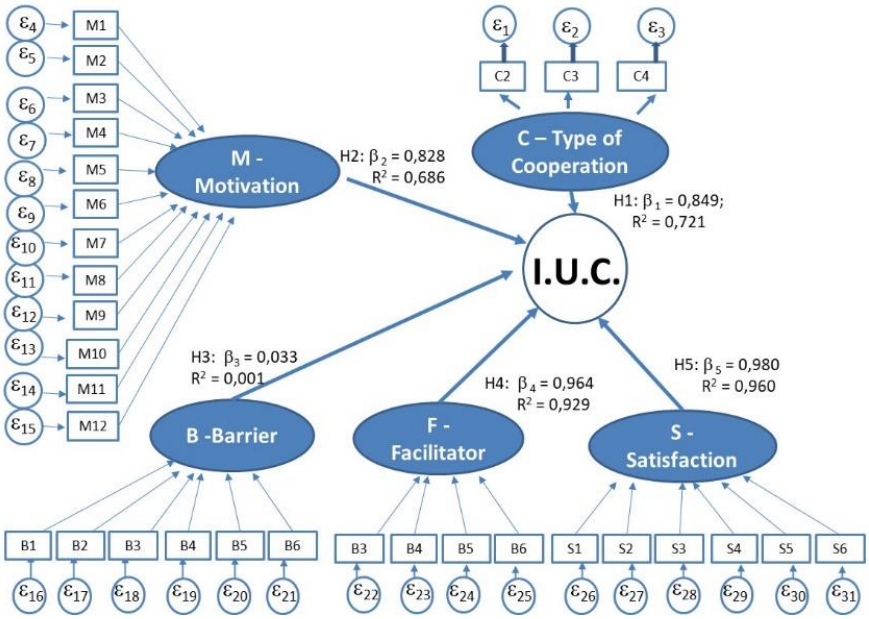
Source: Prepared by the authors

Figure 2 shows the structural model that shows the relationship between the types of cooperation, motivations in the cooperation process, barriers in the cooperation process, facilitators in the cooperation process and satisfaction in the cooperation process with the connections between Industry and University.

Figure 2 –Structural Model



Source: Prepared by the authors

The discussion of the results, after analyzing the data obtained from 72 questionnaires with 5 blocks presenting 38 (thirty eight) questions about factors related to the connections between the Industry and University. Using the exploratory factorial analysis technique, it was possible to reorganize the theoretical model and continue with the modeling of structural equations in order to validate the resulting model and conclude on the defined hypotheses. In relation to the proposed theoretical model, several analyzes were carried out seeking a better fit and adjustment of the model. In the factorial analysis the majority of the indicators of each construct presented a high

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power of explanation. These procedures were performed based on the recommended statistical tests (HAIR Jr. et al., 2005; KLINE, 2011). The internal validation of the model was confirmed by Cronbach's alpha index (72.80%). The factor analysis showed a better fit for the proposed model in the analysis between the blocks than in the intrablock analysis. After reorganizing the theoretical model, we proceeded with the modeling of structural equations in order to validate the resulting model and conclude on the hypotheses defined. In the structural analysis of the model we found a final model with a satisfactory level of adjustment for the Chi-square test (X ^ 2) divided by the degrees of freedom (GL) and with the GFI indicator (0,91) showing a value minimum stipulated. With this, it was verified that of the constructs proposed only the construct Barriers of the cooperation process were not significant in the Industry-University connections.

5 FINAL CONSIDERATIONS

The values obtained in the Kaiser-Meyer-Olkin (KMO) statistic and the Bartlett test results for each construct, separately, showed a good fit of the model, in which the majority of the indicators of each construct presented a high explanatory power. Some indicators (C1, S1 and S2) obtained reasonable explanations (below 0.40) and were suppressed from the final model. And the internal validation of the model was confirmed through Cronbach's Alpha index.

The construct M - Motivations of the Cooperation Process presented the highest value (0.943) as indicator M1 (The additional financial resources to be provided by industries for the research) contributing to a high power of explanation of this construct.

The adjustment of the model found for each construct was 62.94% for the construct C - Types of cooperation; 68.19% for construct M - Motivations of the cooperation process; 67.26% for construct B - Barriers to cooperation process; 62.10%

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for the construct F - Facilitators of the cooperation process; 70.91% for construct S - Satisfaction of the cooperation process.

To verify the degree of explanation of each indicator within the construct performed the Matrix Component rotated for up to three factors, where we found in the construct C-Types of cooperation and S- Satisfaction of the cooperation process, items in Factor 1; in the construct M - Motivations of the cooperation process, the items are divided into factors Factor 1, Factor 2 and Factor 3 and in constructs B - Barriers of the cooperation process and F - Facilitators of the cooperation process, items are divided into factors Factor 1 and Factor 2.

In the factor analysis (AF) between the blocks, all items of the constructs were used together. It was observed that the model presented a good fit; the majority of indicators achieved a high explanatory power (above 0.7) and the maximum value found was 0.924 for item C2 - Informal personal relationships. The factorial analysis showed a better fit (72.80%) for the proposed model in the analysis between the blocks than in the intrabloc analysis.

In the Matrix Component analysis rotated to up to 10 factors, the items of the C-Types construct of cooperation are found in Factor 3 and Factor 10; the items of construct M - Motivations of the cooperation process are divided into factors Factor 1, Factor 5; Factor 6 and Factor 8. The items in construct B - Barriers of the cooperation process are in Factor 4 and Factor 9. In construct F - Facilitators of the cooperation process, the items are divided into Factor 7 and Factor 8 factors. items of the S-construct Satisfaction of the cooperation process are all in Factor 2.

After the adjustment of the proposed theoretical model, it was submitted to a confirmatory factorial analysis. In relation to the adjustment of the model, a final model with a satisfactory level for the Chi-square test (X ^ 2) divided by degrees of freedom (GL) was found, where the value found was 4.548 and the GFI indicator, 91) met the minimum stipulated.

H1: The types of cooperation have a positive impact on the connections between Industry and University; H2: Motivations have a positive impact on the

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connections between Industry and University; H3: The barriers have a negative impact H4: Facilitators have a positive impact on the connections between Industry and University and H5: Satisfaction has a positive impact on the connections between Industry and University) only H3 Hypothesis of the construct Barriers of the process cooperation was not confirmed only in the Industry - University connections.

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