

Relationship between Knowledge Conversion Modes and Innovation

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Abstract

This study aims to analyze the relationship between the modes of knowledge conversion and innovation in technology companies of Local productive Arrangement, Trino Polo of Caxias do Sul, Rio Grande do Sul. The research conducted is a quantitative descriptive character type, with cross-cutting, operationalized through a survey of type survey, formed of 24 insertions. The population is composed of all employees of companies belonging to the Trino Polo. The sample is stratified by size and probability of company. The data were collected through a questionnaire applied in person and electronically with the tool Google Drive, to 127 respondents during the period from 25 July to 03 November 2016. For the treatment of data, descriptive statistics were used and multiple regression analysis. The hypothesis that there is significant relationship between the modes of knowledge conversion and innovation was accepted at a significance level of 5%, in the context in technology companies of Local productive Arrangement, Trino Polo.

Keywords: Knowledge conversion modes, product innovation, process innovation

1. Introduction

Innovation can be understood as the process of converting the generated knowledge to create new products or processes that can occupy your space in the market (MOLINA; MARTINEZ, 2010). Thus, knowledge can be considered as an important element for companies to manage and preserve your organizational performance (NONAKA; TAKEUCHI, 2002).

This study aims to analyze the relationship between the modes of knowledge conversion and innovation in technology companies of Local Productive Arrangement, Trino Polo of Caxias do Sul, Rio Grande do Sul, Brazil.

In short, among the main findings of this study is that the modes of knowledge conversion has significant positive relationship to the level of significance of 5% on the product and process innovation, which corroborates with the authors that were used in the theoretical framework.

This article is structured into five sections, in addition to the introduction, the theoretical framework that brings concepts of the Modes of Knowledge Conversion, Innovation and relation between Modes of Knowledge Conversion and Innovation. Then, it presents the methodology used in section 4 the results and discussions and in section 5 the final considerations, and finally, references.

2. Theoretical Framework

The following items, a description of the Modes of Knowledge Conversion, innovation and the relationship between of Knowledge Conversion Mode and Innovation, based on the area of knowledge management and innovation.

2.1 Knowledge Conversion Modes

As Davenport and Prusak (1998), knowledge can be defined as a combination of experiences, values, information, and insight, whose origin is in the mind of the people.

The authors Nonaka and Takeuchi (2002, 2004), classify the conversion of knowledge in different modes such as Socialization, Externalization, Combination and Internalization. These modes are originated by the harmonization of tacit and explicit knowledge (VORAKULPIPAT; REZGUI, 2008; HEINRICHS; LIM, 2005; NIELSEN, 2006).

For Nonaka and Takeuchi (2002), tacit knowledge is that practiced in action by the individual. By attributing himself to practical knowledge, he is subjective and achieved with experience, for example, within a particular occupation.

Nonaka and Takeuchi (2008), were the first to relate the success of a company to its ability to create new knowledge and thus apply them to the development and/or improvement of products and technologies. In this way, for these authors the modes of knowledge complement each other when one perceives the conversion of knowledge.

Nonaka and Takeuchi (2008) understand that knowledge develops through a spiral process, through social relationships that promote the integration between tacit and explicit knowledge, resulting in what they call the conversion of knowledge. For these authors the conversion of knowledge occurs through the exchanges experienced by individuals and is manifested by four distinct models – SECI (MARTINS, 2010), ie:

- Tacit knowledge for tacit knowledge-characterized by socialization: knowledge is acquired through experience;
- Tacit knowledge for explicit knowledge-characterized by outsourcing: occurs through reflection or dialogue between individuals;
- Explicit knowledge for explicit knowledge-characterized by the combination: at this stage the knowledge is processed and distributed to individuals. It is the knowledge created and prevailing in the organization;
- Explicit knowledge for tacit knowledge-characterized by internalization: it is observed through learning in the accomplishment of tasks. When the knowledge is indoors by the capacity of realization, a new spiral of knowledge creation begins (MARTINS, 2010).

In table 1, shows the four modes of knowledge conversion according to Nonaka.

Table 1: Nonaka's Four Modes of Knowledge Conversion

Socialization	Tacit knowledge X Tacit knowledge
Externalization	Tacit knowledge X Explicit knowledge
Combination	Explicit knowledge X Explicit knowledge
Internalization	Explicit knowledge X Tacit knowledge

[Note: SPSS version 20 has been used to calculate the tables]

The concept of knowledge is varied, from scientific knowledge to the technology and being able to get to the innovation, where you can generate financial resources (STEINER, 2006). In addition, the author states that the knowledge you have the possibility to collaborate with economic and socially focused on education, technology, science and innovation.

2.2 Inovation

In 1912, Schumpeter conferred for innovation, a new paradigm in economic theory, starting a new concept around the subject. For him, the innovation is the Foundation of a process of economic development, since it deals with new values.

The innovation consists in the introduction of a new method or product, which enable the opening of a new market, which can be achieved through the discovery of a new raw material, product, process, or a new service, either in the productive environment or in Marketing (SCHUMPETER, 1912; KIM; NELSON, 2005).

Innovation is the proposition of the companies, in view of the changes occurring in the environment constants (NELSON; WINTER, 1982).

At the time that notes a chance, the organization follows in search of an alternative to meet the needs of change.

In this way, scholars such as Schumpeter (1912); Kim; Nelson (2005); Nelson; Winter, (1982) and Bell; Pavitt, (1993), argue that the search and selection are functions worked simultaneously and integrated development of the organization.

Similarly, the changes or innovations may occur in two ways: the insertion of a new product on the market, an innovative process or, even, the use of new machinery and equipment; the second alternative focuses on incremental improvement as regards techniques, products and processes within the Organization (BELL; PAVITT, 1993).

Considering the relationship between the diversity of variants that somehow influence innovation and also the relevance of evolution that suffers the knowledge. The authors Freeman and Soete (1997), consider this approach the first new business arrangement involving innovation.

In line, understanding innovation is an idea that really worked, generated value and managed to insert themselves into the economy. Thus, in the design of the authors, this transformation can occur in many ways, for the reason there are several alternatives to acquire knowledge on the part of the Organization, but knowledge other than those found in company, for a Association between existing knowledge and new knowledge.

A definition of innovation is described in PINTEC-OECD (2005), stating that she is the creation of something new, or improved, as a product, a good, a service or a new process. Using research methodology it is possible to identify the perceived extent of innovation, because it is a differentiation. To do so, makes a distinction between innovation within the Organization, in the national and international market.

The PINTEC-OECD (2005), follows the Oslo Manual guidelines, designed to meet the understanding of innovation, architecting the development of policies that enable the improvement of organizational innovation, making it possible to confront the performance This ability with other Nations. The concept more current mentions the creation of a new product, with improvements in a product already known, a marketing process or organizational method (PINTEC-OECD, 2005).

Following the Shumpeteriana vision, innovation requires reverse in earnings to the Organization and coach that these gains be guaranteed once they are obtained from the effort made to your obtaining. Thus, the invention shall be considered when your innovation market absorption or their structures are internationalized by the company (SCHUMPETER, 1912).

From that understanding there is a differentiation between invention and innovation. The invention, although possessing a rationality, ignores the requirement for a positive financial result. On the other hand, innovation is endowed with economic rationality, with financial gains, generated by the new product, new process or even new procedure (FREEMAN, 1982).

As the company becomes a collaborator in the process of absorption of knowledge, it is understood that innovation performance is differentiated, with several studies showing that (LANE; KOKA; PATHAK, 2006).

For Zawislak and Martins (2007), business changes with regard to innovation in respect of competition occurs between companies that innovate and promote this process, making the innovative thinking to flourish within the organization.

So, join the discontinuity, the changes, the exchange of products together with new ideas and incorporate new values.

Teece (1986) relates the concept of innovation to profit and stresses that consists in the knowledge of improvement of processes in relation to the adopted so far.

Similarly, Dosi (1988), reiterates that innovation is linked to new organisational methods, new production processes and the assimilation of new products on the market. In addition, is delegated to the innovation, favoring the evolution of technology, generating economic development (FREEMAN, 1982).

With respect to the definitions of innovation in the literature, including in particular approaches, creative thinking, a new idea or object perceived as new by individuals, the creation of new techniques, do differently, make changes and even the tooling of the entrepreneur.

Finally, based on the concept of the Oslo Manual (OECD, 2005), define four dimensions of innovation: product innovation, process innovation, organizational innovation and marketing innovation.

In this study, one of the four dimensions of innovation the Oslo Manual (OECD, 2005), were chosen the product and process.

2.3 Knowledge Conversion Modes and Innovation

According to Nonaka and Takeuchi (2008), for innovation to happen, it is necessary that there is also a predisposition among the people who are part of Local Productive Arrangement Trino Polo of Caxias do Sul, Brazil, in sharing their knowledge and experiences among the other actors so that going on collaboration, raise considerably the possibilities of innovation (NONAKA; VONKROGH, 2009).

Promotes knowledge generation or evolution of processes and products of the company thus appears as an important component in the development of innovation (KUMAR; SCHEER; KOTLER, 2000).

Johannessen, Olsen and Olaisen (1999) highlight the relevance of knowledge conversion, including the explicit and tacit modes to what concerns the generation of new knowledge, therefore, will generate innovations. The company that values knowledge, its forms, methods of conversion, and the Spurs, will surely be in the path of the innovation process and will have competitive advantage. Knowledge generates sustainable competitiveness by providing increasing returns and solid. Assets, materials adverse assets of knowledge increases with the use (DAVENPORT; PRUSAK, 2003; GUERRA; TONDOLO; CAMARGO, 2006; GUERRA; CAMARGO, 2016).

According to the statements described one can propose the following hypothesis: H₁: The modes of knowledge Conversion has positive effect on innovation.

3. Methodological Procedures

This research, how to approach the problem, is classified as quantitative and, in relation to the objectives, is descriptive and cross-sectional (MALHOTRA, 2006; MARCONI; LAKATOS, 2006).

3.1 Statistical Population and Statistical Samples

The study population was made up of all employees of companies belonging to the Local Productive Arrangement Trino Polo, which is composed of 117 companies. The sampling unit was the employees and directors of the companies involved in the research. Because it is a non-probability sampling, we opted for the determination of the minimum number of respondents to the Marôco recommendation (2014), which in this case was considered to be 5 (five) respondents for each of the questions of the questionnaire. So, as the questionnaire is made up of 24 issues, the minimum size of the sample needed is of 120 respondents, but the final sample was 123 respondents.

3.2 Data Collection Instrument

The questionnaire consisted of three parts: the first part is about the independent variable (modes of knowledge Conversion), based on (HUANG, WANG, 2002).

The second part presents items concerning the dependent variable (innovation), based on (MILLER; FRIESES, 1982; SUBRAMANIAN; NILAKANTA, 1996, PRAJOGO; SOHAL, 2006). Finally, the third part is about demographic and occupational characteristics. The questionnaire adopted used the Likert scale (5 points): (strongly disagree = 1; Disagree = 2; Neutral = 3; I agree = 4; and I fully agree = 5).

3.3 Reliability of the Questionnaire

To check the clarity and coherence of the questionnaire, was conducted a pilot survey. Pilot sample were selected randomly, 6 companies of which participated in 20 employees and/or directors and the

application of the questionnaire was attendance. Was not deleted no items of scales based on research pilot.

Reliability was assessed by calculating the coefficient of internal consistency (Cronbach's alpha). The results for all variables of the instrument are presented in Table 2.

Table 2: Reliability test (Cronbach's Alpha)

Variables	Items	Cronbach's alpha
Socialization	4	0,860
Externalization	4	0,782
Combination	4	0,886
Internalization	5	0,929
Modes of Knowledge Conversion	17	0,823
Inovation	7	0,904
Total	24	0,829

[Note: SPSS version 20 has been used to calculate the tables]

In table 2, the Cronbach's alpha coefficient values of the instrument of data collection varied from 0.782 to 0.929, so that all values are greater than 0.60. This indicates the consistency between items of the instrument (SEKARAN; BOUGIE, 2010). So, as the coefficients (Cronbach's alpha) of the instrument and its items are considered acceptable and valid for purposes of statistical analysis.

3.4 Multicollinearity Analysis

Before examining the study hypothesis, certain tests were performed to confirm the adequacy of the data for multiple linear regression analysis. It was initially confirmed that there is no high correlation between the independent variables, represented by the mean of the knowledge conversion modes, for this was calculated the Tolerance Factor for each of the independent variables. The following values are found: MSocialization = 0.772; MExternalização = 0.845; MCombinação = 0.720 and for MInternalização = 0.816. In order not to have multicollinearity the value of the tolerance should not be greater than (0.05), so there is no multicollinearity between the independent variables. In table 3 is shown the correlation coefficients between the independent variables.

According to Table 3, the highest correlation between the independent variables is (0.451) between (MCombination) and (MSocialization), while the values of the Pearson correlation coefficient between the other independent variables were smaller. This indicates the absence of the multicollinearity between the independent variables, the above correlation (0.80) is an indication of the existence of this problem, so this confirms that the sample of the study is free of high linear correlation (MONTGOMERY; PECK VINING, 2012).

Table 3: Correlation coefficients between independent variables

Variable	Correlation Coefficients			
	(MSocialization)	MExternalization	MCombination	MInternalization
MSocialization	1			
MExternalization	0.187*	1		
p-value	0.039			
MCombination	0.451**	0.229*	1	
p-value	0.000	0.011		
MInternalization	0.034	0.348**	0.286**	1
p-value	0.709	0.000	0.001	

* The correlation is significant at the 0.05 level (2-tailed); ** The correlation is significant at the 0.01 level (2-tailed)

[Note: SPSS version 20 has been used to calculate the tables]

4. Characterization Research Environment

The Trino Polo began in mid-2002, through meetings, congregating twenty-five computer companies in Caxias of the Sul, the Municipal public power, the State Government entities and business associations and teaching institutions and research of the Caxias do Sul, State Rio grande do Sul, Brazil.

The motivation for the structuring of Local Productive Arrangement Trino Polo, called at the time "Informatics Pole", was due to the awareness on the part of the community involved, about the potential for development of the it sector (Technology of Information) in Caxias of the Sul and region and the need to speed up the design of the Computer Polo in order to contribute to increasing the capacity and international competitiveness of micro, small and medium-sized enterprises in Caxias do Sul.

After preliminary meetings of the community of the computer industry in Caxias do Sul and the municipal public power, was established the Association of enterprises of the Informatics Pole of the Caxias do Sul, with the participation of 59 companies in the municipality. Subsequently, protocols were signed intentions to membership and participation of business entities and employees, government agencies and educational and Research Institutions of Caxias do Sul.

In 2006, was formed the Association of Informatics Pole of Caxias do Sul, as civil, non-profit institution (bringing together only the entities that make up the governance of Local Productive Arrangement. For your feature to use the triple helix as reference to bring together the private sector, educational institutions and public authorities, the Local Productive Arrangement began to call themselves Trino Polo.

Currently, there are 10 and 117 entities associated companies and contributors to the APL. It is the Association of it companies with the largest number of members of the State of Rio Grande do Sul, which collaborate to promote the development of the it sector in the region of the Serra Gaúcha.

5. Analysis and Discussion of the Results

In the following items we present the descriptive analysis of the demographic characteristics of the respondents. The descriptive analysis of the knowledge conversion modes and innovation. The multiple regression analysis is presented below.

5.1 Descriptive Analysis of the Demographic Characteristics

The number of respondents was registered in 123, considered valid. The variables that were employed for the characterization of the respondents are: sex, educational level and the position he holds in the company.

As for the sex of the respondents, 95 were men, accounting for 77% of the total and women were 28, representing 23%. On the question of assessment of the educational level of respondents, 36 of them, representing 29.3%, stated that joined the upper reaches without however complete it. Only 40 respondents or 32.5%, have confirmed they have completed undergraduate degree. Other 39 respondents, namely, 31.7% had joined to the post-graduate degree without having completed the same and 8 respondents, or 6.5%, had finished the course of post graduation.

When questioned about the size of the organization according to the number of employees, 45 respondents informed that in their companies work up to 10 people, representing 36.59% of the entities. 19 of the questionnaires answered affirm that in their companies, the functional framework is composed of 11 to 20 employees, making 15.457% of the total respondents. 7.32% or 9 people questioned gave a return where they mentioned that the corporation owned between 21:30 employees. Already between 31 and 40 employees in their entities, was the information provided by 10 people who corresponded to 8.13%.

Between 41 and 50 people work in institutions mentioned by 11 respondents, which indicates a percentage of 8.94%. Eight other respondents have clarified that their organization has a collaborator board between 51 and 60 people, indicating 6.5%, and finally, 21 interviews have shown that their institutions employ more than 61 employees corresponding in the end to 17.07%.

When questioned regarding the position that each of the respondents occupying in your institution. Of the respondents, only 2 reported be administrators or 1.63%; 17.07% or 21 respondents are analysts; 3 persons or 2.44% declared being the CEO; 5 people who correspond to 4.07% are consultants; 7 respondents, which represent 5.69%, are engineers; 12 are developers and represent 9.76%; 28 respondents are the directors of these companies, corresponding to 22.76%; managers are 18.70% of all people who have given and which were 23 people; programmers were a number of 4, represent 3.25%; 3 people reported only partners of the Organization, representing 2.44% and, finally, the supervisors were 4, i.e., 3.25%.

5.2 Descriptive Analysis of the Knowledge Conversion Modes of and Innovation

In table 4 presents the descriptive measures (mean, standard deviation and coefficient of variation) of knowledge conversion modes construct, composed of 17 variables, that is, four related to Socialization (SO1 to SO4), four relating to Externalization (EX1 the EX4), four for Combination (CO1 to CO4), five for Internalisation (INT1 to INT5).

In table 5 presents descriptive measures (mean, standard deviation and coefficient of variation) of compost of innovation 7 construct variables (IV1 the IV7).

For the analysis of the coefficient of variation was a decision criterion proposed by Jocelyn et al. (2009), in which the variables with values of coefficient of variation above 30% are considered to be heterogeneous with values below 30% are considered homogeneous.

Before that, analyzing the variables presented in Tables 4 and 5, you can see that only the variable IV6 "my company has introduced changes in methodologies, techniques and technologies", can be regarded as heterogeneous, since that was the only one who presented coefficient of variation above 30%. While, other variables can be classified as homogeneous.

Table 4: Descriptive analysis of knowledge conversion modes

Variable	Mean	Standard Deviation	Coefficient of variation
SO1 -In the discussion at my company, actively share my experience with the other participants of the company.	4.0976	0.89089	21.74
SO2 -In my company, I and my colleagues share their knowledge and personal experiences and work.	4.1626	0.81355	19.54
SO3 -During the discussion in my company, I try to find out opinions, thoughts and other information of the other.	4.1220	0.86447	20.97
SO4 -During the discussion in my company, present concepts, ideas and information.	4.1626	0.86246	20.72
EX1 -When others don't understand me, generally I am referring to aid in understanding.	4.0325	0.81919	20.31
EX2 -Most of the time, here are some thoughts disorganized in concrete ideas.	3.7561	0.96106	25.59
EX3 - Describe professional or technical terms with colloquial language to facilitate communication among my colleagues	3.7967	1.10111	29.00
EX4 - I usually use analogy to express abstract concepts.	4.1057	0.85711	20.88
CO1 - During the discussion with my coworkers, assisted in the Organization of ideas to facilitate the discussion and conclusion.	4.0976	0.92696	22.62
CO2 -When problems occur, I use my experience to assist in the resolution.	4.1301	0.88669	21.47
CO3 -After each event, I have a habit to organize and summarize what happened.	4.1382	0.89007	21.51
CO4 -During the discussion I organize mentally.	4.1626	0.93541	22.47
INT1 - To understand a new idea or concept, compare it with my experience	3.5447	0.99385	28.04
INT2 -Understand better the thoughts of others, repeating what they say and	3.5041	0.95277	27.19

questioning them: "is that what you mean"?			
INT3 -Tell the other what I think to make sure that the understanding is the same of them.	3.5772	0.97517	27.26
INT4 -When I finish, I question the other person if it is necessary to repeat, to make sure the real understanding.	3.5122	0.98651	28.09
INT5 -To communicate with my coworkers, I would provide the necessary time to reflect on the discussion.	3.5203	0.96962	27.54

[Note: SPSS version 20 has been used to calculate the tables]

Table 5: Descriptive analysis of the construct innovation

Variables	Mean	Standard Deviation	Coefficient of variation
IV1 -My colleagues develop new products and/or technological processes.	3.7317	1.00876	27.03
IV2 -Innovation (product, process) developed in my company are launched on the market.	3.8211	1.01652	26.60
IV3 -The development of new products and processes have been frequent.	3.8618	1.01080	26.17
IV4 -My colleagues have developed new products or processes.	3.8618	1.05834	27.41
IV5 -The development of processes and methodologies have been presented with frequency.	3.7967	1.06324	28.00
IV6 -My company has introduced changes in methodologies, techniques and technologies.	3.6016	1.11429	30.94
IV7 -There is new technology in products and processes on the Market	3.7398	1.06999	28.61

[Note: SPSS version 20 has been used to calculate the tables]

5.3 Multiple Regression Analysis

Table 6 shows that the value of β for (MSocialization) is 0.220 and that the value of t_{cal} is 2.539 and that the level of significance is (Sig = 0.003), indicating that the effect of this dimension is significant. The value of β for (MExternalization) is 0.180 and that the value of t_{cal} is 2.174 and that the level of significance is (Sig = 0.012), indicating that the effect of this dimension is significant. The value of β for (MCombinação) is 0.182 and that the value of t_{cal} is 2.024 and that the level of significance is (Sig = 0.045), indicating that the effect of this dimension is significant. The value of β for (MInternalización) is 0.264 and that the value of t_{cal} is 3.135 and that the level of significance is (Sig = 0.002), indicating that the effect of this dimension is significant.

Based on the above, we accept the hypothesis that the knowledge conversion modes have a positive and significant influence on product and process innovation at the 5% level of significance. Figure 1 shows the relationship between the knowledge conversion modes and innovation. Innovation is explained in 31.11% by of knowledge conversion modes.

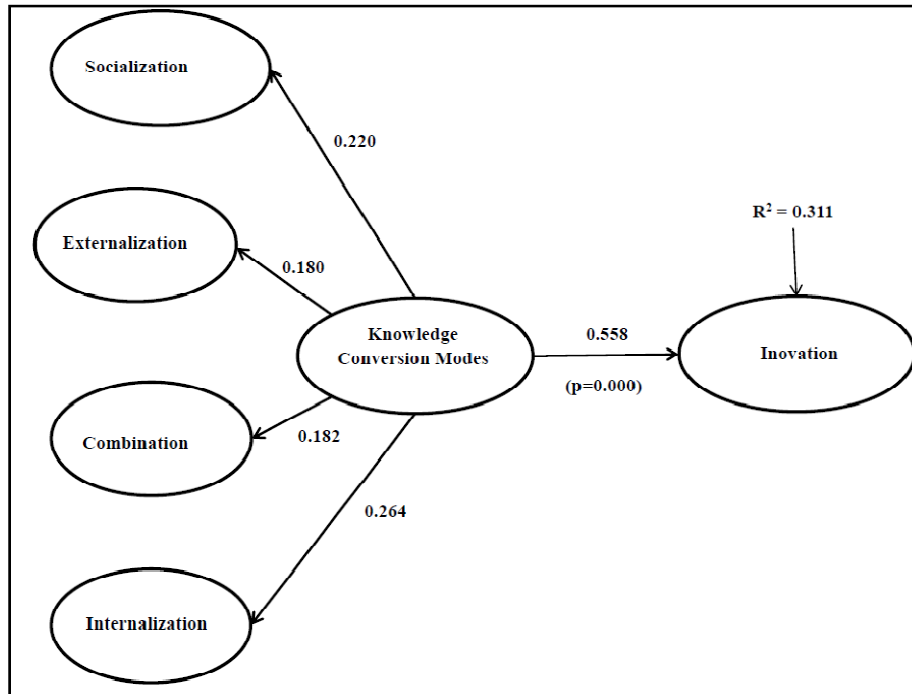
Table 6: Coefficients

Predictors	Unstandardized Coefficients		Standardized Coefficients	t_{cal}	Sig.
	B	Std. Error	B		
(Constant)	1.218	0.397		3.066	0.003
MSocialização	0.186	0.073	0.220	2.539	0.012
MExternalização	0.186	0.085	0.180	2.174	0.032
MCombinação	0.133	0.066	0.182	2.024	0.045
MInternalização	0.202	0.064	0.264	3.135	0.002

a. Dependent Variable: Mean of innovation

[Note: SPSS version 20 has been used to calculate the tables]

Figure 1: Representation of the relationship between knowledge conversion modes and innovation



[Note: SPSS version 20 has been used to calculate the tables]

The results confirm the theory, because according to Prajogo, Power and Sohal (2004) the conversion of knowledge has a positive effect on product and process innovation.

For Nonaka and Takeuchi (2008) the modes of knowledge conversion: Socialization: tacit to tacit; Outsourcing: tacit to explicit; Combination: explicit to explicit; Internalization: explicit to tacit, combine and interact in a spiral movement, creating new knowledge and, as a consequence, can generate innovation.

This result is also in agreement with the findings of CAMELO et. al. (2011), which states that knowledge conversion modes enables the assimilation of this knowledge by the organization and, finally, it acts in the generation and development of new products, processes and services.

Table 8: Results of General model resolution by Multiple Regression Analysis

Hypotheses	B	t-value	p-value	Results
H ₁ : The socialization has a positive effect on innovation	0.220	2.539	0.003	H ₁ Supported
H ₂ : The externalization has a positive effect on innovation	0.180	2.174	0.012	H ₂ Supported
H ₃ : The combination has a positive effect on innovation	0.182	2.024	0.032	H ₃ Supported
H ₄ : The internalization has a positive effect on innovation	0.264	3.135	0.045	H ₄ Supported

[Note: SPSS version 20 has been used to calculate the tables]

5. Final Considerations

This article aimed to study the relationship between modes of conversion of knowledge (externalization, combination, internalization and socialization) and the innovation of product and process. In summary, the modes of knowledge conversion (socialization, externalization, combination and internalization) has positive influence on innovation, in other words, socialization ($\beta_1 = 0.220$); outsourcing ($\beta_2 = 0.180$); the combination ($\beta_3 = 0.182$); internalization ($\beta_4 = 0.264$), and the modes of knowledge conversion explained in 31.5% innovation (product and process), which corroborates with the authors that were used in the theoretical framework.

Thus, the results found present both academic and managerial implications. For the academy, it becomes explicit, through the analyzed sample, the relationship between the modes of conversion of knowledge and innovation. For companies, research provides relationships and allowances for reflection on the benefits of ways of converting innovation knowledge.

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