

# OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

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## Abstract

Given the current scenario established by dynamic and competitive practices, organizations seek strategies that meet the market's demand, create organizational value and allow the emergence of differentials before the competition. On one hand, innovation is considered a tool for achieving competitive advantage and has been sought through stimulation for creating ideas, the development of intellectual capital and efficient resources use. On the other hand, what is seen in some organizations is the absence of resources that allow financial, personal or technological growth. In this sense, the use of open innovation emerges as a proposal to create organizational value and allows companies to support each other, transferring knowledge, financial and even technological resources. This study aims to determine which factors stemming from open innovation can influence Technology-based Companies to create value. For such, a quantitative and descriptive survey was carried out, with a questionnaire applied to employees of Technologically Based Companies. The results pointed out that the knowledge networks and the organization innovation profile are necessary aspects for the definition of open innovation practices and open innovation factors such as the Partnership Establishment, product development through licensing and patents, spin in and spin-off, corporate venturing and chain value are able to influence value creation.

**Keywords:** Value creation; Innovation; Innovation Profile; Knowledge networks; Open innovation.

## 1 Introduction

Since the Industrial Revolution, companies began to act on a global scale increasing the volume of production looking for economic advantages and protection of investments and resources. With the technological advance, business perspectives were modified and the verticalized managements opened space for the modular and flexible organizational architectures (Chersbrough, 2006; Pitassi, 2012). Knowledge becomes the most important element of organizations and is seen as a strategic tool for the search for organizational value (Ziviani et al., 2016). The demand for capabilities for product development, services and businesses that serve the market makes the use of Technologies, allied to the organizations strategic planning and opens space for Technology-Based Companies (Chandra & Chao, 2011; Bocken, 2015).

According to Santos and Pinho (2010, p. 1), the TBC's "are companies whose intense innovative dynamics are based on solid technical skills, with an expectation of accelerated growth in relation to them." Technology-based companies have maintained control over their own internal development and innovation capacity, keeping their information and resources confidential. However, maintaining a highly qualified development team and an internal R & D center can be costly and unfeasible (Johannson et al, 2015). The reality of many of these organizations is characterized by the lack of sufficient intellectual capital, the reduced resources availability, and the innovation budget reduction, making them incapable of developing, innovating and competing in the market (Stal, Nohara & Chagas Junior, 2014).

However, the development of partnerships emerges as a strategic opportunity to be used by organizations (Desiderio & Popadiuk, 2015, Rodrigues, Macarri & Campanario, 2015) and gives visibility to a new type of innovation that allows the creation of competencies and values which would not be built in isolation.

It is recognized that suppliers, consumers, research centers and even competitors can be sources of ideas capable of supporting organizational growth (Vecchiato, 2014, Herrera, 2015). Open innovation creates a two-way path in which knowledge and resources are continually being addressed, supplying the existing deficits in partner organizations (Liu & Zheng, 2011, Chen, 2014). Technology-based companies can grow with ideas or resources from other companies, but within their own organizational perspective, respecting the values and characteristics of the market

Lindegaard (2010) and Saebi and Foss (2015) emphasize that well-defined strategies and the motives

## OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

behind the pursuit of open innovation, ensure that the organizational goal is reached. Therefore, it is necessary to create a favorable environment for innovation and a culture that is capable of stimulating it (Dias, 2013; Costa, 2015). Identifying the influence factors of open innovation in companies can present itself as an opportunity for organizational growth. In this sense, this study aims to determine which factors arising from open innovation can influence Technology-based Companies to create value. The study also seeks to answer the following question: which factors that constitutes the open innovation can influence Technology-based Companies in value creation? To address this perspective, this paper is organized into four sections. The first presents an introductory exposition. The second section presents the main concepts that supported the analysis and discussion of results. The third section elucidates the methodological procedures used and the fourth section presents the conclusions. To conclude the study the bibliographical references were listed.

### 2. Open Innovation And Value Creation

Due to the increased level of competition from direct competitors and new entrants, organizations need to have what Chesbrough (2006) calls an "endless stream of ideas," in which organizations allow ideas to flow in a continuous way independent of positions and hierarchies. Innovation then becomes an important element of organizations (Chersbrough, 2003, Flores et al., 2000) and investments in specific sectors such as research and development (R & D), and the search for skilled and creative intellectual capital, (Velic & Marjanovic, 2016). According to Law No. 10,973 of December 2004, innovation is the "introduction of novelty or improvement in the productive or social environment resulting in new products, processes or services" (Brasil, 2004).

Rodrigues, Maccari and Campanário (2010) say that this disoriented search for creative intellectual capital and constant innovations, led to inefficient business, high turnover and little knowledge transfer. The lack of human and even financial resources makes organizations that are considered market leaders, to face difficulties in sustaining internal investments and therefore creating relationships that go beyond their R&D. These relationships allow us to innovate with ideas and resources from any environment, as long as it creates value for the business and creates the flexibility to follow the global market (Chersbrough, 2004).

Celadon (2014) states that it is impossible to keep all knowledge within organizations, therefore, organizational processes can not be limited to internal know-how and should be directed towards finding professionals capable of maximizing results. It is then the opening of a path that directs organizations to the sources of external knowledge and allows space for the emergence of other types of innovation, such as open innovation For Chesbrough (2003, p.8) "open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology." In addition, Johannsson et al. (2015) says that open innovation is a new way of democratizing innovation activities.

Organizations in this type of innovation create value with ideas from other organizations. Value is created when companies correlate resources and knowledge with the ability to innovate, reacting to the external environment and market-orienting themselves (Moreira et al., 2008; Collis & Montgomery, 2014).. The capabilities and uses of services can come from consumers themselves; other competing companies; from suppliers, universities and research and institutes centers. This is because projects that do not add value to an organization can be an example for the development of others (Chesbrough, 2003; Liu & Zheng, 2011). Likewise, pioneerism is not a major factor in open innovation.

For this type of innovation the company does not need to carry out the first product or business to develop and there is no need for absolute secrecy as a method for gaining competitive advantage and creating value during the implementation of new ideas. (Ades et al., 2013, Oliveira and Alves, 2013). Even though there is greater openness to open innovation, it is still possible to stimulate internal skills and advance patent control (Kim and Park, 2008). Lindegard (2010) and Sener and Hobikoglu (2015) emphasize that if intellectual property rights that can not be transformed into income as a patent or license,

## OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

are not continuously improved and are not profitable, they must be transformed into values and shared for search for common improvements.

For this study, open innovation is composed of 5 other constructs: Partnership Establishment, Product Development by Licensing and Patents, Spin-off and Spin in, Corporate Venturing and Chain Value. The research's instrument was constructed from theoretical references of several authors, according to table 1.

|  | Item  | Question  | Author(s)   |
|--|-------|---|---|
| Partnership Establishment                    | EP1   | My company seeks partnerships with universities, research centers and institutes to implement innovations.  | Chersbrough (2004)                                  |
|  | EP2   | My company seeks partnerships with other companies to obtain resources and knowledge.   | Chersbrough, (2004)                                 |
|  | EP3   | My company has already developed or develops products in conjunction with other companies or institutions.  | Chersbrough, (2004)                                 |
| Product Development by Licensing and Patents | DPLP1 | My company shares its equipments and technologies with other companies/institutions.  | Lindergard (2010) e Sener & Hobikoglu (2015)        |
|  | DPLP2 | My company receives equipments and technologies from other companies/institutions.  | Lindergard (2010) & Sener & Hobikoglu (2015)        |
| Spin In Spin Off                             | SIO1  | My company creates new business when it detects different opportunities other than the main market, investing in the development of these projects in parallel.   | Ades <i>et al.</i> (2013); Oliveira & Alves (2013). |
|  | SIO2  | My company uses existing businesses or products to generate new business.   | Ades <i>et al.</i> (2013); Oliveira & Alves (2013). |
| Corporate Venturing                          | COV1  | It is common for my company to financially invest in training and/or maintenance of external research and development (R & D) centers.  | Oliveira & Alves (2013)                             |
|  | COV2  | Financing and loans are done in a planned and calculated way to improve my own company's research and development centers.  | Oliveira & Alves (2013)                             |
| Value Chain                                  | CAV1  | My company understands that good ideas can come from any hierarchical or local level, so it maintains relationships with its employees, suppliers, customers and competitors.                             | Chesbrough (2003); Liu & Zheng (2011)               |
|  | CAV2  | My company has proposed or proposes solutions to the problems of the partners that constitute chain value (Suppliers, Customers, Competitors, and Employees).   | Chesbrough (2003); Liu & Zheng (2011)               |
|  | CAV3  | My company has proposed or proposes solutions to the problems of the partners that constitute chain value (Suppliers, Customers, Competitors, and Employees).   | Chesbrough (2003); Liu & Zheng (2011)               |
|  | CAV4  | My company has received or receives solutions to problems from the partners that make up the value chain (Suppliers, Clients, Competitors and Employees).   | Chesbrough (2003); Liu & Zheng (2011)               |
|  | CAV5  | When an idea is not considered important to my company, it is shared with stakeholders in the value chain (Suppliers, Clients, Competitors, and Partners) so that it can be used and developed elsewhere. | Chesbrough (2003); Liu & Zheng (2011)               |

**Table 1. Items of Open Innovation Construct**

Source: Adapted from Chersbrough (2003), Chersbrough, (2004), Lindergard (2010), Liu & Zheng (2011) & Sener & Hobikoglu (2015)

Moreover, the research instrument of this study addresses issues, built from the theoretical references of several authors, to compose the Value Creation construct (Table 2).

|                | Item | Question  | Author(s)                                    |
|----------------|------|---|--|
| Value Creation | CV1  | In an aspect, my company's competitiveness was generated from the relations with the other companies.   | Chersbrough, (2004)                          |
|                | CV2  | My company is more qualified and secure by maintaining relationships and exchanging information with other companies.                                       | Chersbrough, (2004)                          |
|                | CV3  | My company has already obtained or obtains financial or productivity gains, due to the partnerships between universities, institutes, and research centers. | Chersbrough, (2004)                          |
|                | CV4  | My company has already gained or gains financial or productivity by developing products with other companies or institutions.                               | Lindergard (2010) & Sener & Hobikoglu (2015) |

# OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

|  | Item | Question  | Author(s)  |
|--|------|---|--|
|  | CV5  | My company generates gains due to the sharing or reception of equipment and technologies.   | Ades <i>et al.</i> (2013);<br>Oliveira & Alves (2013). |
|  | CV6  | My company obtained or gains in competitiveness or productivity by investing in other businesses, originating from existing products or businesses.                       | Ades <i>et al.</i> (2013);<br>Oliveira & Alves (2013). |
|  | CV7  | My company generates gains due to the practices of obtaining or providing financial investments.  | Ades <i>et al.</i> (2013);<br>Oliveira & Alves (2013). |
|  | CV8  | My company generates gains due to the practices of obtaining or providing financial investments.  | Chesbrough (2003);<br>Liu e Zheng (2011)               |
|  | CV9  | My company obtained or obtains competitive and value differentials due to the collaborative actions with the chain value (Suppliers, Clients, Competitors and Employees). | Chesbrough (2003);<br>Liu e Zheng (2011)               |

**Table 2. Items of the Value Creation construct**

Source: Adapted from: Chesbrough (2003), Chesbrough, (2004), Lindergard (2010), Liu & Zheng (2011) & Sener & Hobikoglu (2015)

## 2.1 The Premises of Open Innovation: Knowledge and Innovation Networks

In organizations that aim for innovation, networking becomes a positive practice. Through the integration with internal and external participants with the company, a complementarity of skills, access to information and collective learning, fill gaps and deficits. In this sense, companies seek to improve internal procedures through various contacts. (Bonner & Baumann, 2012, Sie *et al.*, 2014) The form and viability of knowledge networks establish the practices of transfer and acquisition of resources and define the potentiality achieved. The networks, when well defined and viable, allow for a high degree of involvement, collective growth and the continuous practice of knowledge

Each organization presents a different context of innovation. The environment, the resources available and the way innovation is viewed directly influences organizational results. For the practice of open innovation, it is necessary for the organization to have a constitute chain value culture to innovation and to stimulate relations and exchanges with the external environment (Herebero, Santos & Equilaz, 2013; Chesbrough, 2004). But it is worth noting that only seeking external resources does not make the practice efficient and therefore internal resources such as portfolios, absorptive capacity, R & D resources themselves, the ways in which leaders and the company itself invest in innovation and in open innovation practices (Rodrigues, Maccari & Campanario, 2011). The way the organization defines the business model, the strategies and processes for innovation define the practices of open innovation.

Chesbrough (2006), Pitassi (2012) and Saebi and Foz (2015) show that when the strategies are well defined and have adequate relationships, what is needed from the external environment is appropriately recognized and it is known what can be provided. Therefore, the open innovation model can encompass two propelling and necessary aspects for its practice: the knowledge networks and the innovative profile of organizations. For this study, the research tool, built from the theoretical references of several authors and that addresses issues that make up the Knowledge Networks and Organizational Innovation Profile constructs can be seen in Table 3.

|                    | Item | Question   | Author(s)                                       |
|--------------------|------|--|---|
| Knowledge Networks | RC1  | My company establishes relationships with other companies in exchange of information and knowledge.                                | Sie <i>et al.</i> (2014)                        |
|                    | RC2  | My company establishes a relationship between the areas and employees of the company itself to exchange information and knowledge. | Sie <i>et al.</i> (2014)                        |
|                    | RC3  | The companies with which my company maintains contacts are trustworthy for information sharing.                                    | Desiderio & Popadiuk (2015); Guan e Liu (2016). |

# OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

|                    | Item   | Question   | Author(s)                               |
|--------------------|--|--|---|
| Innovation Profile | PIN1   | My company describes in its strategic planning the innovation practices that are used by the organization.             | Pitassi (2012); Saebi & Foz (2015)      |
|                    | PIN2   | In my company, the operation and business strategies for innovation practices are known to all employees.              | Pitassi (2012); Saebi & Foz (2015)      |
|                    | PIN3   | My company promotes or promoted adaptation in the internal culture to better act in the field of innovation.           | Herebero, Santos & Equilaz, (2013)      |
|                    | PIN4   | There is easy access, rapport and reliability between employees and the leaders of my company when seeking innovation. | Rodrigues, Maccari & Campanario, (2011) |
|                    | PIN5   | The environment of my company is favorable and ready to stimulate innovation.  | Herebero, Santos & Equilaz, (2013)      |
|                    | PIN6   | In my company, employees in all areas are encouraged to give suggestions and ideas for the business.                   | Rodrigues, Maccari & Campanario, (2011) |
|                    | PIN6   | My company has an investment plan for innovation for medium and long term.   | Pitassi (2012); Saebi & Foz (2015)      |
|                    | PIN7   | When it comes to innovation, my company has a clear perception of the points to be improved internally.                | Chesbrough (2006)                       |
|                    | PIN8   | When it comes to innovation, my company has a clear perception of the strengths it presents to the market.             | Chesbrough (2006)                       |
| PIN9               | In my company, there is an internal structure of research, development and innovation. | Chesbrough (2006)  |   |

**Tabela 3. Itens dos constructos Knowledge Networks e Perfil inovador Organizacional**

Source: Adapted Chesbrough (2006), Rodrigues, Maccari & Campanario, (2011), Pitassi (2012), Herebero, Santos & Equilaz, (2013), Sie *et al.* (2014) e Saebi e Foz (2015),

## 2. Methodology

This study is characterized as a research with a quantitative and descriptive approach. According to Vergara (2015), quantitative research aims to identify relationships between variables so that the collected data can be measured and statistical analyzes performed. In order to meet the objective of this research, which proposes to determine which factors that constitute open innovation influence the creation of value for Technology-Based Companies, it was decided to perform the data collection through a structured survey questionnaire, with 5 point likert scale, ranging from 1, totally disagree to 5, totally agree. The scale was standardized by subtracting from the original value the central value 3 and then the result was divided by 2 so that the scale oscillated from -1 to 1.

The questionnaire consisted of 45 questions, divided into 9 constructs: Knowledge Networks, Innovation, Partnerships, Product Development by Licensing and Patents, Spin off and Spin in, Corporate Venturing and Chain of Value. The pre-test was carried out with 10 TBC's employees and 2 professors from the areas of innovation research and knowledge management. In addition to the literature review, it was considered a characterization of the respondent groups regarding job title, time of experience in the innovation field, location and segment of the company.

The research universe is composed of Brazilian TBC's collaborators, regardless of the technological solution proposed by the organization. For the composition of the sample the snowball sampling was employed, according to Baldin and Munhoz (2011: 332), "it is a non-probabilistic sample form [...] in which the initial participants of the study indicate new participants that in turn, indicate new participants and so on, until the proposed objective is reached", using the propagation of respondents through the indication by the participants of the research. A total of 466 responses were obtained, 111 being disregarded because they presented more than 10% of missing data. In the end, there were 355 valid answers. It should be noted that due to the chosen technique, there is no exact measurement of the companies participating in the study, as well as the characterization of the employee by company.

For the quality control of the surveys answers, the existence of outliers was analyzed, which are observations that present a pattern of response different from the others. Absolute and relative frequencies were used to describe the variables characterizing the sample. In the description of the items of the constructs it was used measures of central tendency and dispersion. Due to the presence of second-order

constructs, that is, constructs that are not formed directly by the items but by other latent variables (indicators), the "Two-Step" approach was employed. To test the hypothetical theoretical models, the modeling of structural equations using the Partial Least Square (PLS) approach was applied (Vinzi et al., 2010).

All the constructs that had a CC index above 0.7, were one-dimensional by the Parallel Analysis method and had a AVE greater than 0.40. Thus, the data indicate that a validated index can be created representing the innovative profile, knowledge networks and open innovation constructs, by means of the average of the presented items. It should be noted that all items presented factor loads above 0.50 and the confidence intervals (CI - 95%) indicate the significance of all weights, evidencing the relevance of the items to the formation of the indicator that will represent the construct. The software used for statistical analysis was R (version 3.1.3).

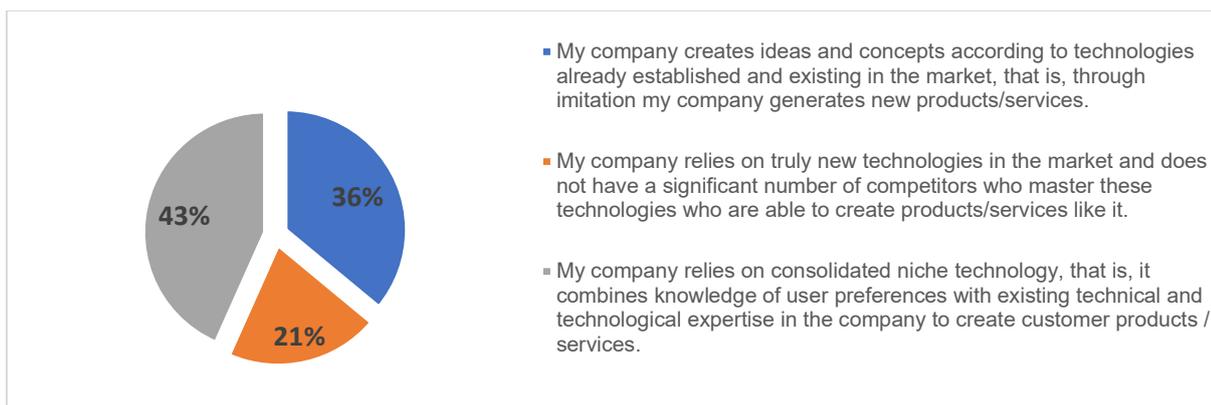
### 3. Study Development

This section presents the analyses carried out with the collected data from TBC's professionals, segmented into two subsections: sample descriptive analysis and structural model analysis.

#### 3.1 Sample Descriptive Analysis

The survey is built of 355 valid respondents. Of the respondents, 55.51% worked for more than 1 year in the areas of innovation and R & D of products/services and have a higher education level (36.34%). From the researched organizations, 80% are from the private sector and operating in the Brazilian state of Minas Gerais for more than 10 years (50.99%). Most companies are characterized by the aerospace, pharmaceutical, computer, electronics, telecommunications and instruments segments (52%) and, according to the OECD (2005), have a high technological intensity. These characterizations allow assertiveness and credibility in the research, since the respondents experience daily practices of innovation in the companies and have a relevant degree of education.

Regarding the type of innovation, 43% of companies are based on consolidated niche technology, according to Picture 1.



Picture 1. Companies classification according to innovation type

Source: Research Data

This result reflects the statements of Pinho et al. (2005) and Santos and Pinho (2010). The authors point out that TBC's seek to combine their customers/users' knowledge preferences with the skills they develop internally so that new products are created through incremental innovations. TBC's, mainly Brazilian ones, are focused on making technological efforts to manufacture "incremental" products from imitation and adaptation (Pinho et al., 2005), a factor that was also identified in this study.

## OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

When conducting a descriptive analysis of the constructs, on average, a significant tendency of the respondents that agree with all the items of the innovative profile construct was found. However, the items "In my company, the operations and business strategies for innovation practices are known by all employees" (PI2) and "In my company, employees in all areas are encouraged to give suggestions and ideas" for (PI6) presented a difference in the concordance scale, according to Table 4.

| Construct          | Items  | Weight | CI - 95%*    |
|--------------------|--|--------|--------------|
| Innovative Profile | PI1- My company describes in its strategic planning the innovation practices that are used by the organization.                      | 0,12   | [0,11; 0,13] |
|                    | PI2- In my company, the operations and business strategies for innovation practices are known by all employees.                      | 0,12   | [0,11; 0,13] |
|                    | PI3- My company promotes or promoted adaptation in the internal culture to improve performance in the field of innovation.           | 0,14   | [0,13; 0,15] |
|                    | PI4- There is easy access, relationship and reliability between the employees and the leaders of my company when seeking innovation. | 0,12   | [0,11; 0,13] |
|                    | PI5- My company's environment is favorable and ready to stimulate innovation.  | 0,12   | [0,11; 0,13] |
|                    | PI6- In my company, employees in all areas are encouraged to give suggestions and ideas  | 0,13   | [0,12; 0,13] |
|                    | My company has an investment plan for innovation for medium and long term.   | 0,13   | [0,12; 0,14] |
|                    | PI8- When it comes to innovation, my company has a clear perception of the points to be improved internally.                         | 0,14   | [0,13; 0,15] |
|                    | PI9- When it comes to innovation, my company has a clear perception of the strengths it presents in the market.                      | 0,13   | [0,12; 0,14] |
|                    | PI10- In my company, there is an internal structure for research, development and innovation.  | 0,14   | [0,13; 0,15] |

**Table 4. Confidence interval of the Innovative profile construct**

Source: Research Data

The type of segment researched already brings in its concept the parameters of innovation. For Santos and Pinho (2010) the TBC's have an innovative intensity capable of sustaining solid technical skills and presenting a high expectation of growth. However, for there to be a considerable and real innovative intensity, all the employees of an organization need to be involved, so that ideas can arise from any hierarchical or environmental level (Chen et al., 2015). Hence, in a process of innovation it is necessary to clearly communicate the objectives of innovation and the recognition of opportunities and rewards by the employees. Only then, activities that bring new ideas, techniques and methods will be stimulated and the workforce will be directly proportional to the performance of activities (Chen & Huang, 2010). The employees feeling part of the company will assume responsibility for the effectiveness of its actions.

In regard of the construct knowledge networks, on average, there was a significant tendency to the respondents to agree with all items. There was a greater tendency of agreement with the item "My company establishes a relationship between the areas and the collaborators of the company to exchange information and knowledge" (Table 5). This result reinforces the importance of keeping ties for sharing resources and solutions.

| Construct          | Items   | Average | CI - 95%*    |
|--------------------|---|---------|--------------|
| Knowledge Networks | RC1 My company establishes relationships with other companies to exchange information and knowledge.                                    | 0,44    | [0,42; 0,48] |
|                    | RC2 My company establishes a relationship between the areas and the collaborators of the company to exchange information and knowledge. | 0,36    | [0,33; 0,39] |
|                    | RC3 The companies which my company maintains contact are trustworthy for sharing information.   | 0,40    | [0,36; 0,43] |

**Table 5. Confidence Interval of the Construct Knowledge Networks**

Source: Research Data

## OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

The development of knowledge networks allows information and experience to be shared and works as a source of value. Through networks, ideas originate new products, processes and discoveries (Schimid, Knierim & Knuth, 2016) and the uncertainties of the innovation process are shared and reduced. Although there is a positive trend in all items, the formation of partnerships with companies is still inferior to other partnerships. Nonaka and Takeuchi (2008) argue that knowledge does not occur only within the organization, but also through external connections, which includes private companies. In this sense, the TBCs surveyed can enhance their relationships with other companies and be aware that diversity in the types of partners in a network can help achieve different types of innovation performance.

As for the items of open innovation, each first-order construct was evaluated. For the construct "Partnership Establishment", according to Table 6, there was on average a significant tendency of respondents to agree on all items. Only the item "My company seeks partnerships with universities, research centers and institutes to implement innovations (EP1)" showed a smaller tendency between the agreement scales. The agreement in most of the related items refers once more to the recognition of the opportunity that exists when partnerships are maintained. However, attention is drawn to the contradiction found in the answers. When reporting the "Knowledge Networks" construct, the relationship between companies were found to be less frequent. Massaini and Oliva (2015) already pointed out that the centralization of innovation processes is still constant, leading to a lack of awareness of the benefits of establishing partnerships. This may be a reason for the different results.

For the construct "Product Development by Licensing and Patents" there was also a significant tendency to agree to the item "My company shares its equipment and its technologies with other companies/institutions (DPLP1)". However, the item "My company receives equipment and technologies from other companies/institutions (DPLP2)" did not present enough information to confirm agreement or disagreement (Table 6).

| Constructo                                       | Itens   | Média | IC - 95%*     |
|--|---|-------|---------------|
| Partnership Establishment                        | EP1. My company seeks partnerships with universities, research centers and institutes to implement innovations. | 0,08  | [0,01; 0,15]  |
|  | EP2. My company seeks partnerships with other companies to capture resources and knowledge.                     | 0,18  | [0,12; 0,24]  |
|  | EP3 My company has already developed or develops products along with other companies or institutions.           | 0,15  | [0,09; 0,22]  |
| Product Development por Licenciamento e Patentes | DPLP1 My company shares its equipment and technologies with other companies / institutions.                     | 0,03  | [-0,04; 0,09] |
|  | DPLP2 My company receives equipment and technologies from other companies / institutions.                       | 0,12  | [0,05; 0,19]  |

**Table 6. Confidence Interval of the Constructs Partnership Establishment and Product Development by Licensing and Patents**

Source: Research Data

Open Innovation proposes a democratization on innovation processes, so that capabilities, resources and technologies are acquired and also transferred, creating what is called a "two-way" for innovation (Chen, 2014). What is observed in the TBCs surveyed is that the use of Open Innovation as a transfer of resources stands out in face of Open Innovation for resources acquisition. The result demonstrates a distinct validation of the studies contained in the literature, which were hitherto performed. The studies of Rodrigues, Maccari and Campanário (2010) and Desiderio and Popadiuk (2015), when presenting an analysis of Brazilian companies, points to the excellence of the acquisition of equipment and/or technologies by companies, contradicting the result of this research.

The collaborative use of technologies implies in a greater amount of creation and research of innovative ideas. The quicker a technology goes beyond the confines of a laboratory, the quicker it will emerge to apply, balance, and integrate that technology into new products (Chesbrough, 2006, Flores and others, 2015, Guan & Liu, 2016). This is an advantage opportunity taken by the companies researched.

## OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

But receiving new technologies would also enable external skills and knowledge to be internally aggregated and allow different views on a process, solving problems, and filling organizational gaps.

Regarding the "Spin in and Spin off" construct, the significant tendency to agree with all items also occurred (Table 7). The item "My company uses businesses or products already on the market to generate new business (SIO2)" showed a significantly higher level of agreement. In the market, it is common for organizations to seek business and/or external products, and group them into business models, strategies, and production. Besides, it is also common to find internal opportunities, coming from projects different from the original. Moreira et al. (2008) explain that the importance of ideas and/or business can vary from one organization to another. Projects that do not have an advantage or interest for one company can originate new business and market expansion for another and therefore are grouped or developed in parallel.

It should be noted that the Spin off construct is already constant in the Open Innovation models presented by Oliveira and Alves (2013) and Saebi and Foss (2015), and it can be observed that it is also constant in the companies surveyed. However, Spin In is not yet a common construct in the models related to the study of Open Innovation, allowing the proposal of this study to complement the theories found. This can be observed by the types of innovations performed by the companies, since incremental is still a recurring practice.

. For the "Corporate Venturing" construct (Table 7), the result was neutral, with no agreement or disagreement between the items. On the one hand, it is recognized that the research and development centers boundaries are broken when it comes to open innovation. On the other hand, it should be stressed that R & D should not be disregarded when this kind of innovation is applied. Corporate venturing is a form of investment and capital investment in businesses that present potential growth and may also be embryonic. Since the items in Corporate Venturing did not present a significant trend to agree or disagree with the results, it is clear that this type of investment should be better discussed by the TBCs in question.

| Construct            | Items   | Average | IC - 95%*     |
|----------------------|---|---------|---------------|
| Spin in and Spin off | SIO1 My company creates new business when it detects other opportunities outwith the main market, investing in the development of these projects in parallel. | 0,19    | [0,13; 0,25]  |
|                      | SIO2. My company uses existing businesses or products to generate new business.   | 0,34    | [0,28; 0,40]  |
| Corporate Venturing  | COV1. It is common for my company to invest financially in the training and/or maintenance of external research and development (R & D) centers.              | 0,00    | [-0,06; 0,07] |
|                      | COV2 Financing and lending are done in a planned and calculated way to improve my own company's research and development centers.                             | 0,07    | [-0,01; 0,13] |

**Tabela 7. Confidence interval of the Spin In and Spin-Off and Corporate Venturing constructs**

Source: Research Data

Investing in R & D, whether internal or external, allows empowered and creative intellectual capital to be aggregated to organizations for the advantages to be obtained (Velic & Marjanovic, 2016). To innovate, you need investment in research and innovation departments. This response may be a reflection of the item "innovation", in which it was seen that there is no clear communication of innovative processes. The "Value Chain" construct presented a significant trend, except for the item "When an idea is not considered important for my company, it is shared with the partners in the Chain Value (Suppliers, Clients, Competitors and Collaborators) so that can be used and developed elsewhere (CAV4)" (TABLE 7).

## OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

| Construct   | Items  | Average | IC - 95%*     |
|-------------|--|---------|---------------|
| Value Chain | CAV1 My company understands that good ideas can come from any hierarchical or local level, so it maintains relationships with its employees, suppliers, customers and competitors.                                 | 0,29    | [0,23; 0,36]  |
|             | CAV2 My company has proposed or proposes solutions to problems of the partners that constitute the value chain (Suppliers, Customers, Competitors and Employees).  | 0,23    | [0,17; 0,29]  |
|             | CAV3 My company has received or receives solutions to problems from partners that constitute the Chain Value (Suppliers, Customers, Competitors and Employees).  | 0,24    | [0,18; 0,30]  |
|             | CAV4 When an idea is not considered important to my company, it is shared with stakeholders in the Chain Value (Suppliers, Clients, Competitors and Collaborators) so that it can be used and developed elsewhere. | 0,05    | [-0,01; 0,11] |
|             | CAV5 My company's competitiveness Aspects were generated from the relationships in the Chain Value (Suppliers, Customers, Competitors and Employees).  | 0,21    | [0,14; 0,27]  |

**Table 8. Confidence interval of the Chain Value construct**

Source: Research Data

Through the positive result, the importance of the relationship between the organization and the partners that make up the value chain is emphasized. Attention is drawn to " When an idea is not considered important to my company, it is shared with stakeholders in the Chain Value (Suppliers, Clients, Competitors and Collaborators) so that it can be used and developed elsewhere. (CAV4) ". Having a non-significant trend demonstrates that in the relationship between business and the value chain, the open innovation for delivering supply of resources is not as widely used as demonstrated in the technology delivery results. This result was also found in the studies of Rodrigues, Maccari and Campanário (2010) and Desiderio and Popadiuk (2015).

To be successful, TBCs needs to: listen to stakeholders and maintain relationships with partners to acquire new knowledge; Know-how to combine this new knowledge with company resources; And know how to spread these new ideas, which will be formed with the external ideas and the ideas of the company itself. Therefore, the importance of the Chain Value in this process.

### 3.2.2 Structural model Analysis

Continuing the analysis, the influence of the Innovative Profile, Knowledge Networks, Partnerships, Patent and Licensing Products, Spin In and Spin off, Chain Value and Value Creation influences were evaluated in the structural model of this study. It should be noted that no variables were discarded after the analysis. The results point out that there was a significant influence of the Innovative Profile and Knowledge Networks on the constructs that constitute the Open Innovation, as these constructs presented a positive and significant influence on the Value Creation, according to Table 9 and Picture 2.

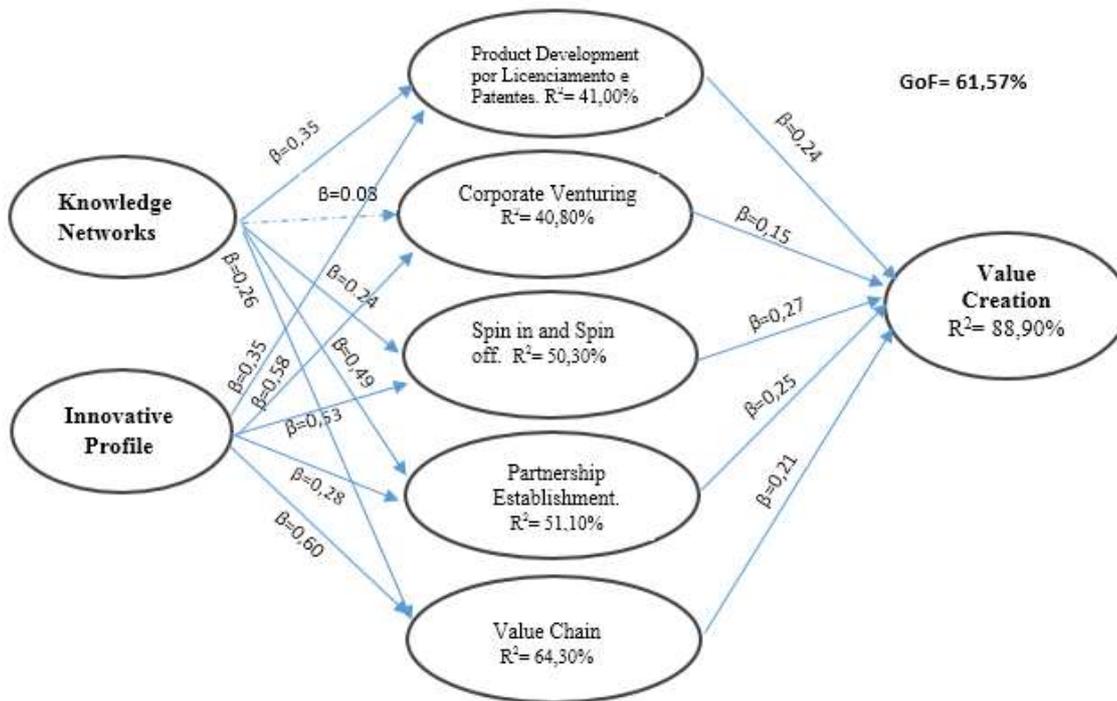
Knowledge Networks and the Innovation Profile are capable of composing the Chain Value in a higher level and, to a lesser extent, Corporate Venturing. This indicates that the companies surveyed have a network and innovation relationship when they maintain partnerships with the partners of the entire production and sales process. Thus, the Corporate Venturing item presented, in a lesser degree, the influence on Value Creation. Lindegaard (2010) and Kim and Park (2008) argue that open innovation requires the recognition that intelligence and the best ideas may not be a part of the organization or not being originate from R & D. Therefore, the innovation model must be aligned with external skills and knowledge.

# OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

| Endogenous                | Exogenous                 | $\beta$ | E.P. ( $\beta$ ) | C.I. - 95%    | P-Value | R <sup>2</sup> |
|---------------------------|---------------------------|---------|------------------|---------------|---------|----------------|
| Partnership Establishment | Knowledge Networks        | 0,49    | 0,05             | [0,38; 0,59]  | 0,000   | 51,10%         |
|                           | Inovation                 | 0,28    | 0,05             | [0,18; 0,40]  | 0,000   |                |
| Product Development       | Knowledge Networks        | 0,35    | 0,06             | [0,23; 0,46]  | 0,000   | 41,00%         |
|                           | Inovation                 | 0,35    | 0,06             | [0,24; 0,48]  | 0,000   |                |
| Spin off & Spin in        | Knowledge Networks        | 0,24    | 0,05             | [0,13; 0,35]  | 0,000   | 50,30%         |
|                           | Inovation                 | 0,53    | 0,05             | [0,43; 0,62]  | 0,000   |                |
| Corporate Venturing       | Knowledge Networks        | 0,08    | 0,06             | [-0,04; 0,20] | 0,170   | 40,80%         |
|                           | Inovation                 | 0,58    | 0,06             | [0,47; 0,70]  | 0,000   |                |
| Chain Value               | Knowledge Networks        | 0,26    | 0,04             | [0,15; 0,36]  | 0,000   | 64,30%         |
|                           | Inovation                 | 0,60    | 0,04             | [0,51; 0,70]  | 0,000   |                |
| VC                        | Partnership Establishment | 0,25    | 0,03             | [0,19; 0,31]  | 0,000   | 88,90%         |
|                           | Product Development       | 0,24    | 0,03             | [0,18; 0,30]  | 0,000   |                |
|                           | Spin off & Spin in        | 0,27    | 0,03             | [0,21; 0,33]  | 0,000   |                |
|                           | Corporate Venturing       | 0,15    | 0,02             | [0,09; 0,22]  | 0,000   |                |
|                           | Chain Value               | 0,21    | 0,03             | [0,15; 0,27]  | 0,000   |                |

**Tabela 9. Structural Model and Measurement Coefficients**

Source: Research Data



**Picture 2. Structural Model**

Source: Research Data

Often, interactions with scientific systems open the field for application of ideas that could be developed only within these systems, due to the lack of human, financial and equipment resources in the organizations. The combination of business models with other organizations may also be able to accelerate production steps and increase the likelihood of innovation. It is therefore important to break down internal investment barriers. Sharing resources allows new ways of integrating and applying these to new products, to be known and continuously improved (Chesbrough, 2006; Sener & Hobikoglu, 2015). Thus, companies, even with few resources, can develop with external investments and create their own value.

It should be noted that the coefficient represented by  $\beta$  quantifies the strength and the direction of the relationships between the Partnership Establishment (0.35), Product Development by Licensing and

## OPEN INNOVATION AS A STRATEGY FOR CREATING VALUE IN TECHNOLOGY-BASED COMPANIES

Patents (0.24), Spin in and Spin off (0,27), Corporate Venturing (0.27) and Chain Value (0.21) on Value Creation. The bootstrap confidence intervals are in agreement with the results found via p-value, evidencing a greater validity of the presented results. In addition, the constructs that make the Open Innovation, account for 88.90% of Value Creation. In addition to the relationships between exogenous and endogenous variables, there were indirect and significant effects of the relations between Knowledge Networks and Value Creation (0.34 [0.25, 0.42])

### 4. Final Considerations

Innovation is considered a tool capable of making changes in organizational structures, providing socio-economic benefits and supporting the development of companies. However, the reality still shows the disparity of market domination, in which some organizations have competitive advantages and growth possibilities greater than others. This is due to the lack of material, financial, technological and intellectual resources that make it impossible for organizations to carry out and maintain innovative practices. From this perspective, open innovation emerges as a possibility for the democratization of innovation, allowing organizations of any size to compete with each other. This democratization arises from the Knowledge Networks formation that enables the information, resources and knowledge sharing. But for open innovation to be applied, organizations need to maintain efficient processes and present business models that create strategies and influence an organizational culture focused on innovation. The role of leadership in these cases is critical.

In this perspective, through a quantitative and descriptive research, this study sought to define which factors proposed by the open innovation can influence Technology-Based Companies (TBCs) to create value. In open innovation, the following factors were defined: Partnership Establishment, Product Development through Licensing and Patents, Spin in and Spin off, Corporate Venturing and Chain Value. A survey was conducted and 355 respondents who did not show a discriminatory pattern in the answers and who had the questionnaires completely answered. The respondents are collaborators of Technologically Based Companies, without distinction of position and hierarchy, that work directly with aspects of research, development and innovation.

The companies, which were mostly in Minas Gerais, showed the main factors used in open innovation. It was observed that some initial practices of open innovation are already present in the TBC's surveyed. It was identified practices of establishing partnership, Spin in and Spin off, Product Development by Licensing and Patents and Chain Value. The corporate venturing factor has not shown sufficient results to indicate its use. The result also pointed out that all the open innovation factors proposed in the model (Partnership Establishment, Product Development by licensing and patents, spin in and spin off, Corporate Venturing and Chain Value) correlate significantly and positively in the creation of Value of TBC's. Partnership Establishment, Product Development, spin in and spin off, Corporate Venturing and Chain Value were able to account for 88.90% of value creation.

In general, the research allowed the identification of the factors proposed by the open innovation for value creation and contributed, through the measurement of the result, to the identification that open innovation practices are still incipient in Technologic-Based Companies. As limitations to this study, it is reported that there is no measurement of the exact number of companies participating in the study, since the chosen data collection technique was Snowball. After reaching the results and identifying the limitations of the study, it is suggested that new research is performed by aggregating qualitative analyses that identify characteristics that the quantitative does not offer. Another suggestion of future research is the validation of the proposed model for the identification of open innovation in other organizational segments, since the results found are specific from TBCs.

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