Planejamento de Experimentos para apoio à Tomada de decisão em Gestão de Negócios e Inovação

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SUMÁRIO

CAPÍTULO 1

A MANAGEMENT MODEL TO MEASURE THE RISK SIGNIFICANCE RELATED TO THE PROCESS OF TECHNOLOGICAL ACCESS IN THE CONTEXT OF OPEN INNOVATION [1]

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ABSTRACT: The objective of this study is to propose a model for the management of risks in the process of access to external sources of technological innovation, as part of a managerial model for open innovation. Taguchi method was used, and data was collected by observation. Empirical evidences were verified, demonstrating the influence and significance of open innovation factors, such as: partnership between companies and universities, the risk of lack of investment in R&D, internal and external, and the absence of intellectual property to maximize the results regarding innovation. Overall, the results demonstrate that technological companies should be open on a day-to-day basis, and have tolerance for a combination of probabilistic risks, as for example, condition to obtain the best results with innovation and to access the external sources of innovation with less associated risk.

KEYWORDS: Access Risk; external sources of innovation; Open innovation; Intellectual property; Research & Development.

1 I INTRODUCTION

It is noticeable that the trying process of anticipating future situation, involves the unpredictability and uncertainty, because even when calculating the probabilities of events, in

1. A Management Model to Measure the Risk Significance Related to the Process of Technological Access in the Context of Open Innovation. International Journal of Emerging Research in Management and Technology, v. 6, p. 142-155, 2018.

some cases, the anticipated event could occur partially or totally different from the previous calculated event.

The challenge for the managers of TBCs seems to consist in the development of new forms of innovation management, not only for the stable phases of the business, but also for the uncertainties, which cause impact over the process of innovation access. Seeking intrinsic risks minimization in the process is essential to succeed in innovation management, especially in managing process based on external innovation, such as the case of open innovation proposed by Chesbrough 2003.

The development of models and alternative strategies to access and or generate innovation could be a way for the corporation to sustain their business efficiently. Von Hippel 1986, Prahalad and Hamel 1990, Hamel 200, Bovet and Martha 2001, have pointed the necessity of the corporations to make their process of business innovation dynamic. Nonetheless, it was Chesbrough 2003, 2007, who demonstrated different approaches over the wide concept of administrative process mechanisms that boost the prospecting and incorporation of innovations, which was called Open Innovation.

On the one hand, the risks and uncertainties coming from technological scenarios influence the strategies of management innovation. On the other hand, the technological collaboration, in the context of open innovation, could be one of the options for the corporations to access external sources of technologies, seeking to share technologies and mitigate the risks in R&D, research and development, on innovation.

How to effectively diagnose the most valuable innovations is the main challenge for corporations relying on external sources of innovations. (JEPPESEN AND LAKHANI, 2010; POETZ AND SCHREIER, 2012). Therefore, the present studies focus on the influence and significance of technological and corporative risks and in the mobility of access to technological innovation, over the performance regarding innovation of twenty-eight TBCs in Brazil.

One of the fundamental skills in innovation management to innovation access is to recognize the limitations of technological base of the company, and to be able to access external sources of knowledge, machines, information, and other. In addition, it is important to transfer the different technologies from external sources and to connect them as internal and relevant parts of the company. In the knowledge economy, with the advances in the information technology area, the strategies to access and to develop technological innovation are each time more favourable to the potential, offered by the increase of available connection in the company (WEST & BORGES, 2014).

One of the fundamental principles to develop strategies is related to the access to external sources of innovation, in the context of open innovation, which consider the collaboration between companies and other institutions, such as, universities, research centres, clients, suppliers, government and others. Some of the reasons for different companies to access external sources of knowledge, related to the development of technology in a collaborative way, are: reduction of risks of development or entrance in the markets, reduction of technological costs, achievement of economies of scale, reduction of time to develop and commercialize new products.

2 I METHODS

Experimental and inferential statistical methods were used. The design of experiment that describes the present study is presented in Fig. 1, which describes: (1) the choice of the object of the research; (2) the selection and categorization of input variables and their respective levels of observation; (3) selection of dependent variable; (4) selection of experimental matrix (observational); (5) population definition; (6) data collection: instruments and informant profiles; (7) sample arrangement and structured observation, according to the experimental matrix and (8) quantitative data analysis and results interpretation.

The TBCs were selected as the objective of the researchers, because they are innovative companies, which have knowledge and interest in the innovation subject. They are companies influenced by the risks of innovation and tend to understand the benefits of accessing external sources of technology.

The independent variables were characterized by specific risk factors of innovation process and by corporate risks. The independent variables were used to determine the profile of the risks for the studied companies, as a critical preliminary condition for decision making during the process of accessing external sources of innovation.

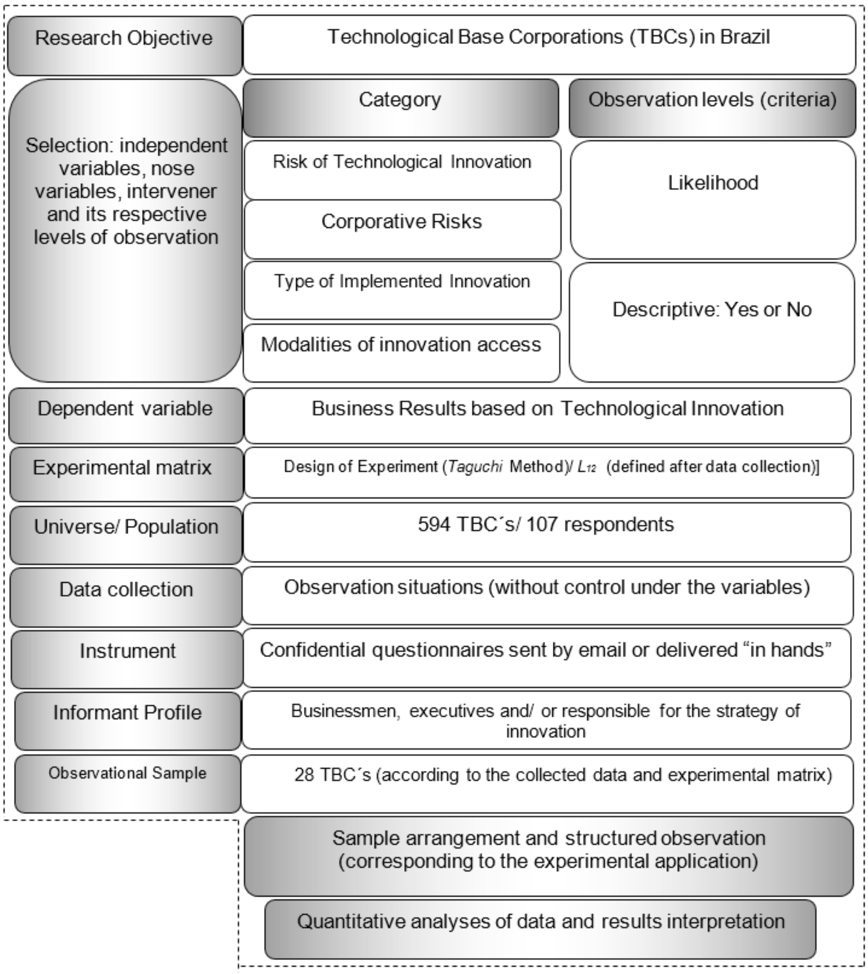

Fig. 1 Schematic illustration of the method utilized in this research: experimental (observational), statistic and inferential

Elements that could generate risks were identified by using theoretical framework of technological innovation processes, including open systems of innovation and access to external sources of technology (Table I). The following theoretical framework were used as base of this work, and thirty-three factors of risks were determined: Freeman (1974); Duysters, Kok e Vaandrager (1999); Ministério do Desenvolvimento, Indústria e Comércio Exterior (2007); Tidd, Bessant e Pavitt (2008); Instituto Brasileiro de Geografia e Estatística (2008); Sensato (2008); Chesbrough, Vanhaverbeke e West (2008) e Chesbrough (2003, 2007, 2012a, 2012b).

	Independent Variables (risk factors of technological innovation)
1	Complexity increase.
2	High innovation costs.
3	Lack of prospecting mechanisms.
4	Incompatibility between the technological profile of the company and the desired innovation.
5	Low entrance barriers to competitors in the innovation production
6	Lack of resources to develop innovation
7	Resource dependence with uncertain availability and cost.
8	Innovation sector in risk of stagnation or retraction
9	Unawareness of potential request for new products or services
10	Lack of incentive from government (excessive taxation, public polices, line of credit)
11	Difficulty to adequate the laws, regulations and others.
12	Unawareness of all legal aspects surrounding innovation
13	Errors in the innovation management
14	Intensity of economic effects in the country that generates and/ or receives the technological innovation
15	No acceptance of new products or services by the clients
16	Wrong launch of new product or service in the market
17	Lack of technical knowledge
18	Lack of information regarding technology
19	Lack of technical services
20	Lack of opportunities to develop cooperation with other companies / institutions
21	Centralization of innovative activities in other factory or company from the same group
22	Lack of intellectual property
23	Lack of qualified people
24	Loss of knowledge (collaboration)
25	Loss of control or domain (collaboration)
26	Cultural incompatibility (collaboration)
27	Insufficient trust (collaboration)
28	High cost of coordination
29	Lack of commitment.
30	Time/ unreal expectations
31	Information leakage (collaboration).
32	Lack of investments in internal R&D.
33	Lack of investments in externa R&D.

Table I: Independent Variables (Risk Factors Of Technological Innovation)

Considering that the strategies for innovation are developed in the context of corporate strategies, factors of corporate risks were selected as independent variables. To guarantee that the selection of independent variables, which determine the corporate risks of the companies, were determined, a second list (Table II) was created based on Padoveze e Bertolucci (2008), Fama, Cardoso e Mendonca (2002); International Federation Accountants (1999); Barrese e Scordis (2003) e Brito (2003).

Dimensions	Independent Variables (corporative risk factors)	
Infrastructure	1	Availability and capacity of actives.
	2	Access to capital.
	3	Fusions / acquisitions
Personal	4	Fraudulent activities
Process	5	Quality and rotation of suppliers
	6	Change in customer demands
Technology	7	Acquisition, maintenance, distribution, confidentiality and availability of data.
	8	Availability, capacity, selection, development and reliability of the system
Economic	9	Concession, default, credit and warranties degradation.
	10	Pay-off, funding, cash flow
	11	Derivatives, hedge, interest rates, exchange rates, actions, inflation
	12	Commodity prices
	13	Opposition between existing competitors, new competitors.
	14	Net worth evaluation, value of real estate
Technological	15	Access to external data
	16	Emergent technology
Environment	17	Energy
	18	Sustainable development
Politics/Public Politics	19	Changes on government, policies, legislation and regulations
	20	Monetary reform, price control
	21	Barriers to send money abroad

Table II Independent Variables (Corporative Risk Factors)

Furthermore, Table III demonstrates the criteria and indicators used to measure the independent variables and levels of observation. The method used was based on the adaptation model of probability evaluation of risk occurrence of International Federation of Accountants (1999), combined with the determination of two levels of observation for independent variables. Thus, the high level (1), has shown the levels correspondent to “Probable” and “Possible”, while the low level (2) has shown the levels correspondent to “Moderate” and “Remote”.

The levels of observation were useful to verify the answers that were affected by the changes of factor levels and for codification of original variables, so, the standardization of the random variables (BARROS NETO; SCARMÍNIO; BRUNS, 2007).

Level		Description	Indicators
High "1"	Likely	The possibility of occurrence, for example, is once a year, or there is a chance to occur, higher than 25%.	Potential – to occur several times in the next 10 years. Occurred in the past 2 years. Representative of operations from this nature, because of the external influences.
	Possible	The possibility of occurrence, in the period of 5 years is less than 25% and more than 12.5%.	It could occur in the next 5 years. It can be difficult to control because of the external influences. There is a recent historical of occurrence in the organization.
Low "2"	Moderate	The possibility of occurrence in a period of 10 years is less than 12.5% and more than 2%.	It could occur in the next 10 years. There is a remote historical of occurrence in the organization.
	Remote	The possibility of occurrence is less than 2%	An occurrence would be surprising.

TABLE III: probability of occurrence as an indicator for the measurement of independent variables and determination of observational level

Source: adapted from International Federation of Accountants (1999)

The classification of noise variables was integrated by types of innovation, because, according to Freeman (1982), Teixeira (1983) e Leifer, O'Connor e Rice (2002), intrinsically to the innovation processes, occur the uncertainty situations (noise), which grow proportionally to the innovation radicalness, in other words, in function of innovation. In practice, the control of the independent variables implies that TBCs can operationalize their own processes, exposing themselves into intervals of probabilities of occurrence. On the other hand, the control of uncertainties (even if experimental) demonstrates that the TBCs can correlate the level of uncertainties, which they are exposed to, based on the types of innovation relevant to their business.

To define the observational levels of noise, descriptive criteria were used. In this case TBCs were asked about which type of innovation they executed effectively, among the sixteen options demonstrated in Table IV. The positive answers (Yes) were considered as high observational level (2), while the negative answers (No) represented the low level (1) of observation of noise.

Level of uncertainty	Variable of noise (Types of Innovation) Which are the types of innovation developed by TBCs?	Levels of observation	
		High	Low
Genuine uncertainty	1. Basic research.	Yes	No
	2. Fundamental invention.	Yes	No
Super high level of uncertainty	3. Radical innovation in products.	Yes	No
	4. Radical innovation in processes (executed outside of the company)	Yes	No

High level of uncertainty	5. Significant innovation in products	Yes	No
	6. Radical innovation in processes (executed inside of the company)	Yes	No
Moderate level of uncertainty	7. New generation of products already established	Yes	No
Low level of uncertainty	8. Innovation license	Yes	No
	9. Imitation of innovation in products	Yes	No
	10. Modification in products and processes	Yes	No
	11. Adoption of processes (in the initial phase of life cycle)	Yes	No
Super low level of uncertainty	12. New model of established product	Yes	No
	13. Product differentiation	Yes	No
	14. Outsourcing of innovation of established products	Yes	No
	15. Adoption of processes (in the middle phase of life cycle)	Yes	No
	16. Small technical improvements in processes or products	Yes	No

TABLE IV: innovation and level of uncertainty

Source: adapted from Teixeira, 1983, p. 63.

The player variables (Table V) were selected based on the classification of Gomes e Kругliankas (2009).

The player variables correspond to the modalities of access to the external sources of technological innovation, which can be influenced and defined based on the type of innovation and risks to the innovation process, influencing the results and performance regarding innovation in the companies. To define the levels of observation of the player variables, descriptive criteria were used, so, “Yes” (in the case of the company to use the modality of access) or “No” (in the case of the company to do not use the modality of access). According to West & Borges (2014), the use of external innovations appears to enhance performance, but it only impacts in some specific results.

Player variables (Modality of Access to external sources of innovation) Which are the modalities of access used by TBCs?		Level of Observation	
		High	Low
1	Partnership with suppliers	Yes	No
2	Partnership with Universities	Yes	No
3	Partnership with competitors	Yes	No
4	Hiring of consultants	Yes	No
5	Partnership with other companies	Yes	No
6	Forums of special interest	Yes	No
7	Subcontracting	Yes	No
8	License acquisition	Yes	No
9	Venture capital.	Yes	No

10	Consortium of company	Yes	No
11	*Joint venture*.	Yes	No
12	Patents acquisition	Yes	No
13	Companies acquisition	Yes	No
14	Cooperation network	Yes	No

TABLE V: Player Variables: Modality Of Access To External Sources Of Innovation

The dependents variables were defined in nineteen factors (Table VI) which demonstrate the performance of the companies regarding innovation (DAVILA; EPSTEIN; SHELTON, 2006).

The dependent variables were measured based on the values assigned by the informants of each indicator listed by Davila, Epstein e Shelton (2006). The innovative performance, which directs the access to the minor associated risk is represented by the answers to the qualitative questions, measured in a scale of one to ten, which means: (1 = very very bad); (2 = very bad); (3 = bad); (4 = Not so bad); (5 = Partially Reasonable); (6 = reasonable); (7 = Not so good); (8 = good); (9 = very good) and (10 = very very good).

To justify and maximize the process, according to Taguchi techniques (1987), "higher value is synonym of better results" (ratio signal-noise: $S/N = -10 \log (\sum 1/y^2)/n$), the criteria to measure the answers were based on the premise that the companies which have innovative profiles, presented positive answers to the studied results.

Business results based on technological innovation	
Answers code (An)	Dependent variables (description of the answers)
R_1	Return of the capital invested in innovation
R_2	Growth of sales new products of innovation
R_3	Designed innovation that reaches the Market
R_4	Volume of sales of new products of innovation
R_5	Value invested on internal R&D
R_6	Value invested on external R&D
R_7	Failure control in the projects of innovation
R_8	Cost of development of New Products of Innovation
R_9	Time of development and delivery of innovation
R_{10}	Quality of product and process of innovation
R_{11}	Ease of access to new technologies
R_{12}	Culture for innovation
R_{13}	Customer satisfaction of new products of innovation
R_{14}	Customer satisfaction with the existent products
R_{15}	Increase in the customer portfolio based on innovation
R_{16}	Customer complains – research on customer satisfaction
R_{17}	Initiatives dedicated to internal innovation of product and process
R_{18}	Launched products based on partnership with Universities and Research Centres
R_{19}	Number of Registered Patents

TABLE VI: dependent variables (business results based on technological innovation)

The universe of this study was composed by 594 technological companies active in Brazil, indistinctly in the economic sector in which they act. In this case, a common point, is the fundamental relationship between these companies and innovation. On the other hand, the population of this study was represented by 107 TBCs, limited by the maximum of answering companies.

The term Design of Experiments can induce the reader to believe that this method is only applicable in situation where the data collection and data analyses are allowed, such as results of experiments, where the variables are controlled by the researcher. However, Ribeiro e Caten (2003) demonstrated that in the Design of Experiments, the data can be planned in two situations: (1) experimental data, where the observations of X and Y are planned as results of the experiment and (2) observational data, where observing the values of X and Y are done without the control of the researcher.

Due to the circumstances of this research, the selected and adequate data collection was the observational, which allowed that the values of the variables were observed, without the control of the researchers. In certain situations, the results obtained by the TBCs represented the experiment in managing of innovation. The situation that guided the obtaining of the data with the answering companies, was the observation under the perspectives and opinions of executives and responsibilities for strategies to develop technological innovation.

The instruments for data collection were structured questionnaires, with confidential questions. The questionnaires were sent by email, or via Customer Service Attendance of companies, or they were delivered in person to the social subjects that integrate the universe of the research.

To assure a probabilistic sample, only the companies that presented behaviours regarding their factors / levels of observation, similar to the specifications of Taguchi matrix L12 were used. As a result, eleven sampling factors were selected, that could be represented by the letters exhibited in the first column of Table VII. Twenty-eight companies were selected with the level of observation of factors with inputs similar to the matrix L12.

The obtained data was analysed, according to Taguchi method and the logical matrix L12. Therefore, the data was analysed in a quantitative way, by the inferential statistics procedures. Analysis of variance (ANOVA) was used in the parametric group of statistic tests, in order to observe the homogeneity of the data, the significance of differences between the averages, and if the input variables were significantly over the output variables. The data analysis was done by the use of the software MINITAB version 14. To guarantee a confidence level of 95% regarding the quality of the answers, the analysis of data and the interpretation of the results were done using the factors that presented the significance level of 5% or higher.

	Input factors (independent variables, noises and players)	Categories
A	Lack of mechanisms for prospection.	Risk of Technological Innovation.
B	Politicians: Changes in the government, political instability, legislation/regimentation.	Corporative Risks (external).
C	Patent acquisition.	Modality of access.
D	Limited possibilities of cooperation with other companies / institutions.	Risk of Technological Innovation.
E	Absence of Intellectual Property.	Risk of Technological Innovation.
F	Partnership with Universities.	Modality of access.
G	Lack of investment in R&D (internal and external).	Technological Innovation Risk.
H	Infrastructure: Availability and capacity of actives.	Corporative Risks (internal).
J	New generation of products already established.	Type of innovation.
K	Imitation of innovation in products.	Type of innovation.
L	No acceptance of new products or process by the customers.	Risk of Technological Innovation.

TABLE VII: sampling factors of input

3 I RESULTS

The analysis of the effects of the factors over the average of the answers was used to identify and quantify the size of the influence of the factors over the answers. Table VIII shows the principal effects of the factors over the averages of R1 (Return on invested Capital in innovation).

Level	A	B	C	D	E	F	G	H	J	K	L
Low (-)	7,375	7,847	7,722	8,013	8,333	7,292	8,083	7,778	7,833	7,653	7,820
High (+)	8,125	7,653	7,778	7,487	7,167	8,208	7,417	7,722	7,667	7,847	7,680
Effect	0,750	0,193	0,057	0,527	1,167	0,917	0,667	0,057	0,167	0,193	0,140
Rank	**3**	**7**	**11**	**5**	**1**	**2**	**4**	**10**	**8**	**6**	**9**

TABLE VIII : Calculation Of The Effects Of The Factors Over The Averages Of R_1.

The “rank”, in the last row of Table VIII, corresponds to the classification, in numerical decreasing scale, of the influence of the principal factors over the answers.

Analysis of variance (ANOVA) was used to do the tests of significance of the effects of the factors over the answers to evaluate the quality adjustment of the model. In other words, ANOVA was used to analyse the influence of the factors over the answers, thus, to identify / quantify the significant factors to occur the maximization of the studied answers. The Table IX shows the ANOVA effect over the averages of R1 (Return on invested Capital in innovation).

Source of variation	DF	Seq SS	Adj SS	Adj MS	F	P
A	1	1,6875	1,68750	1,68750	175,17	0,006
B	1	0,1121	0,11213	0,11213	11,64	0,076
D	1	0,8321	0,83213	0,83213	86,38	0,011
E	1	4,0833	4,08333	4,08333	423,88	0,002
F	1	2,5208	2,52083	2,52083	261,68	0,004
G	1	1,3333	1,33333	1,33333	138,41	0,007
J	1	0,0833	0,08333	0,08333	8,65	0,099
K	1	0,1121	0,11213	0,11213	11,64	0,076
L	1	0,0588	0,05880	0,05880	6,10	0,132
Residual Error	2	0,0193	0,01927	0,00963		
Total	11	10,8428				

TABLE IX: Analysis Of Variance (Anova) Over The Averages Of R_1

The level of statistic confidence adopted was 95%, in other words, the factors that presented values of P (last column of Table IX) similar or less than 0.05 were considered significants to maximize R1.

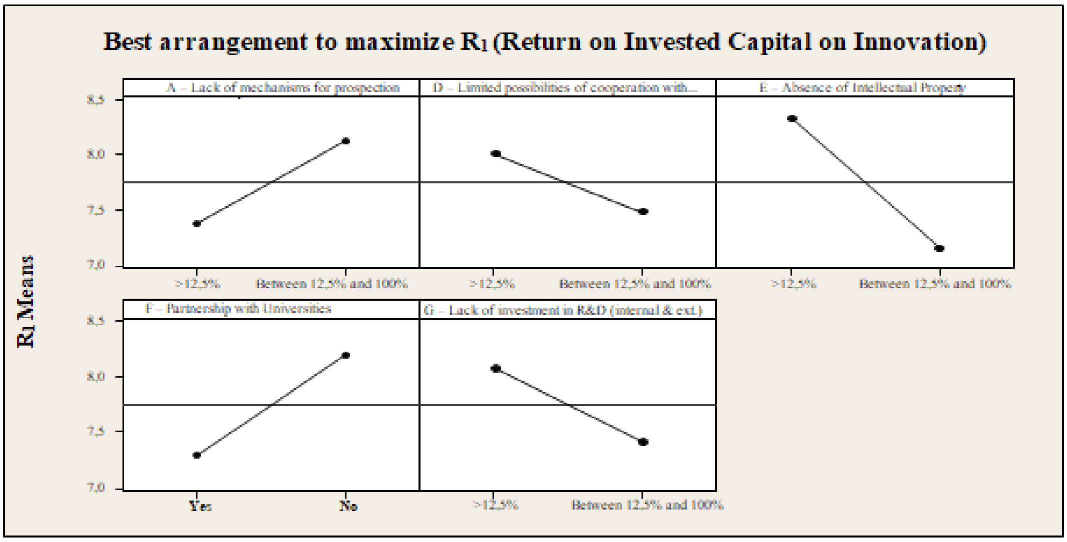

Fig. 2 Combination of the levels of observation for the maximization of R1.

The procedure, proposal of better combination of observational levels of significant variables to maximize R1 (Return on invested Capital in innovation), was used to propose a combination between the significant factors and their respective levels of observation, which lead to maximization of the business results, based on technological innovation and indicate the best condition to access to external sources of technologies, so, $\mathbf{A}_{(2)}\,\mathbf{D}_{(1)}\,\mathbf{E}_{(1)}\,\mathbf{F}_{(2)}\,\mathbf{G}_{(1)}$, according to Fig. 2.

The statistic procedures used for observation of the inferences of the factors over R1, were also applied for the analysis of selected factors over the other studied answers (R2 to R19). With the aim of synthetize this work, the other answers were omitted from the text. On the other hand, the organization of the discussion and results was established based on two evidences observed in the set of all studied answers:

- at first, among the eleven studied factors (A to L). Three of them represent

50% of the significance over the answers. This evidence is highlighted in the last column of the Table X, while the sum of the answers, where each factor was considered significant, represented the total of 86. The sum of the values related to the factors E (11), F (17) and G (15) represent the total of 43, so, 50% of the total quantity of incidences of significance of the factors over the set of answers;

- Second, these three factors were considered significants for the answers, keeping their respective levels of observation unchanged. For all the other eight factors, the oscillation between the levels of observation was conditional to their significances in the set composed by nineteen answers.

As a view of the systems, there is a certain agreement of these factors, regarding to uniformity of the levels of observation, as well as the quantity of the answers that were considered significants, emerging the results of analysis like conditioning elements to maximize the answers. Therefore, the input variables: (E) technological risk of absence of intellectual property, (G) technological risk of lack of investments in internal and external R&D, and (F) modality to the access to the external sources – partnership with Universities and other research centres – directing the discussions, because they showed their set of answers as essential factors.

The factor "G" of Table X (risk of lack of investment in internal and external R&D) showed significance over 15 of the answers (78.94%), and in all of them it presented the level of observation as low (1). In other words, it means that the TBCs which keep their level of exposition to the risk of lack of investment in internal and external R&D between 0 and 12.5%, consequently can maximize their results, based on this factor. The level of investment in R&D is determined by each company in order to maximize profits (STIGLITZ, 2014).

Factors/levels of observation with significance over the answers 1		**Dependent studied variables**																			Total $_1$
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
A	Lack of mechanisms of prospection	2	1		2	2	1						2					2			**7**
B	Changes in government, legislation, etc.		2	1	1								2				1		2		**5**
C	Patent acquisition						1						2			2	2		1	1	**6**
D	Absence of cooperation with institutions	1					2										2			2	**4**
E	Absence of Intellectual Property	1	1	1			1	1			1		1		1		1	1		1	**11**
F	Partnership with Universities	2	2	2		2	2	2	2	2	2		2	2	2	2	2	2	2	2	**17**
G	Lack of investments in internal and external R&D	1	1	1		1	1	1	1	1	1	1	1				1	1	1	1	**15**

H	Availability and capacity of actives		1			2		2		-			2				2	2		2	**8**
J	New generations of already stablished products			1	1											1	2				**4**
K	Imitation of innovation in products					2							2	2	2		2	2			**6**
L	No acceptance of new products / services		1			2							1								**3**
Total2		**5**	**7**	**5**	**3**	**6**	**6**	**4**	**2**	**3**	**3**	**1**	**9**	**2**	**3**	**3**	**8**	**6**	**4**	**6**	

$Total_2$ = quantity of factors that are considered significant for a specific answer

$Total_1$ = quantity of answers where the factors that are considered significant

TABLE X: Inferential Relationship Of Significance Between The Eleven Factors/ Levels Of Observation And The Nineteen Answers Studied

In one system of Open Innovation, the activity of internal R&D is dividing between the search for incorporation of technologies and the external knowledge, ensuring the role of the universities as significant elements in the process of innovation. In general, the companies which uses the mechanism, such as: agreement on research with universities and other research groups motivated by individual or bilateral interests; absence of corporation in R&D with suppliers, and customers, bilateral agreement with other companies for R&D in specific areas or for mitigation of costs of innovation projects (CHESBROUGH; VANHAVERBEKE, 2011).

The factor “F” of the Table X (partnership with universities and other research centers) showed significance over 17 answers (89.47%), and in all of them it presented the level of observation as high (2). In other words, it means that the TBCs which are establishing partnership with universities and other research centers, consequently, can maximize their results, based on this modality of access. However, determinants that were not approached in this research may impact the partnership university–industry. Maietta (2015) suggests some of them, such as academic research quality and the infrastructure of the university and its laboratories.

In Brazil, the universities and research institutes has an important role in the development of innovation in partnership with companies and vice-versa. One of the major difficulties in this area is to find a common interest between the expectations of the companies, guided by the market and the academic objectives. In this context, the management and protection of the generated knowledge in the collaborative projects become essential.

The factor “E” (absence of intellectual property) showed significance over eleven answers (57.89%), and in all of them it presented the level of observation as low (1). This demonstrates that the TBCs which keep their level of exposition to this kind of risk between 0 to 12.5%, consequently can maximize their results, based on this factor. On the other hand, 42.11% of the answers did not be impacted by this factor. This can be explained because that a stronger intellectual property rights may lead to a lower level of innovation (STIGLITZ, 2014).

The management of intellectual property is a strategical activity, and essential in the system of open innovation. Due to the indispensable role of exchanging ideas, knowledge and technologies, the flux of processes of open innovation would be impassable in a system capable of juridical protection to intellectual property of their transitional partners. In open innovation, the intellectual property has a role to make viable the collaboration between the two parts, instead of, prevent the use of non-authorized protected technology (CHESBROUGH; VANHAVERBEKE, 2011).

Fig. 2 describes the proposed model, from the process of technological access in the context of open innovation, followed by several methodological steps (describe in the section 3), until the compatibilization and dynamic equilibrium between the profile of risk, technological profile, the objectives of the companies and recommendation to the subsequent process of the system – the incorporation – over the best conditions to access to external sources of innovation.

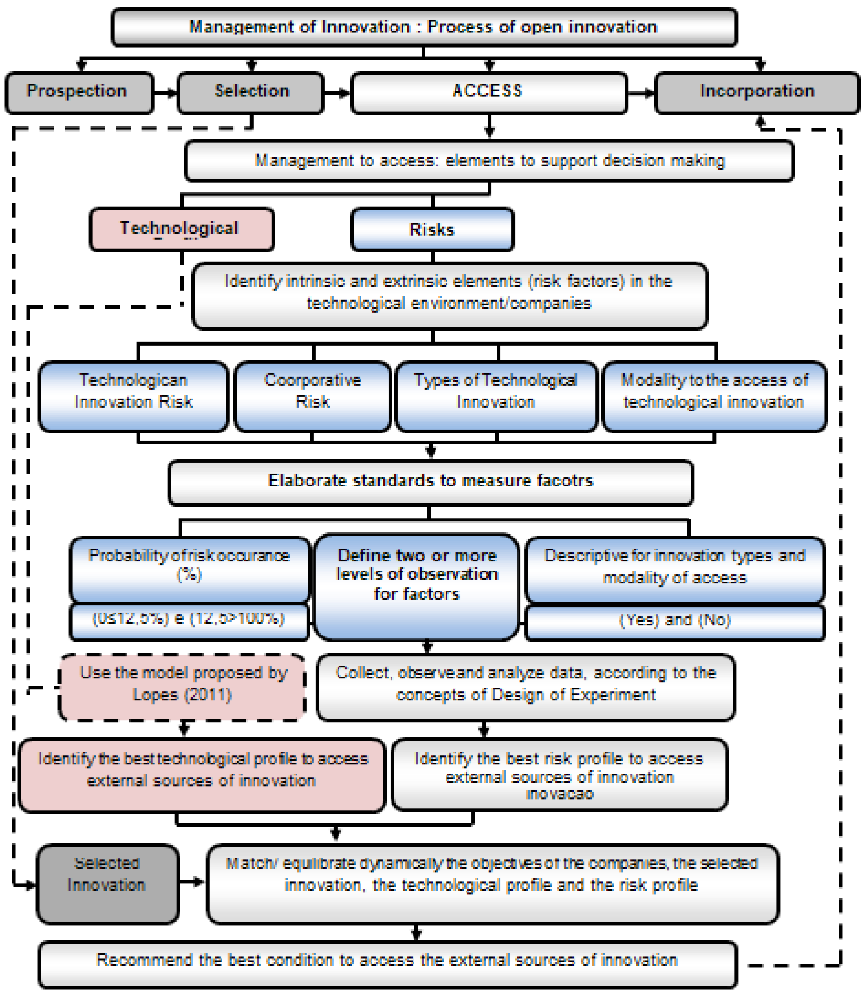

Fig. 2 – Model of mitigation of risks in the process of access to external sources to innovation

For a systemic dimension, the processes of open innovation are integrated, wherein the process – selection – offer to the subsequent process – access – to the useful information about the selected innovation. In the process of access, there must be a definition for the profile of the risk, and for the technological profile proposed by Lopes (2011). Many researches does not contemplate the risks of utilizing external sources of innovation (WEST & BORGES, 2014). The analysis and compatibility between the profile of risk, the capacity of generation and the adsorption of technology (technological profile) and the strategies to innovation must lead the company to identify their better conditions to access to external sources of innovation with less associated risk.

4 I CONCLUSIONS

Based on the calculus of the effects of the factors was verified that the selected variables for observation presented influence over all the studied answers; which, effectively confirm that the risks of technological innovation, as well as the corporative risks, influence the process of access to the external sources of technological innovation and the business results obtained from innovation. Beyond the inferential statistical analysis, based on the analysis of variance, it was proved that the factors of risks selectees were significants for the maximization of, at least, three of the studied answers, consequently, reaffirming the importance of the TBCs on assure the practicability of access to technological innovation, inside an acceptable level of risk.

The organization and the arrangement of the applied concepts in this study checked the same specific criteria, which we integrated and exposed in the form of referential model to maximize the business results and mitigation of risks during the access of technological innovation. Therefore, the general objective of this study was achieving, once it was presented the proposal of a model to the mitigation of risks in the process of access to technological innovation, as part of the management model of processes of open innovation.

When analyzed under the perspective of the proposed model, the empirical results allowed the managers of innovation to analyze the triggering of their decision making. Based on the composition of several factors and answers. In this sense, it is important to observe that, based on methods, it was possible to identify certain factors that were considered signifiers in different levels of observation in relation to the distinct answers. Thus, it is possible to conclude that the companies cannot maximize fully and simultaneously all the results in individual forms.

These evidences indicate the need for a broad management over the significant factors and expected results. It is not enough for the companies to only know their levels of exposition and tolerance to the risks, but they need to know the level of risks that leads to the obtainment of the best result to innovation. Thus, the companies can mobilize their resources to be more resilient to risks, and at same time to maximize their results, since the composition between the expected result and the risk is not the main condition to the investment in R&D.

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