Innovation Networks as a Proposal to Overcome Problems and Improve Innovation Projects

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Abstract

Organizations need to overcome your competitors to remain in the market more quickly. The innovation provides a strategic advantage for organizations, and benefit society in the form of creating new knowledge and technology diffusion. But, costs and risks required for R and D limit the participation of companies and lead to failure many innovation projects. The collaboration between organizations, which have a common goal, shares costs and risks and increases the chances of innovation project successful. In addition, collaboration allows for many organizations to develop projects that would be impossible to do alone. This paper is a study on Brazilian companies' metrics and indicators of innovation processes obtained in the Technological Innovation Surveys - PINTEC. It examines the extent of collaboration affect in the innovation process and suggests, through the use of knowledge taxonomies, the creation of innovation networks as a solution to various difficulties of organizations in their innovation processes.

1. Introduction

Innovation is an important element of change and organizations need to invest in it. Market is a propitious environment for innovation emergence. According to Tidd, the best strategy is the union of organization with its competitors, instead of huge organization creation. Large organization does not necessarily increase its innovative power. On the contrary, its performance can become less appropriate and competitive in the global market [7].

According to Edquist and Johnson, technological innovation is introduction of new knowledge or a new combination of existing knowledge in the economy. That is, innovation is result of a process of interactive learning. It is possible to obtain new knowledge or a new combination from different parts of knowledge through interactions in the economy [1].

Organizations are not alone. They belong to an environment, which influences and suffers influence

by them. Innovations are new ideas that add value to organization. These ideas are formed through an iterative process, which people and organization's internal and external environment interact. Collaboration between actors in innovation process is essential, so that, there is a flow of knowledge. It will result in innovative ideas from new knowledge or new knowledge combination.

According to Trist, by the same token in nature, market collaboration is as common as competition when there are common interests. Innovation networks are a promising way to obtain knowledge, collaboration and innovation. It allows conciliate search for a common goal and share risks, difficulties, costs, profits and knowledge [2]. According to Porter, organization can be part of a cluster of large national customers, suppliers and industries. And they have a major competitive advantage, because the cluster has a better vision about future needs of market and technology [11].

This paper focuses on the potential effect of collaboration through innovation networks and the analysis of data obtained in the Pesquisa de Inovação Tecnológica – PINTEC (Technological Innovation Survey) concerning last three editions – 2003, 2005 and 2008.

In next section, there is a review of the literature on collaboration, knowledge and innovation. Section 3 highlights the importance of metrics, indicators of S and T and PINTEC in the innovation process. Section 4 analyzes the metrics obtained in PINTEC 2005 [15] and 2008 [16], and in some cases in PINTEC 2003 [15][16]. Section 5 highlights the ways in which the collaboration acts in innovation process and suggests the collaboration as solution according to the different types of knowledge required. Final section concludes the study and suggests future work associated with this research theme.

2. Increasing knowledge and innovation through networks

In general, innovation activity involves multidisciplinary knowledge and management of various external and internal organizational factors.

Collaboration networks between organizations and public institutions of R and D are widely recognized as an important form of organizational innovation, due to they are responsible networks support flow and changes of scientific and technical knowledge [9].

Tidd proposes to expand the network of participants in the innovation process, in order to capture and use of knowledge as an efficient way to manage innovation. That is, learning to management innovation in “network level”. He emphasizes the power of the network through its most logical aspect – “the whole is greater than the sum of its parts” – and more critical – the increasing efforts of the participants in solving coordination and management problems, otherwise they will not achieve their goals [7].

Organizations understand more and more the benefits of cooperation that innovation networks offer. And this recognition leads to new trends and models for cooperation in researches, for example, Connect and Develop and Open Innovation.

Procter and Gamble developed Connect and Develop model. It identifies promising ideas around the world through participation in a collaborative network and uses its own resources to develop them, creating better products, cheaper and faster [8]. Open Innovation is a paradigm. It proposes free flow of ideas. Valuable ideas can arrive to company and market internally and externally without suffering any kind of control. Thus, these ideas are available for use, and generally those who made them are also available to help [5]. According to Powell, the collaboration in a network exercises a transformation power under its participants. Collaborative relationships in a network can change the perception about the competition – organizations don’t need more to possess an exclusive asset for profit. This way, network participants become partners and not more competitors [14]. National System of Innovation (NSI) is a set of organizations. These organizations are part of a network of institutions of public and private sectors, which creates, imports, modifies and diffuses new technologies through activities and interactions [15]. Figure 1 shows a simplified NSI, where it’s possible to identify cooperation between actors of NSI through knowledge flow and support through financing flow.

In Hakansson Model, actors of organizational networks perform activities and control resources on various levels, as shown in Figure 2. Two dynamic network processes can illustrate cyclical nature of cooperation: the structuring and heterogeneity process and the hierarchy and outsourcing process [4].

In the first process, the network arises through investments and relationships between actors. Heterogeneity of resources establishes them. The network evolves due to actions and adaptations of

activities and resources and commitment among the actors. Actors in privileged positions strengthen themselves and other actors become dependent on them.

Figure 1. Innovation National System [15]

Then, second process starts and the emergence of hierarchy relations leads the actors to seek new relationships outside the network – outsourcing. From outsourcing, a new network is created until there is a new imbalance between cooperation relations and benefits achieved through the network.

Figure 2. Hakansson Model [4]

According to Nonaka, innovation process is not a simple information processing. It is a process that involves the acquisition, creation, leveling and retention of knowledge. He argues that an innovation has its origin in innovator’s belief and image about the world, i.e. the innovation process begins with beliefs and aspirations of an individual and it is crystallized within and between organizations through cooperation [6].

Accumulated tacit knowledge is an important element in the process of innovation, in the same way that it’s a type of knowledge difficult to imitate and capture, especially when it is tightly integrated in organizations and regions. Thus, cooperation becomes an efficient way to obtain such knowledge as relations are based on trust and mutual respect.

Ahuja classified the networks in open and closed, shown in Figures 3 (a) and (b) [3]. Closed networks are networks in which participants have relationships of long-term commitment. These networks allow the creation of environments favorable to cooperation rather than opportunism. Open networks have structural holes. The structural hole occurs when a participant has contact with other participants, which do not interact themselves. There is a fast access to desired information in the networks open, but there are no trust relations in entire network, due to lack of relationship between some participants. This way, the innovation process becomes difficult.

Figure 3. Close and open network

The links between organizations can be direct and indirect. In direct links, there is a partnership without intermediates, resulting in sharing of resources and knowledge and in confidence. While in indirect links, organization has access to other organizations through a partner organization, resulting in a simple sharing of information for the focal firm. These links hardly will result in innovation projects due to lack of trust and identification with other organizations in the network.

Thus, cooperation of networks has the trust as a cohesion element. A common goal among the participants of network is not enough. It must be reconciled with the confidence, in order to allow development of innovation project through cooperation and sharing of risks and outcomes, be they good or not.

Zack classified knowledge useful to the organization as procedural, causal, conditional and relational [12], while [13] as declarative. Knowledge classification allows identifying its characteristics and its better employment as solution to organizational problems.

Different types of knowledge need different supports also, by the some token their respective flows. Definition of these needs improves performance of organizational knowledge flow and allows for a better requirements elicitation for knowledge management systems development.

It is possible to identify more precisely the actor that will help better in the collaborative context, knowing the type of knowledge needed to solve a

particular problem. Table 1 shows the taxonomies mentioned above.

Table 1. Knowledge taxonomies

Types	Definition	Examples
Declarative	Know-about	What drug is appropriate for an illness
Procedural	Know-how	How to administer a particular drug
Causal	Know-why	Understanding why the drug works
Conditional	Know-when	Understanding when to prescribe the drug
Relational	Know-with	Understanding how the drug interacts with other drugs

Section 3 describes metrics and indicators' importance role in innovation projects development. And it introduces some characteristics of PINTEC survey.

3. The importance of measuring innovation

Holbrook highlights that most of S and T indicators are created by and for developed economies. Therefore, these indicators lack important policy areas to measure innovation in developing countries [15]. For example, developing economies may have a very low level of activities in R and D, but investment level for scientific activities can be substantial.

Measure and monitor the knowledge stocks in S and T or technological capital is as important as measuring physical stocks of capital. As a result, Organizational for Economic Cooperation and Development (OECD) made a study about it [15]. Study concluded that technologic investments in acquisition of equipment, imported or internally produced, are important and should be considered to measure knowledge intensity of countries.

Technological Innovation Survey (Pesquisa de Inovação Tecnológica - PINTEC) is a Brazilian survey and its periodicity currently every three years. The survey aims to build technological innovation indicators of Brazilian companies' activities. Indicators are on national sector and specifically for regional industries (IBGE). These indicators are comparable with information from other countries because research methodology follows the Oslo Manual's guidelines, 3rd edition, OECD, 2005. PINTEC was inspired by Eurostat model – third and fourth versions of Community Innovation Survey. PINTEC 2005's data collection has information relating to the period from 2003 to 2005, while PINTEC 2008's data collection the period from 2006 to 2008. The latter was released in October 2010.

In the next section, we will present some PINTEC's metrics, in order to discuss issues concerning difficulties, information sources and cooperation in the innovation process.

4. Collaboration and innovation metrics analyses

Firstly, research shows that few Brazilian companies develop innovations for the world market. Most companies develop product or process that are innovations only for own company, as shown in Figure 4.

Comparison between PINTEC 2005 and 2008 shows a considerable increase in product and processes innovations news for the company and existing for national market. Innovations for national market and existing for global market also shows an increase, while ones for the global market don't present significant changes.

Thus, there are risks in innovation development, but in lower level for existing products in global or national market, because their characteristics and production techniques are already well known.

Since 2008, PINTEC groups its results in accordance with new Classificação Nacional de Atividades Econômicas (National Classification of Economic Activities) – CNAE 2.0. This new classification investigates activities of extractive and processing industry, selected services (such as edition, telecommunications and computer) and research and development. For this reason, table 2 presents telecommunications and computer activities in the survey 2005 and selected activities in the survey 2008.

Figure 4. Main product/process in innovation projects of companies.

Industrial companies, that have implemented innovation products, obtained a higher rate for company itself as the main responsible in 2005 and 2008 survey: 89,5% and 84,2%, respectively. While in process innovation development were other

companies or institutions with 87,1% in 2005 and 83,4% in 2008, as shown in Table 2. Product innovation, the company usually has the initiative alone, bearing all the risks and costs of innovation activity and enjoying his own success or failure. By contrast, there is a more active participation of the organization in innovation process with other companies or institutions. It increases the number of stakeholders.

It is possible to identify companies that use a channel for exchange of knowledge or that are linked by networks forming a national innovation system through collaboration between companies or other institutions. Table 2 shows that in both cases, products and processes development, cooperation level of activities is not high.

Table 2. Main responsible for innovation development

Activities		Main Responsible (%)			
		Company	Other company in same group	Collaboration with others or institutes	Others companies or institutes
Product 2003-2005	Industry	89,5	1,5	5,0	4,0
	Telecommunication	46,7	1,8	20,6	30,9
	Computer	84,4	1,5	4,5	9,7
	R and D	64,1	2,6	28,2	5,1
Process 2003-2005	Industry	9,2	0,7	3,0	87,1
	Telecommunication	54,2	2,6	25,7	17,5
	Computer	34,1	1,2	5,8	58,9
	R and D	61,2	5,6	27,8	5,6
Product 2006-2008	Industry	84,2	1,7	7,8	6,4
	Selected Services	86,7	2,8	5,8	4,7
	R and D	55,9	0,0	44,1	0,0
Process 2006-2008	Industry	12,2	1,0	3,4	83,4
	Selected Services	25,1	0,7	9,2	65,1
	R and D	39,4	0,0	27,3	33,3

The R and D activities have the highest rates for the collaboration with other companies or institutes as main responsible. This trend is not only PINTEC 2005's data, but also PINTEC 2008's data. These PINTEC 2005's rates for the collaboration in innovation development of product and process are 28,2% and 27,8%, respectively. While in PINTEC 2008, products innovation rate presents an increase – 44,1%, process innovation rate shows a little decrease – 27,3%.

In both surveys, there is a difference between product and process innovation in relation to

industry's main responsible to obtain them. In the first, the own company receives a dominate role, while the later others companies or institutes have it. According IBGE [17], this fact strengthens the importance of technology as capital goods for the innovations process.

Figure 5 shows percentage of companies, which assign high and medium importance degrees for each innovation projects activities in PINTEC 2005 and 2008. Few companies attributed a high and medium degree of importance for external R and D and external knowledge acquisition activities.

In spite of R and D companies assign a significant increase to acquisition of external R and D activity – from 17,1% to 38,5% – the others companies consider this activity as the less importance in both surveys. The internal R and D activity received high and medium importance degree from 100% of R and D companies. This fact is due to these companies perform internal R and D as target activity.

Figure 5. Degree of activities in innovation projects

However, most companies consider of great importance to acquire machinery and equipment to develop innovations. In doing so, innovation projects have access technologic knowledge through machinery and equipment acquisition. In accordance with PINTEC 2005 and 2008, this activity has been considered the most relevant in innovations projects for industry, selected services, computer and telecommunications, while for R and D companies it

has occupied the second place. This trend is in accordance with characteristic rates of underdeveloped countries. Since, technology acquisition is an indicator of great importance to innovation in emerging economies [15].

Figure 6 shows percentage of innovative firms, which attributed a high and medium importance degree for each information source. It demonstrates the importance of these actors in innovation process for Brazilian companies.

Figure 6. Degree of information sources in innovation projects

According PINTEC 2005, most R and D companies identified internal development of research in R and D department as information source with 92,7%; followed by university and research institute with 90.2%; and information network and conferences meetings and publications both with 85.4%. PINTEC 2008's R and D companies remained same actors as information

sources main: R and D department in first place with 100%; conferences, meetings and publications in second place with 92,3%; university or graduate center in third place 87,2%; and finally information network with 84,6%.

Regarding industry, others company's area (64,6%), supplier (63,8%), client (60,9%) and information network (56,8%) occupy the top four places in high and medium importance degree as information sources in PINTEC 2005. Whereas top four of PINTEC 2008 are: information network (68,8%), client (68,2%), suppliers (65,7%) and others company's area (61,5%). So far others company's area source had occupied the first place in last surveys, while information network source used to occupy the fourth place in PINTEC 2005. In face of this change, a new standard for Brazilian industry to obtain knowledge can emerges, due to the web information accessibility's power own over other forms of knowledge obtainment. Information networks in question are computerized networks.

The most telecommunications and computer companies, in PINTEC 2003, and selected services companies, in PINTEC 2005, identified as top four main the same information sources of industry did. Some ones occupied distinct places in comparison with industry.

Unfortunately, few companies attach high and medium importance level for universities and research institute (PINTEC 2005) and research institute or technological center and university or graduate center (PINTEC 2008) as information sources, except for R and D companies. These companies have a distinct trend for information sources use. As a result, it reveals that the others companies underestimate these actors in process innovation as knowledge sources and as partners.

The table 3 shows companies' participation percentage that cooperate with other companies in relation to innovations developers companies' sum. The percentages indicate that the larger the company, the bigger the company's cooperation in their projects of innovation. Table 3's bold percentages show it. But companies R and D are exceptions again, because all of them had cooperation relations according PINTEC 2005, and most of them, according PINTEC 2008. This fact is due to R and D companies' role as technologic infrastructure agent of Innovation National System.

Despite industry's cooperation relationships has low scores, indicators show a growth of cooperation between industrial companies in last years, especially the larger ones, as evidenced by PINTEC 2003, 2005 and 2008. Number of industrial companies that had established cooperation relations in innovation projects was 1,0 thousand in 2003 survey. While in 2005 survey, this number increased to 2,2 thousands. And finally in 2008 survey, among 41,3 thousands

innovation companies, 10,1% established cooperation relations.

Table 3. Collaboration in innovation process

Enterprises have cooperation relations with others organizations in total of enterprises that development innovation (%)					
<i>Number of Employees</i>	2001 - 2003	2003 - 2005			
	<i>Industry</i>	<i>Industry</i>	<i>Telecommunication</i>	<i>Computer</i>	<i>R and D</i>
Total	3,8	7,2	64,2	19,3	100,0
From 10 to 49	2,1	4,7	58,3	16,5	100,0
From 50 to 99	1,9	6,8	56,2	34,9	100,0
From 100 to 249	3,7	10,2	60,0	30,7	100,0
From 250 to 499	8,5	12,4	71,4	49,2	100,0
500 and more	40,3	39,1	90,0	42,4	100,0
<i>Number of Employees</i>	2005 - 2008				
	<i>Industry</i>	<i>Selected Services</i>			<i>R and D</i>
Total	10,1	13,1			92,3
From 10 to 49	8,4	11,8			100,0
From 50 to 99	11,3	13,6			66,7
From 100 to 249	14,2	18,1			100,0
From 250 to 499	15,4	20,8			87,5
500 and more	35,3	33,8			100,0

PINTEC 2003 has no data to compare with telecommunications, computer and R and D areas, due to this survey cover only industry area. In accordance with PINTEC 2005, in telecommunications enterprises, percentage of companies that cooperate is promising. It gets the rate of 90% in companies with 500 or more employees. In the computer enterprises, the rate of companies cooperating is greater than the industry's rate, but it does not present levels as promising as telecommunications enterprises. The R and D companies totally work in cooperation to development their innovation projects.

PINTEC 2008 identified the same trend for cooperative arrangements. Industry had an increase in cooperation rate from 7,2% to 10,1% in comparison with PINTEC 2005's rate. And R and D companies had a slight decrease from 100% to 92,3%. It is not possible to do a comparison with other activities, due to classification's change – CNAE 2.0.

Figure 7 shows problems and obstacles that innovation developers companies in each market segment reported as high and medium importance degree for 2005 and 2008 research. According

PINTEC 2005, among innovative telecommunication companies, 67,8% reported barriers to innovation. Computer companies' rates were lower – 43,9%, followed for industry – 34,3%. R and D companies had the highest percentage – 75,6%. In PINTEC 2008 turn, industrial companies have a lower rate – 49%, followed for selected services companies' rate: 54%. In the same way that PINTEC 2005, R and D companies have the highest percentage – 79%.

Figure 7. Main problems with companies in innovation projects

In survey of 2005, industry reported following categories of problems with high and medium importance degree: high innovation costs (80,6%), few financial sources (77,4%) and excessive economic risks (48,4%). These problems also

obtained highest percentage in PINTEC 2003. Besides that, all problems are economics. According to PINTEC 2008, one more time industry identified economic problems as high and medium importance degree: high innovation costs (73,2%), excessive economic risks (65,9%), lack of qualified staff (57,8%) and few financial sources (51,6%).

According to PINTEC 2005, telecommunications and computer companies attributed the highest percentage for high and medium importance degree to following problems: high innovation costs (72,5% and 52,1%) and lack of qualified staff (67,6% and 60,3%). In addition to those problems, telecommunications companies related other economic problem: excessive economic risks (63,4%), while computer companies identified adaptation difficulty to standards (51,2%). According PINTEC 2008 selected services' top three problems are the same of telecommunications and computer companies, except for adaptation difficulty to standards problem. Main problems are: high innovation costs (72,1%), lack of qualified staff (70,4%) and excessive economic risks (62,6%).

In the next section, there is a correlation between problems and information sources of PINTEC, and knowledge classification based in a solution propose.

5. Overcoming innovation projects' problems

Innovation networks are excellent solutions for companies, due to risk mitigation and cost sharing. And theses benefits offer advantages in knowledge quest and overcoming difficulties. For this, innovation network is a very attractive solution, especially for small and medium companies. These companies usually don't have enough capital for R and D investments and to take risks in innovation development. Besides, innovation networks become their members stronger, than alone.

PINTEC's indicators can identify main problems for companies from different sectors and with different features. So, main problems for each sector are already known and there are possible solutions for each problem. In doing so, solution's knowledge type definition would support knowledge flow according to its features in collaborative arrangements. Finally, knowledge flow with support obtained, in turn, would help to improve innovations development.

The Table 4 lists each one of PINTEC's problems (see Figure 7). There are one or more knowledge type, a suggested solution and potential partners for each problem. Knowledge type is based in suggested solutions and in accordance with classification of [10], [13] and [12]. Collaborators are PINTEC's main collaborators in innovation projects (see Figure 6).

Table 4. Relations between problems, knowledge and collaborators

Innovation Problem	Knowledge Type	Suggested Solution	Potential Contributor
Innovation activity centralized in other group's enterprise	Procedural	Learning how to decentralize activities	-Internal
Rigor organizational	Conditional	Understanding when a internal policy should be changed	-Internal
Few possibilities for cooperation	Relational	Understanding how to interact with potential partners	-Information networks -Client -Competitor -Supplier -University -Conferences
Weak consumer response	Causal	Identify the reason why product not interested and so identify to know-how to get it	-Competitor -Client
Lack of information about market	Declarative	Define what are the means to obtain information on market	-Client, -Competitor -Supplier
Adaptation difficult to standards	Causal	Understanding difficulties and then eliminate them	-Internal
Lack of information about technology	Declarative	Find out which organizations have technology desired	-Information networks -Client -Competitor -Supplier -University
Few technical support	Declarative	Identify which vendors offer technical support	-Supplier
Lack of qualified staff	Declarative	Finding which training programs are appropriate	-University
Few financial sources	Procedural/ Relational	How to get funding from government programs to support innovation and discovering which organizations have similar goals to establish partnerships	-Government -Information networks -Client -Competitor -Supplier -University
Excessive economic risks	Procedural/ Relational	How to mitigate risks and discover which organizations	-Information networks -Competitor

		have similar goals to establish partnerships	
High innovation costs	Relational	Identifying which organizations have similar goals to establish partnerships	-Information networks -Competitor

All in all, PINTEC's problems and information sources, suggested solutions and classification of knowledge would enable a collaborative quest of knowledge and innovation development through innovation network. This way, innovate companies' rate can increase, encouraging non-innovative companies and improving companies' projects through formation of innovation networks.

6. Conclusion

Growth and expansion of companies contribute to market becomes increasingly competitive. And collaboration emerged as a way for enterprises to keep in the market and develop innovations that would not be possible they development alone. Through innovation networks, companies can expand their portfolio of ideas and knowledge, while the small and middle size companies can also overcome their deficiencies – mainly structural ones. It is necessary that organizations adapt their internal structure and promote a collaboration culture; in order to stimulate the innovation networks creation as well as the strengthening of relations. Analysis of metrics and indicators indicates that there is companies' need to spend a greater importance to activities related to collaboration (see Figure 5). It important that companies, universities and research institutes should be sources of information in innovation process (see Figure 6). Increase participation of these actors with government's participation will allow formation of innovation networks according the Triple Helix model. Another point considered as important is set of problems that companies encountered in innovation projects. Use propose of knowledge, according to the classification of [10], [13] and [12], and partnerships as solution illustrate transformer power of collaboration in organizational environment, especially in innovation projects.

Innovation project's success brings benefits to participants of network and to society in which the network operates. It changes the nation due to improve technological level of various market segments, to spread new knowledge and technologies and to increase revenues through the expansion and strengthening of organizations. Networks of innovation's collaboration enable innovations development to reduce risks and costs and to

increase infrastructure and knowledge for innovation projects development.

This paper is part of a series of studies on innovation networks and how to improve management of innovation networks. Future work is eliciting requirements to development of innovation networks management tool. Knowledge management systems applied innovation networks can help develop and enhance links between network's components, in order to spread knowledge flow. It will become environment even more conducive to innovation.

References

- [1] Edquist, C. and Johnson, B. (1997) System of Innovation: Overview and Basic Concepts, in "Systems of Innovation: Technologies, Institutions, and Organizations". Routledge Press. 1^a edition, November.
- [2] Trist, E. L. (1983) 'Referent Organizations and the Development of Interorganizational Domains', in Human Relations, V. 36, p. 269-284
- [3] Ahuja, G. (2000) 'Collaboration Networks, Structural Holes, and Innovation: A Longitudinal Study'. Administrative Science Quarterly, v. 45, p. 425-455.
- [4] Hakansson, H. (1987) Industrial Technological Development: A Network Approach, Routledge, London.
- [5] Chesbrough, H. W. (2003) 'Open innovation: the new imperative for creating and profiting from technology', Harvard Business School Press, pp 43-44
- [6] Nonaka, I. (1996) 'Knowledge Has to Do with Truth, Goodness, and Beauty - Conversation with Professor Ikujiro Nonaka', Tokyo, February 23.
- [7] Tidd, J. (2006) 'A review of innovation models' (discussion paper, nr.1). London: Imperial College London, Tanaka Business School; <http://www3.imperial.ac.uk/portal/pls/portal/portal/docs/1/7290726.PDF>. (30 March 2010).
- [8] Huston, L. and Sakkab, N. (2006) 'Connect and Develop: Inside Procter and Gamble's New Model for Innovation', Harvard Business Review, Vol. 84, No. 3, March 2006. <http://harvardbusiness.org/product/connect-and-develop-inside-procter-gamble-s-new-mo/an/R0603C-PDF-ENG>. (30 March 2010).
- [9] Nesta, L. and Mangematin, V. (2004) 'The Dynamics of Innovation Networks'. The Freeman Center, University Sussex. <http://www.sussex.ac.uk/Units/spru/publications/imprint/sewps/sewp114/sewp114.pdf>. (30 March 2010).
- [10] Alavi, M. and Leidner, D. (2001) 'Review: knowledge management and knowledge management systems, conceptual foundations and research issues'. MIS Quarterly, v. 25, n. 1, p. 107-136, Mar.
- [11] Porter, M. (1990) 'New Global Strategies for Competitive Advantage'. Planning Review, May/June: pp 4-14.
- [12] Zack, M. (1998) 'What Knowledge-Problems Can Information Technology Help to Solve', Proceedings of the Fourth Americas Conference on Information Systems, E. Hoadley and I. Benbasat (eds.), Baltimore, MD, August, pp.644-646.
- [13] Nolan Norton Institute (1998) 'Putting the Knowing Organization to Value', White Paper, August.
- [14] Powell, W. W. (1987) 'Hybrid organizational arrangements'. California management review. California, Vol. XXX, N°. 1, p.67-87, fall.
- [15] Holbrook, J. A. D. 'The Use of National Systems of Innovation Models to Develop Indicators of Innovation and Technological Capacity', CPROST Report # 97-06, <http://www.sfu.ca/cprost/docs/9706.pdf>. (30 March 2010).
- [16] IBGE (2007) 'Pesquisa de Inovação Tecnológica 2005', Instituto Brasileiro de Geografia e Estatística (IBGE); <http://www.pintec.ibge.gov.br/downloads/PUBLICACAO/Publicacao%20PINTEC%202005.pdf> (28 January 2011).
- [17] IBGE (2010) 'Pesquisa de Inovação Tecnológica 2008', Instituto Brasileiro de Geografia e Estatística (IBGE); <http://www.pintec.ibge.gov.br/downloads/PUBLICACAO/Publicacao%20PINTEC%202008.pdf> (28 January 2011).