

**Theme: Building the innovative markets, places and networks**

***Mauricio Henrique Benedetti*** – Universidade Presbiteriana Mackenzie

e-mail: mhbenedetti@uol.com.br

Address: Rua da Consolação, 930 – ZIP CODE: 01302-907 – São Paulo – S.P. – Brazil.

He has PhD degree in Production Engineering from the Federal University of São Carlos (2011), holds a Masters in Business Administration from Mackenzie University (2002) and a degree in Mechanical Engineering from University Mackenzie (1992). Currently he is full time professor in Mackenzie University and responsible for managing the Technology Transfer Office at the university. He has experience in Administration with emphasis in Management Production, acting on the following themes: technological innovation, entrepreneurship, logistics and production processes and sustainability

***Ana Lúcia Vitale Torkomian*** – Federal University of São Carlos

e-mail: torkomia@power.ufscar.br .

Address: Rodovia Washington Luís, km 235 – ZIP CODE: 13565-905 – São Carlos – S.P. - Brazil

Graduated in Production Engineering (1987) from the Federal University of São Carlos and Masters (1992) and Ph.D. (1997) in Business Administration, from University of São Paulo. Since 1993 she is professor at the Department of Production Engineering, at Federal University of São Carlos, working in Management of Technology, on the following topics: university-enterprise cooperation, entrepreneurship, technology parks and clusters, technological innovation and intellectual property. From 2001 to 2009 she was Director of the Foundation for Institutional Support to Scientific and Technological Development (FAI) at UFSCar 2002-2009. She was elected as a member of the National Coordination of the

National Forum of Managers of Innovation and Technology Transfer - Fortec in 2006 and reelected in 2008. In May 2008 assumed the executive board of the Innovation Agency UFSCar, where she remained until October 2009, when it was transferred to the Ministry of Science and Technology. In November of that year to July 2011 she served as Deputy Secretary of the Department of Development and Technological Innovation SETEC / MCT.

### **The search of external sources in the open innovation process**

#### **Abstract**

The objective of this study was to investigate the role of external sources in the process of technological innovation in a company that adopts an open innovation model. A field research was conducted, which consisted of a multiple-case study of four companies whose data were processed using the qualitative method and the content analysis technique. In general, it was observed that the search for external sources for the innovation process is not a new approach; it has long been used by companies. This search includes sources that have commercially ready technology, including acquisitions of companies or patents, and co-development partnerships. There are several different reasons that lead companies to seek external sources; however, there are some specific and temporary needs involving competencies that companies do not have and are not worth to develop internally mainly due to time and cost-related issues.

**Keywords:** Innovation, open innovation, technology transfer, intellectual property.

## 1 INTRODUCTION

It's possible to observe that some leader large companies have had difficulties to maintain control and integration of research and development (R&D) activities. It's happening because is too hard invest in laboratories and professionals specially trained and dedicated to the research of new technologies. Given the difficulties, some of these companies have searched beyond their borders for options to strengthen their innovative processes. Moreover, there has been increasing interest in understanding how the external sources integrate the innovation process of the companies to develop new products and introduce them into the market (WITZEMAN et al., 2006).

The use of external sources has been pointed as essential in the innovation process of companies was introduced by Chesbrough (2003), who coined the term "open innovation" and stated that it assumes that the useful knowledge is widely distributed and that even the most capable R&D department must identify, connect to, and leverage external knowledge sources as a core process in the innovation process. Therefore, it would be a paradigm shift from a closed to an open innovation model for occurrence of innovation and commercial exploitation of knowledge.

The participation of external sources in the innovation process of the companies is evident when they recognize that they do not have conditions to produce all the knowledge needed for R&D. So, their innovation processes become opened interacting harmoniously with the external actors to achieve desired results. Networks are formed between partners with complementary competences, which together contribute to the development of innovations. Competence complementarity affects business models since the value proposition set to meet customer needs and the way that value will be achieved and delivered to customers are essential for value chain partners to achieve the desired results.

Presented the context and circumstances that show a favorable environment for the companies adopt an open innovation model, one question can be risen up:

*What is the role of external sources in the process of technological innovation in a company that adopts an open innovation model?*

The overall objective of this study was to provide answers to the research question raised above. In addition, the following specific objectives were included: a) to investigate the external source search process by companies aiming at the development of innovation and b) identify the motivations and antecedents for the adoption of open innovation.

## **2 LITERATURE REVIEW**

### **2.1 Innovation**

Innovation can be defined as an idea, practice, or material artifact that is perceived as a new and relevant application (ZALTMAN et al., 1973). It concerns the search for, experimentation, discovery, imitation, development, and adoption of new products, new processes, and new organizational configuration (DOSI, 1988).

It is common for large companies that focus their competitive advantage on their innovation capability to maintain their R&D activities as an internal, hierarchical, and vertically integrated process to assure secrecy of new products. In these cases, the process of seeking a better understanding of customer needs as an opportunity to generate new ideas is responsibility of the company marketing departments, which, together with internal competencies, boost potential innovation projects that can be introduced into the market (VON HIPPEL; THOMKE; SONNACK, 2000).

The benefits of scale and scope for internal R&D gave rise to a vertically integrated innovation model, in which large companies internalized their specific R&D activities and the commercialization of innovation through internal development, manufacturing, and

distribution processes (CHESBROUGH, 2006a). This is not an organizational closed model such as those typically found in mechanistic structures since these companies seek to interact with the external environment to guide their strategies and operations but focusing on the control and centralization of R&D activities. As a result, the company innovation capability relies only on the company own competencies.

## **2.2 Open Innovation**

Companies that adopt open innovation use internal and external knowledge and internal and external applications to commercialize ideas. People and organizations are external sources of new ideas and business opportunities, opening to new possibilities to convert ideas into money, exploring multiple paths to market (SANDULLI; CHESBROUGH, 2009). According to Perkmann and Walsh (2007), in the context of open innovation, the process of search and incorporation helps companies to acquire specific technologies from external sources rather than from inside the company. However, this must be a continuous process which should be part of R&D routine.

The search for external sources was commonly justified by promoting risk and cost reduction, rapid innovation cycle, and flexibility increase (SLOWINSKI et al., 2009). Nevertheless, more recently it has become a strategic approach that considers the strategy of company, the strategy of its partners, and the relationship between the company and supply chain members in the long term. According to Slowinski et al. (2009), the search for external innovations is no longer just a possibility; it has become vital for boosting R&D.

Companies open up their business and expand their relationships with partners to be able to introduce a larger number of new products into the market (MUNSCH, 2009). As a result, cultural adjustments, new ways to negotiate contracts and intellectual property licensing, and business competitiveness take place. The shift from a traditional closed

innovation model to an open innovation model implies changing views of innovation. It means giving up part of the control of the innovative process to access and use external ideas and knowledge (CHESBROUGH, 2003).

One source of resistance to the use of external technologies is the “not-invented-here syndrome”, *i.e.*, people do not believe that what comes from outside the company can be better than what is created and developed internally (COHEN; WESLEY; LEVINTHAL, 1990; CHESBROUGH, 2006b; WITZEMAN, et al., 2006; KLEYN; KITNEY; ATUN, 2007). Other reasons are: shorter time to test and evaluate external technologies, increased perceived risk, and uncertainty in terms of R&D team expertise and competences when dealing with external technology acquisition and cooperation (CHESBROUGH, 2006b). Another potential problem in the co-development of innovations is disagreements over goal setting and over the key capabilities that should be developed in the partnership or over selecting products to be launched onto the market (CHESBROUGH; SCHWARTZ, 2007).

### **2.2.1 Business Model**

According to Chesbrough (2003), the business model is a key element of the paradigm of open innovation. This model will be responsible for the link between innovation and the value generated by its marketing. The same technology reaching the market through two different models imply differences in the perceived value and delivered value.

A change in the business model affects the value delivered with the product throughout the value chain, which means that the introduction of a new product into the market depends on acceptance of the value that is passed from one member of the chain to next. Therefore, due to the change in the business model, the same product or service can have a new value, or it can be offered in a different way other than the one it was previously offered (MAGRETTA, 2002). Mature products that have been standardized can be revitalized

using a new business model. Chesbrough (2003), Ballon and Hawkins (2009), and Magretta (2002) argue that product or service failure does not always result from its own flaws, but rather to the fact that it was used in a business model that does not aggregate its due correct value. Determining a business model becomes even more difficult as the environment complexity increases due to a large number of actors involved in a network in which the value distributed must serve the interests of those involved.

Having determined the business model, the company identifies resources that are fundamental to a target market and strives to find its ecosystem's natural resources. Hence, the value chain is built consisting of a network of companies that are sources of funds to be used as strategic elements for the organization's competitive advantage (SANDULLI; CHESBROUGH, 2009).

As reported by Magretta (2002), the business model must be determined in order to identify the customers and their real needs, to generate real value for these customers, to decide how to profit from the business and establish the production process to cover the costs of value generation and delivery. According to Chesbrough and Schwartz (2007), all companies have a network of relationships in their supply chain, but few take the time to articulate their business models.

### **2.2.2 Search for external sources of technology**

In the open innovation model, companies strengthen their relationships with other companies and research institutes to expand their ability to develop new products, services, and even new businesses. However, it was not only due to the development of the open innovation concept that companies started to consider outside sources to improve the process of innovation. Authors such as Dosi (1988), Pavitt (1984), Bell and Pavitt (1995), Nelson and Winter (1982), Freeman (1991) and Cohen, and Wesley and Levinthal (1990), among others,

have reported the interaction between external agents and internal members of organizations as a way to increase their chances of developing new knowledge and innovations.

An important component of industrial technology change is the complex structure of relationships between companies. Both the interaction between the user and the manufacturer and the acquisition of new technologies by suppliers or by sources belonging to other chains are identified by Bell and Pavitt (1995) as means that lead to technological change and result in new products, processes, or businesses. The authors add that the R&D activities should be closely related to production and that the contribution of research institutes to the development of new technologies depends on whether the production sector is qualified and prepared to acquire and use new knowledge.

The ability to integrate external and internal ideas was also emphasized by Freeman (1991), who observed that among the critical factors that contribute to innovation is the combination of external sources of technological expertise with the research conducted internally by companies based on their accumulated knowledge. External information sources combined with user collaboration play an important role in the process of creating new products. They are formal and informal networks that foster the development and diffusion of new technologies and contribute to new network formation enabling other forms of research collaboration.

The effectiveness of external innovation search is based on what the company is seeking for the process to begin. This means knowing what is needed to generate and aggregate value to the chain by involving consumers in order to identify and meet their needs (BRORING; HERZOG, 2008). The search process includes the selection of suppliers based on technological capability to contribute to projects, exchange and collaboration between engineers and researchers, as well as the sharing of knowledge, experiences, and intellectual property rights (SLOWINSKI et al., 2009).

After concluding the search, the company focuses on the acquisition process and then on managing its relationships so that the transfer of knowledge and technology is beneficial to both parties involved. The positive results contribute to and improve the portfolio of collaboration projects with suppliers with mutual gains in long-term relationships (SLOWINSKI et al., 2009).

Addressing the creation and diffusion of knowledge within chain tiers, Cowan, Jonard and Zimmermann (2007) highlight two points to consider: firstly, the value of a cognitive complementarity between the parties, *i.e.*, the ability to integrate their respective knowledge; secondly, the knowledge created jointly changes the position of the company owner individually and its future connections with other companies. These two elements exert direct influence on the choice of a partner and on the structure and relationship that will be involved in this partnership.

### **3 RESEARCH METHODOLOGY**

Exploratory research was found to be the most appropriate methodology for achieving the proposed objectives of this study. As reported by Triviños (2007), exploratory studies typically take place before experimental or descriptive studies. This type of research is conducted into an issue or problem where there are few or no earlier studies to refer to. The focus is on gaining insights and familiarity for later investigation. It is used to identify and obtain information on a particular problem or issue. Therefore, a literature review and a field research were conducted to gain a deeper understanding of open innovation in companies located in Brazil with outstanding participation in Latin American market. Although the possibility of using external sources in the innovation process of companies is not something new, as shown in the literature review, this practice has gained ground in business management due to the systematization proposed by the open innovation model.

Nevertheless, there are few empirical studies that contribute to the strengthening of the theory confirming the exploratory nature of this study that aims at expanding knowledge in this subject by deepening the understanding of aspects that involve companies searching for external sources to participate in their innovation process.

Since the main objective of this study was to investigate possible relationships between the constructs that were established from the research question, the qualitative approach seemed appropriate because it involves the search for information that is not properly structured and deserves to be better understood for a thorough analysis in the light of a theory that is still under development. The qualitative method enables an in-depth study of the phenomenon broadening and expanding the subject knowledge. The researcher plays a fundamental role in deepening the issues addressed and analyzing the information obtained.

Since further research is needed due to a limited research environment, the multiple case study design seemed more appropriate to this study. The case study design is a form of analysis in which one or a few units (e.g. individuals, companies, or products) are studied. It is known as an intensive analysis or a thorough investigation in the subject matter that can be used either in field research or in a workplace setting or a laboratory (VERGARA, 2000).

Carrying out a multiple case study starts from selecting the units of study, *i.e.*, the cases, considering their contemporary relevance to the subject matter and gathering data to be analyzed by a researcher who will process them using a previously defined analytical strategy. The data were collected through interviews, document analysis, and direct observation (YIN, 2005).

The units of study (companies) were chosen based on the study topic, research question, specific objectives, location, and adherence to the following criteria: a) Large size company; b) Innovation as strategy; c) Over five years of collaboration with external sources

exceeding; d) Structure divided into business units, and e) Research and development in at least two areas of technology.

Four companies were chosen as units of study: Alpha (fictitious name), 3M (Minnesota Mining and Manufacturing), Braskem, and Whirlpool. A fictitious name was used for company Alpha to preserve its identity because its managers consider that its open innovation strategy is fairly recent and is still under implementation process. They believe that since open innovation is not yet fully implemented, the disclosing of information about its real identity could harm the consolidation of this strategy. As for the three other companies, after reviewing the content of each individual case analysis, they suggested changes to the wording of the proposed texts; the final version of the text approved by those companies was sent via e-mail message.

Data collected in the four companies were processed using qualitative content analysis. (BARDIN, 2004) and were categorized using the interview notes and transcripts and the notes taken during direct observation and reviewing of the documents and publications. The categorization process aims to data classification, by which communication is broken down according to differentiation, and the elements are then grouped according to pre-established rules. The categories are named in such a way that they reflect objectively and easily the common characteristics of their elements in order to classify a group of elements that are brought together under a generic title.

In this study, the categories were grouped before carrying out the field research based on the specific goals set (BARDIN, 2004) and were defined as follows: *ways to search for external sources*; and *motivation and antecedents*. The steps of content analysis were: material organization, preliminary reading, encoding, recording unit and context unit determination, categorizing, and text writing (BARDIN, 2004).

#### 4 ANALYSIS AND RESULT INTERPRETATION

The companies chosen as study units and the analysis of the two categories previously defined are presented in a comparative manner as follows:

a) Presentation of the companies:

a.1) Company Alpha

Company Alpha is particularly important in the business sector it operates, and it has been a leader in several segments for many years. Founded by an immigrant, it began operations reselling domestic and imported goods; it began its own production shortly after the purchase of the first machine.

Currently, it has five manufacturing units and is one of the largest manufacturers of its products in Latin America. Since its production relies entirely on its own raw material resources, this company is responsible for a large scale Eucalyptus planting, which provides it with approximately 75% of the raw material used.

Until the 1950s, Alpha and other companies of similar segments needed to import raw materials, mainly from Europe, for the production of its own goods. Studies conducted in the University of North Carolina reported the development of a technology to process raw material with the desired characteristics using eucalyptus. This technology was brought to the company, which within in a few years became the first worldwide manufacturer of this raw material with 100% use of eucalyptus. This was such an important innovation; a fundamental driver for the company's growth.

a.2) 3M

3M, Minnesota Mining and Manufacturing, was founded in 1902 in Minnesota, in the Great Lakes region, in the United States. At first, the company aimed to explore mineral

deposits; however, its founders discovered that the exploitation of the mines would not bring them the desired value due to the low quality of the extracted ore. The company was then transferred to the city of Duluth in 1905, where it began to manufacture abrasives.

3M's global sales reached the \$ 15 billion mark in the 1990s, and in 2004, the sales topped \$ 20 billion. The continued growth of the company over the years was supported by the development of a large number of innovative products in the various areas in which it operates. In 2010, global net sales totaled \$ 26.7 billion.

Currently, 3M has subsidiary operations in 65 countries, and it markets its products in more than 200 countries. It employs approximately 80,000 employees worldwide and has a portfolio of more than 55,000 different products. 3M started its activities in Brazil in 1946, and today it has over 4,000 employees, and in 2010 it generated gross revenue of R \$ 2.4 billion. The company investment in R&D is 6% of its sales. It has 34 laboratories spread across the globe and employs 7,000 scientists worldwide.

### a.3) Braskem

Nowadays, Braskem is an Odebrecht group company, a group that traditionally operated in the construction business and entered the petrochemical industry in 1979 by acquiring one-third of the voting capital of the Camaçari Petrochemical Company (CPC), a producer of PVC.

Currently, Braskem is the largest petrochemical company in the Americas and the third largest producer of polypropylene in the world with more than 6,500 employees and a strategic vision of becoming one of the five largest petrochemical companies in the world in 2020. Focusing on technological autonomy, the company owns the Braskem Technology and Innovation Center, with units in Triunfo (Rio Grande do Sul), São Paulo (SP), and in the United States. Triunfo is considered the largest and most modern research center in Latin

America, where products, processes, applications and new markets are developed in partnership with its customers, *i.e.*, plastic manufacturers which constitute the third generation within the value chain. The Braskem Technology and Innovation Center has secured more than R\$ 300 million in assets, 190 researchers and technicians, 11 laboratories, and six pilot plants.

#### a.4) Whirlpool

Whirlpool Corporation started operations in 1911, when the Upton Machine Company was founded in Michigan, USA, to produce electric washing machines. In 1957, Whirlpool Corporation entered a partnership with Brazil's Brasmotor, which marked the beginning of its international market expansion.

In Brazil, Whirlpool Latin America has three plants, four technology centers, two distribution centers, an administrative center, and a documentation and memory center. The company also has a distribution center in Argentina and seven offices in Latin American countries. There are 20 R&D laboratories and four Technology Centers: Cooking, Air-Conditioning, Refrigeration, and Laundry - considered as one of the largest in the world - involved in the innovation process of Whirlpool Latin America. They are located in Brazil, in Rio Claro (São Paulo), Joinville (Santa Catarina), and Manaus (Amazonas), and are Whirlpool technology reference centers in the world.

The methods and sources used for collection of data in the four companies are shown in Chart 1:

Chart 1: Data Collection Matrix

Methods of data collection	Company Alpha	3M	Braskem	Whirlpool
In-depth interviews	Research and innovation manager and member of the company innovation committee and a researcher - both belong to the Forestry Technology Center of the company	Technical director of the company; a researcher who is an R&D team member and responsible for intellectual property, and the marketing and innovation manager.	Director of Technology & Innovation, responsible for intellectual property	Business excellence and process manager and a representative of R&D institutional relations and intellectual property area
Document analysis	Internal bulletin, institutional folder, and company website	Publications available on the company website; a book about the history of innovation at 3M, and a seminar presentation on innovation given to people outside the company	Publications available on the company website and presentations given by the innovation management team	Publications available on the company website and a presentation of the innovation management process
Direct Observation	Physical space, material artifacts, symbols, and people behavior at the Technology Center located in the province of Sao Paulo state	Physical space, material artifacts, symbols, and people behavior at the Customer Technical Center (CTC) located in Santo Andre (SP)	Physical space, material artifacts, symbols, and people behavior at the administration office located in São Paulo (SP)	Physical space, material artifacts, symbols, and people behavior at the administration office located in Joinville (SC)

Source: Elaborated by the authors

b) Content Analysis based on the predefined categories

b.1) Category: **ways to search for external sources**

• *Improvement through experience*

The search for external sources to get new ideas or technology is not a new technique; it has long been used by the four companies studied. In this relationship, which is strengthened through experience, it can be noted the cumulative nature of learning as mentioned by Cohen, Wesley and Levinthal (1990). Therefore it can be said that although open innovation has been proposed as something more structured, organized, and systematized in the literature recently, its practice has already been adopted by companies, such as those presented in this study. It was observed that innovation was the central axis of the these companies' growth enabling them to enter new markets, which on several occasions

resulted in the acquisition of other companies that already had the technology necessary to grasp the new opportunities. According to Braskem and 3M, cooperation from external sources also contributed to offer their customers new applications for technologies that could be combined with others.

On the other hand, Alpha Company deserves especial attention because its experience with external sources to develop new technologies began with other companies that had similar difficulties and were also seeking solutions that would be useful to that specific group of companies. It was through a university that they started cooperating, which led to the creation of a research institute. This cooperative relationship was strengthened through experience over time and attracted other companies and researchers enabling the parties involved to learn and accumulate knowledge. However, it is worth mentioning that a problem faced by a company can transcend borders and affect other companies, which makes them to join efforts to find solutions to overcome problems that may be detrimental to the entire sector.

With regard to experience, Whirlpool and Alpha have two points in common. The first refers to the partnership longevity and relationship strengthening, which are considered essential for a partner to be more familiar with the specific needs of the company. The second point is related to the participation of other companies with common needs because they are more likely to find alternatives to grow their business together than alone.

- *Attention to intellectual property and rewards*

The need for maintaining confidentiality and an initial period of exclusivity were the highlights observed in the four companies when dealing with the intellectual property rights of their innovations. There was a consensus among the companies that the use of intellectual

property rights is an efficient way to fully explore and protect their innovations from competitors, no matter if they were achieved through internal research or through partnership.

It was observed that the issue of intellectual property rights makes it more difficult to adopt an open innovation model since different interests and goals may create difficulties in negotiating agreements between partners. All companies stated that the rules regarding intellectual property rights must be defined before starting a cooperation project.

According to the history of 3M with regard to the acquisition of technologies from external sources, there has been considerable attention to the issue of intellectual property rights. 3M's guidelines on intellectual property rights concern exclusive intellectual property rights policy. If the technology has already been protected, the company tries to purchase the patent to hold the sole right to exploit it. The allocation of rights to intellectual property, as well as the distribution of jointly owned profits, is part of the contract transparency which according to Slowinski et al. (2009) is important to avoid any unpleasant surprises that can harm the partnership business. When the technology is achieved through a merger or an acquisition deal, the intellectual property belongs to 3M.

When external sources are involved, it was observed that Whirlpool focuses on guaranteeing transparency and giving credibility to the partnership process to avoid doubts about the earnings that will be distributed to each partner. The earnings may vary, e.g., those derived from participation in intellectual property, prizes for the best ideas, scholarships for college students, and awards for their advisors. In the company Alpha, when other companies or research institutes are involved, intellectual property rights are established before starting the project, which can in some cases discourage cooperation. This shortage of interest in cooperation is similar to that highlighted by Belderbos, Carree and Lokshin (2006). However, this is not a situation in which the researchers should have a passive role since most of the

time the involvement of universities is essential for the company research results, which reinforces the need for a negotiation that is beneficial to both parties.

Since the initial period of exclusivity is considered by Braskem as fundamental, when there are other companies studying the same topic that can lead to the same new technology that has already been developed by Braskem, the patent application is made first in the USA because the patent granting process takes longer in Brazil.

- *Commercially ready technology acquisition*

Commercially ready technology acquisition was evident in the companies 3M and Braskem due to a continuous monitoring of the external environment. Their goal is to find potential new markets entry opportunities as well as suppliers who already have developed or are developing new necessary technologies to grasp these potential opportunities. For 3M, the major ways to obtain knowledge from external sources are mergers and acquisitions of other companies that already have expertise in particular technologies. Through these acquisitions, 3M avoids the risk of becoming dependent on a company that has the technology it needs (WITZEMAN, et al., 2006). This is a process whereby, when acquiring another organization, the company's portfolio technologies are legally incorporated to the technologies owned by 3M. According to 3M, one advantage of obtaining technology through the acquisition of another company is the automatic incorporation of the intellectual property right. Therefore, it prevents the need for contracts that contemplate technology sharing, property rights, and technology licensing.

3M and Braskem believe that the option to acquire companies that already have the technologies desired by them is as an effective way to avoid dependence on suppliers. This reason also led Alpha's managers to search for external sources; however, at first they were focusing on research cooperation rather on acquiring commercially ready technology. This is,

indeed, a characteristic of the Alpha's forestry department, which prefers the joint development of technology to the acquisition of commercially ready technology.

The acquisition of companies has strengthened Braskem's development of radical innovations strategy due to complementary competencies and technologies, thus avoiding dependence on external sources that have the desired technologies for innovations (WITZEMAN, et al., 2006). Its latest acquisition in the U.S. has promoted and fostered research in that unit, which has a modern research facility equipped with state-of-the-art instrumentation, and it is backed up with highly qualified professionals. Comparing the U.S research facilities to those in Brazil, their easy and low cost acquisition and maintenance of equipment and expertise is evident. One respondent stated that due to the current status of the research in the company, especially biotechnology research, R&D activities can be hindered by the lack of skilled and trained professionals throughout the country, while there is an abundance of well-trained and competent professionals in the U.S.. This limited supply of qualified researchers in Brazil leads to a deemed excessive cost of labor, which weakens the company competitiveness regarding the development of new technologies. This does not mean that there are not good researchers in Brazil, but rather a limited number of them, which leads to costly professional hiring and training. Therefore, the scenario as reported by the respondent can mean opportunities for researchers to conduct research in manufacturing companies, increasing job options, which have long been restricted to academic institutions since, in Brazil, most research is carried out in universities rather than in companies.

b.2) Category: **motivation and antecedents**

• *Specific needs*

The common thread among the four studied companies regarding the search for external sources to obtain new technologies is that they have specific needs that must be met,

but they are not able to do it relying only on their internal competencies. In general, customer needs lead to the search for external sources. At Whirlpool, it was found that these needs are related to their products; thus, they concentrate efforts on it to avoid losing focus on their core competencies or developing a technology that is not aligned with their business strategy. In order to speed up this process, it is necessary to choose from developing technology internally or using an external source that may already have the technology desired or can contribute to a joint development, which includes suppliers, universities, and other businesses that are not competitors. Usually, companies choose using external sources when it involves a competence or activity that is not part of the core competencies of the company, similarly to what was stated by Cowan, Jonard and Zimmermann (2007).

It could also be observed that in the companies 3M and Braskem, the identification of needs is related to market segments they are seeking to enter or expand their operations. Therefore, they seek growth opportunities in these markets.

- *Complementary competencies*

Analyzing the cases studied, it was observed that there is no interest in finding partners when the company already has the competence necessary for its innovation process, or even when the partner's competence is not significantly different from its internal competencies. Therefore, only when there is a real need for complementary competencies is that external sources are sought, thus avoiding infrastructure and personnel development costs that would be required if the company had decided to pursue internal development. For the four companies studied, the acquisition of complementary competencies also includes hiring professionals to participate in the project or the acquisition of companies that already have the new competencies they are looking for.

The supposed reduced costs of working with a partner who already has the complementary competencies as compared to those involved in internal development were observed in the four companies studied. Although this is not the main reason for companies to approach external sources of technology, lower costs contribute to the decision not to develop these competences internally.

At 3M, the analysis of the cost of developing a new technology internally in comparison to that of using external sources depends on the specific strategy adopted and the time available. When there is sufficient time for development, the option for internal development prevails but when time frame is a decisive factor and there is no time for internal development, they choose external sources. Therefore, it is not only the lack of specific competence (BRORING; HERZOG, 2008; SLOWINSKI et al., 2009) that makes companies seek external sources; time is a factor that also seems to have relative importance. Hence, it was observed that cost reduction obtained through the use of external sources becomes of secondary importance in relation to the need to speed up technology development.

With regard to Whirlpool, the possibility of speeding up its innovation process was also identified as an important contribution of joint work since the partner already has experience in this area and can apply the knowledge accumulated in this process. According to what the respondents reported, it can be said the time required for technology development becomes more important than the costs required when there is a strict deadline to be met with the possible implementation of the project at the required speed.

- *Knowledge and experience exchange*

Companies Alpha and 3M recognized the importance of maintaining close relationships with other companies in order to facilitate knowledge and experience exchange. Like Alpha, Whirlpool also highlighted the possibility of common benefits when companies

operating in the same area meet to discuss their problems together. In the industry sector in which Alpha operates, representatives of companies are willing to discuss the topics under research and the preliminary results that might be worth sharing. There are also seminars and information and experience exchanges opening new possibilities for application and development of new technologies in other locations where these companies operate. According to Jacobides and Billinger (2006), business exchanges between companies, or even between competitors, can be seen as strategic actions to improve competitiveness and not as a threat.

Exchanging knowledge and experiences with the external environment can be perceived as an extension of what has been happening internally at 3M ever since its first R&D teams were formed. As with the internal relationships, external relationships are also strengthened allowing greater combination of knowledge that can be transformed into innovations. The company has currently been devoted to contribute to spread the culture and practice of innovation throughout the nation in order to strengthen the national innovation system. Therefore, those involved in this process have participated in roundtable discussions in events held at universities, companies, and industry sector events, among others, sharing the experience accumulated throughout its history of innovation, which coincides with the very company history, enriching the discussion of innovation in the country.

Transparent information sharing and high level of reliability occur with deeper ties between companies over time. Alpha's Forestry Technology Center has integrated an information database into its intranet, which is the knowledge management platform and can be accessed by all company employees. However, when other companies or researchers request information stored in this database, an evaluation is carried out to assess whether it affects business strategies before disclosing such information.

- *Licensing and technology commercialization*

None of the four companies studied seek external sources as a means to introduce their technology into the market, *i.e.*, as an alternative means of doing business. That would be an option for financial gain concerning technologies that are not aligned with their current business models and the literature considers as characteristic of an open innovation model. Clearly, these companies focus on guiding their research and future innovations towards a strategic approach that has potential for financial return whether by strengthening its position in the market it operates or by entering new markets.

Although these companies located in Brazil have not practiced licensing and commercialization of their technologies as a strategic source of revenue, a case worth mentioning was reported by 3M as part of its international business activities. In the early 1990's, focusing on expanding its business field to the electronics field, 3M saw the need to establish partnerships with major companies in this segment, which led to confidentiality agreements with manufacturers of plasma displays in Japan and Korea. Through these agreements, 3M began producing the frame of plasma displays at a lower cost. Later, 3M chose to develop a manufacturing process for that specific partner and to license this technology resulting in reduced costs and high-quality assurance. Therefore, at the initial stage of the process, 3M used the patent to guarantee exclusivity, but later on it started reaping the benefits of licensing, *i.e.*, this was a particular case in which the patent was used not only as protection against competitors, but also as a strategic way to generate value (CHESBROUGH, 2003).

Hence, it was found that the search for external sources by these companies is focused on the inflow of new knowledge and technologies without an outflow of technologies that were not applied to their business to exploit the external sources. However, it was observed that the adoption of this practice as proposed in the theoretical model has not been ruled out;

it is still part of a trade-off that occurs between the greater complexity in the management of innovation projects and the greater range of possibilities of generating revenue. Additionally, these companies could use technology brokers as an interesting way to transfer technologies that do not apply to their business to other companies so that there would be financial returns obtained from the revenues generated from the exploitation of these technologies by third parties, which would result in a greater adherence to the open innovation model proposed in the literature.

## **5 FINAL CONSIDERATIONS**

The search for external sources for innovation has not been addressed in the present study as a new practice; but rather as something that has long been used. In some cases, it has virtually been part of the entire history of innovation in the company. This search includes sources that have commercially ready technologies (acquisitions of companies or patents) and partners for co-development. There are several different reasons that lead companies to seek external sources, especially specific and temporary needs that involve competencies that companies do not have and are not worth developing internally, mainly with respect to cost and time.

The relationships with external sources are intense, strengthen with increasing interactions, and the outcomes generate benefits for the parties involved. The internal knowledge is continually expanded either by enhancing the internal team effectiveness or by hiring qualified personnel.

The alignment of innovation with strategy reduces the possibility of developing technologies that do not fit into the company business. Therefore, the open innovation model proposed in the literature, in which the licensing of technologies that are not aligned with the business models of companies should be a strategic approach to revenue generation, has not

being practiced by the companies studied, indicating that the theoretical model does not quite fit reality. Therefore, it is clear that for these companies, the involvement with external sources is focused on the inflow of new knowledge and technologies, rather than the outflow of new technologies that are not aligned with the business, but which have the potential to generate revenue through the exploitation of third parties.

The use of open innovation requires caution. Issues related to intellectual property rights are of paramount importance in terms of innovation strategy, especially when using the open model, since it is important to identify the real ownership of inventions. The concern about appropriability of new technologies, especially patents, is justified by the gains obtained in the period of time when companies can explore and expand the use of their innovations. It was observed that patenting is related to the financial return that the patent can generate for the company, and that the patents that do not show potential application and revenue generation within the current business model of the company may even be disregarded. Accordingly, the recent literature on open innovation is more comprehensive, indicating that the strategic use of patents is not limited to preventing the action of competitors, *i.e.*, the exclusivity period, but the generation of revenue from its commercialization or licensing for the exploitation by third parties.

To sum up this study, it is necessary to consider that the results obtained, as well as their analysis and considerations, were contingent upon some limitations such as the incipient characteristic of the topic and therefore hindered a more detailed comparison of the results with those of other studies. It should also be borne in mind that despite the deep investigation involved in the multiple case study methodology, it is somewhat limited. Like any exploratory research, this article raises the possibility of future studies, *e.g.* a study on whether other companies that adopt open innovation also search for external sources focusing on the licensing and exploitation of their technologies that are not part of the scope of the

technologies commercially exploited by these companies - in order to deeply explain this lack of adherence to the model proposed in the literature.

## 6 REFERENCES

BALLON, Pieter; HAWKINS, Richard. (2009). Standardization and Business Models for Platform Competition: The Case of Mobile Television. *International Journal of IT Standards and Standardization Research*. 7(1), 1-12.

BARDIN, Laurence. (2004). *Análise de conteúdo*. Lisboa: Edições 70.

BELL, Martin; PVITT, Keith. (1995). The Development of Technological Capabilities. In: HAQUE, Irfan et al. *Trade, Technology and International Competitiveness*. Washington D.C.: The World Bank.

BRORING, Stefanie; HERZOG, Philipp. (2008). Organising new business development: open innovation at Degussa. *European Journal of Innovation Management*. 11(3), 330-348.

CHESBROUGH, Henry. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston: Harvard Business School Press.

CHESBROUGH, Henry. Open Innovation: A New Paradigm for Understanding Industrial Innovation. (2006a). In CHESBROUGH, H.; VANHAVERBEKE, W.; WEST, J. (Eds.) *Open Innovation: Research a New Paradigm*. Oxford: Oxford University Press.

CHESBROUGH, Henry. (2006b). New Puzzles and New Findings. In CHESBROUGH, H.; VANHAVERBEKE, W.; WEST, J. (Eds.) *Open Innovation: Research a New Paradigm*. Oxford: Oxford University Press.

CHESBROUGH, Henry; SCHWARTZ, Kevin. (2007). Innovating Business Models With Co-Development Partnerships. *Research Technology Management*. 50(1), 55-59.

COHEN, Wesley M.; LEVINTHAL, Daniel A. (1990). Absorptive Capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*. 35(1), 128-152.

COWAN, Robin; JONARD, Nicolas; ZIMMERMANN, Jean-Benoit. (2007). Bilateral Collaboration and the Emergence of Innovation Networks. *Management Science*. 53(7), 1051-1067.

DOSI, G. (1988). Sources, Procedures and Microeconomic Effects of Innovation. *Journal of Economic Literature*, 26(3), 1120-1171.

FREEMAN, Chris. (1991). Networks of innovators: A synthesis of research issues. *Research Policy*. 20(5), 499-514.

KLEYN, Dominique; KITNEY, Richard; ATUN, Rifat A. (2007). Partnership and innovation in the life sciences. *International Journal of Innovation Management*. 11(2), 323-347.

MAGRETTA, Joan. (2002). Why business models matter. *Harvard Business Review*. 80(5), 86-92.

MOREIRA, Natali V. A.; ALMEIDA, Francisco A. S.; COTA, Marcelo F. M.; SBRAGIA, Roberto. (2007). A Inovação Tecnológica no Brasil: Os avanços no marco regulatório e a gestão dos fundos setoriais. *Revista de Gestão USP*. 14(special issue), 31-44.

MUNSCH, Kenneth. (2009). Open Model Innovation. *Research Technology Management*. 52(3), 48-52.

NELSON, R.; WINTER, S. (1982). *An Evolutionary Theory of Economic Change*. Belknap Press of Harvard University Press: Cambridge MA.

PERKMANN, Markus; WALSH, Kathryn. (2007). University–industry relationships and open innovation: Towards a research agenda. *International Journal of Management Reviews*. 9(4), 259-280.

SANDULLI; Francesco D.; CHESBROUGH; Henry. (2009). Open Business Models: Las dos caras de los Modelos de Negocio Abiertos. *Universia Business Review*. 22, 12-39.

SLOWINSKI, Gene; HUMMEL, Edward; GUPTA, Amitabh; GILMONT, Ernest R. (2009). Effective Practices for Sourcing Innovation. *Research Technology Management*. 52(1), 27-34.

VERGARA, Sylvia Constant. (2000). *Projetos e relatórios de pesquisa em Administração*. 3. ed. São Paulo: Atlas.

VON HIPPEL, Eric; THOMKE, Stefan; SONNACK, Mary. (2000). Creating breakthroughs at 3M. *Health Forum Journal*. 43(4), 20-26.

WITZEMAN, Stewart; SLOWINSKI, Gene; DIRKX, Ryan; GOLLOB, Lawrence; TAO, John; WARD, Susan; MIRAGLIA, Sal. (2006). Harnessing External Technology for Innovation. *Research Technology Management*. 49(3), 19-27.

YIN, R. K. (2005). *Estudo de caso : planejamento e métodos*. Porto Alegre: Bookman.

ZALTMAN, G.; DUNCAN, R.; HOLBEK, J. (1973). *Innovations and Organizations*. New York: Wiley.