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A Study of Innovation Management at Braskem

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Abstract

In the current economic climate, companies must seek new ways to manage innovation, which has recently become a key method of differentiation in competitive markets. The general goal of this article was to study the process of innovation management in a petrochemical company. A case study performed at Braskem showed that the ability to manage and use knowledge is the major drive of technological innovation. Main contribution of the study, it is evident the use of methods aimed at encouraging internal innovation, as suggestions of employees and their selection using established scientific methods.

Keywords: Innovation. Technology. Braskem.

ESTUDO DO PROCESSO DE GESTÃO DA INOVAÇÃO DA BRASKEM

Resumo

O atual cenário mercadológico fez com que as organizações buscassem novas maneiras de gerir seu processo de inovação, uma vez que constataram que a inovação é uma das principais formas de diferenciação em mercados competitivos. O objetivo geral deste artigo foi estudar o processo de gestão da inovação em uma empresa petroquímica. A partir do estudo de caso, desenvolvido na Braskem, evidenciou-se que a capacidade de gerar e usar conhecimento são os grandes propulsores da inovação tecnológica. Como principais contribuições do estudo, evidencia-se o uso de métodos que incentivam a inovação interna, como sugestão de funcionários e sua seleção usando métodos científicos específicos.

Palavras-chave: Inovação. Tecnologia. Braskem.

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In 2006, the National Association for the Research, Development and Engineering of Innovative Companies (ANPEI) published a study based on a 2002 survey performed by the Brazilian Institute of Geography and Statistics (IBGE) with the aim of describing the status of innovation in the country. The study concluded that, “save for a few exceptions, Brazilian companies do not perceive technology to have strategic value.” The study went on to add that the technological strategies used were “in most cases, limited to the application of well-known technological processes to projects in which this could lead to cost reductions and increased production efficiency, associated with the innovation of production processes” (ASSOCIAÇÃO..., 2006, p. 11, 15).

The Brazilian petrochemical industry is characterized by two distinct business models: “a commodity model, which relies on price-based market operations, and a model focused on the production of specialized goods in a competitive environment faced by the constant introduction of new products.” The technological maturity of the former business model results in extremely low R&D investment. However, in the second generation of products, innovation allows for these goods to be adjusted according to client needs. It is important to note that the “lack of complementarity between the two models prevents the sharing of knowledge or returns to scale between them” (AGÊNCIA..., 2009, p. 77).

In light of this market structure, and due the relevance this segment to Brazilian economy, the general goal of this article was to study the process of innovation management in a petrochemical company. To achieve this goal, we aimed to (i) Characterize the petrochemical industry; (ii) Define the general concept of innovation in the organizational setting; and (iii) Describe innovation and its underlying organizational practices.

To ensure our research question was approached with sufficient scientific rigor, we employed exploratory and descriptive methods. A qualitative approach was used, and data were collected using semi-structured interviews.

Innovation Management

The explanation of the business cycle published by the economist Joseph Schumpeter (1982) is still relevant to the current economic climate. According to this author, changes in the economic equilibrium and the expansion of economic activity are caused by the appearance of innovation. The author states that the opening of new markets, the creation of new goods and services, the discovery of new methods of production and commercialization, the use of new technologies or any changes in the structure of the current markets can all be indicators of innovation.

In line with these considerations, Porter (1989) affirms that technological evolution is the most relevant force in changing the rules of competitiveness, and plays an important role in the creation of new markets. The introduction of technological innovation allows for either or both cost reduction and differentiation to occur. In fact, “new innovative practices unrelated to technology can also have this effect” (PORTER, 1989, p.17).

Dealing with technology means to work different stages of research and therefore special management duties and responsibilities. According to Specht (2002), the stages of technology development and pre-development activities belong to technology management. The field of R&D management is determined by adding upstream fundamental research as well as product and process development. Finally, innovation management includes the product and market introduction phase.

Boeddrich (2004) indicates that every innovation is based on an idea from inside or outside the company. The idea acceptance phase consists of several stages through which the ideas have to pass and where they are refined (COOPER, 2005). When realizing the selection of the ideas, it is important to choose efficient ways to preserve or to reduce cost of the resources (AEGERHARD; SCHREIER, 2001). The final success of idea

management strongly depends on the right process structure for the different kinds of ideas and the appropriate organizational implementation (VOIGT; BREM, 2009).

In order to obtain a maximum number of ideas to innovate products and processes, a holistic view of the innovation process is needed. In this context, Tidd and Bessant (2015) understand that organizations should structure the innovation management processes in order to enable the creation of new products and processes in a more assertive way. Therefore, the company must align the innovative efforts with the company's strategies and also ensuring the expected results, defined in the initial planning, are fulfilled in the end of the process.

Hence, there are two ways of gathering ideas: Obtaining them in the existing form (individually or collectively); Generating them through a well thought-out process utilizing creative methods. Consequently, creative practice methods and techniques are needed to foster a continuous spirit of creative evolution (Kelley and Littman, 2005). Key elements for promoting corporate creativity include a motivating reward system, officially recognized creativity initiatives, the encouragement of self-initiated activities, and the allowance of redundancy (STENMARK, 2000; SOMECH; DRACH-ZAHAVY, 2013).

Mattos and Guimarães (2005, p. 30), however, emphasize that the organizational environment may act as an internal inhibitor of innovation. As such, managing a company requires progress on two separate fronts. There is "day-to-day management, where decisions are made which constantly improve the production process" and keep it going, and a second type of model, in which the manager "invents the future, develops scenarios and seeks new ideas" in an attempt to modify the way in which things are seen. The two forms of management, based on reality and perception, respectively, occur in parallel and are essential for implementing changes which occur at all levels of the organization (BRABANDERE, 2006, p.10).

For Davila, Epstein and Shelton (2012), innovation includes the management of large amounts of creativity. In fact, balancing and controlling the inherent tension between creativity and commerce requires a clear innovation strategy, well-defined processes and solid leadership. The authors also claim that the organizational innovation strategy must adapt to the business setting and be transparent to all its members. The company must also invest resources in strategic areas which provide greater return on investment; otherwise, it may face worse results than expected.

Given the need for systemic models of innovation management which increase the chances that an innovative initiative will produce satisfactory results, Tidd and Bessant (2015) presented a model of innovation management consisting of the following stages: (i) search (analysis of the internal and external setting, so as to detect threats and opportunities); (ii) selection (deciding which signs to respond to, so as to facilitate strategy development) and; (iii) implementation (launching an idea into the internal or external market).

According to Drucker (1986), structured innovation, which is approached as a process which can be learned and managed, supersedes others kinds of innovation in terms of its market permanence and loss rate, as well as in the challenges it offers to entrepreneurs. Scherer and Carlomagno (2009) add that, to ensure that it can be managed, innovation must be linked to the corporate strategy adopted by the company. Similarly, Tidd and Bessant (2015) state that organizations must define their basic commercial strategy and the way in which innovation can make it work.

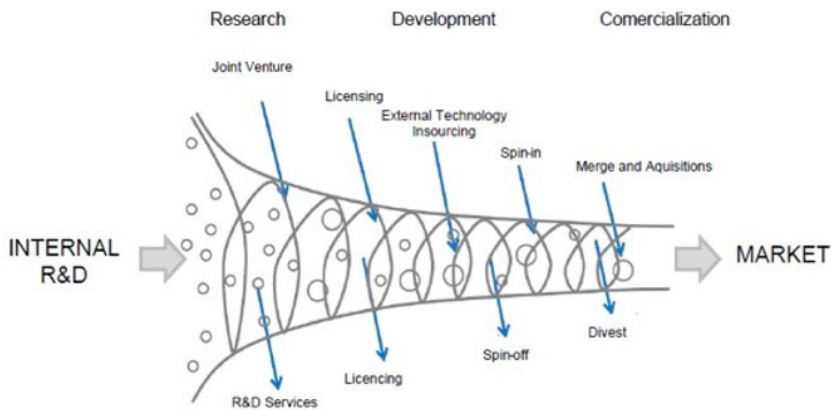
However, companies can still innovate even when their internal knowledge generation is low. To facilitate the innovation process, formal and informal cooperation strategies can be implemented to promote the interaction between companies, academic institutions and government agencies (VAN DE VRANDE, VANHAVERBEKE, GASSMANN, 2010; GUIMARÃES, 2011). The knowledge which is later converted into products and services is largely produced by the research and development (R&D) sectors of the organization, topic that will be addressed in the next chapter.

Research and Development (R&D): creating a setting which favors innovation

The term “technology-push” describes the first forays into R&D management made by organizations, where technology is used to guide the strategies involved in the research and development of new products. However, the increased competitiveness and diversity of products and services in the market resulted in the establishment of “market-pull” management, which placed a greater emphasis on innovation and relied on the market as a guide for R&D activity (ROTHWELL, 1994; MILLER; MORRIS, 1999).

As such, the need to acquire technological competencies, increase financial efficiency and improve the agility of R&D activities led organizations to adopt an open innovation model. This model is based on the flow of internal and external knowledge, and allows for product development outside the traditional scope of business (CHESBROUGH, VANHAVERBEKE; WEST, 2015).

Figure 1 – Open Innovation Model



Source: Adapted from Chesbrough, Vanhaverbeke and West, 2015, p. 7.

The research stage involves the “internal and external generation of ideas and the formation of joint ventures”. In the development stage, companies may “choose to use third-party licenses or enter into collaborative ventures with other organizations.” In a spin-in, universities and technology companies are incorporated into the company’s processes. As a result, new technologies are licensed and spin-offs, or high-tech companies which are usually “not aligned to the core of the organization” (CHESBROUGH, VANHAVERBEKE; WEST, 2015).

The commercialization stage sees the “acquisition of technologies in more advanced stages of development.” In the opposite direction of this process there is alienation, which occurs “when any technology developed by the organization” during the innovation process cannot be used as intended, and is commercialized to third parties or even competitors (CHESBROUGH, VANHAVERBEKE; WEST, 2015).

To illustrate the importance of government agencies in the expansion of scientific knowledge, Etzkowitz and Leydesdorff (2000) conceived the Triple Helix model. According to this model, the combination of science and technology can maximize the systematic generation, accumulation and utilization of knowledge. This metaphor can also be used to guide public policy on science, technology and innovation, aiming to promote the interaction between the three helices of the model (DANELL; PERSSON, 2003; SANTOS; MELLO, 2010).

Even before the introduction of this concept by Etzkowitz and Leydesdorff (2000), authors such as Roussel, Saad and Bohlin (1992, p.13 and 14) had already mentioned the indispensability of universities in organizational R&D. According to these authors, “the aim of research is to develop new knowledge,” while the purpose of development is to “apply scientific knowledge,” connecting information across different areas of study. Technology can therefore be defined as the “use of scientific and engineering knowledge to achieve a practical result.”

Research Methods

To ensure scientific methods were adequately followed so that our results may have scientific rigor, we used a qualitative research design in the form of a case study. According to Yin (2010), the case study is the preferred research method for the study of contemporary events, and situations in which the relevant behaviors cannot be manipulated, but events can be directly observed and systematic interviews can be performed. Although a case study can have several applications according to Yin, our aim in this particular study was to describe a real-life situation through exploratory and descriptive analysis.

Data were collected between June and July of 2012, in two stages: (I) three technical visits were made to the organization's Center for Technology and Innovation, and a fourth visit was organized to the industrial plant, both of which are located in the city of Triunfo, in the state of Rio Grande do Sul; (II) two in-depth interviews were performed with employees responsible for innovation management and who effectively participate in R&D activities in the company's Polymer Science and Innovation Performance Management sector, within the Polymer Unit.

The interviews were recorded and transcribed within a maximum of six hours. Since literal transcription often results in non-linear or confusing text, the interviews were re-written as a coherent narrative (POLKINGHORNE, 2007). These were then returned to the interviewees for any revisions, adjustments or contributions, before being submitted to content analysis. According to Roesch (2005), this method allows for valid inferences to be drawn from text by classifying words, phrases and paragraphs into different content categories. At this stage of the research, the NVivo software was used to compile, compare and analyze interview data.

Additionally, as recommended by Yin (2010) and Lakatos and Marconi (2011), data was triangulated, since, when dealing with multiple variables, researchers must base their findings on "several sources of evidence, whose

data must converge to allow for data analysis” (YIN, 2010, p. 33). In this way, triangulation can be used to increase research validity, increasing the reliability of findings by drawing from multiple sources of data (YIN, 2010).

Characterization of the Case

The object of this study was Braskem S.A., which emerged from the integration of six companies. Its story began on July 2001, when the Odebrecht and Mariani Groups acquired control of Copene, which supplied petrochemical raw materials to the Camaçari plant. The Odebrecht and Mariani groups then integrated their own petrochemical assets with those of Copene. The integration process ended in August 16th, 2002, marking the beginning of Braskem activities (BRASKEM, 2011).

In March 2007, Braskem formed a partnership with Petrobras and began to establish their plant at Triunfo after acquiring all petrochemical assets from the Ipiranga group, including the control of Copesul. Petrobras then made a deal with Braskem and Odebrecht to determine its participation in these and eleven other Braskem assets (BRASKEM, 2014).

So as to strengthen its position in the petrochemical industry, in 2010, Braskem announced the acquisition of Quattor and the incorporation of polypropylene (PP) assets from the North-American company Sunoco Chemical, the fourth largest producer of this resin in the USA. In the same year, Braskem secured its place as the largest resin producer in the Americas and one of the largest polypropylene producers in the world. Still in 2010, the company inaugurated its green ethylene unit, whose production methods rely mostly on sugarcane ethanol (BRASKEM, 2011).

Braskem operates in the first and second generations of the production chain, increasing its operational efficiency in the petrochemical market. Naphtha is still the main raw material used in the petrochemical and plastic

industry in Brazil. Naphtha is first subjected to cracking, which yields basic petrochemical compounds such as ethene, propene and aromatic hydrocarbons. This production cycle is the first step in the petrochemical chain.

Figure 2 – Petrochemical Chain



Source: Adapted from Braskem S.A., 2014.

Basic compounds such as ethene and propene are, in turn, used in the production of thermoplastic resins such as polyethylene, polypropylene and vinyl polychloride (VPC), in the second step of the production chain. Resins are small granules used by the plastic transformation industry (third stage) to produce packages, toys, car parts, domestic utilities, electrical and electronic parts, civil construction utilities, and a number of other products.

Analysis and Discussion

In early 2002, Braskem arose as a result of the fusion of six companies, each of which had its own innovation methods. There was therefore a need to unify these processes into a single innovation methodology which could

be applied across all sectors of Braskem. As a result, in 2004, the company announced the Braskem Innovation Program (BIP). The goal of the BIP was to provide a disciplined framework to ensure the efficacy of the creative processes involved in innovation.

The importance of a strategy which aims to balance the inherent tension between creativity and innovation is corroborated by Davila, Epstein and Sheldon (2012). It is also important to note that expansion strategies based on the acquisition of additional companies were the method chosen by Braskem to ensure its protection in an increasingly competitive market, which requires the constant development of new ways of exploring opportunities and creating differentiation (PORTER, 1989).

The implementation of the BIP confirms that, since its early history, Braskem was governed by a strategic plan with a focus on innovation (PORTER, 1989). The care taken by the company to maintain an innovation-conducive structure is evidenced by its investment in technology and innovation, which, in 2011, reached R\$155 million, more than double that of the previous year.

Within the BIP, projects are conducted by multidisciplinary teams composed of employees from different sectors of the company, as well as clients, technology licensors, universities and suppliers, so as to improve the acquisition of competencies, accelerate results and divide the investment risks incurred by each project. As stated by Tidd and Bessant (2015); Rousel, Saad and Bohlin (1992), this type of organizational structure facilitates innovation.

The BIP addresses the management of ideas and projects. For Braskem, innovation begins with a fragment of an idea. The idea comes from an individual, goes through concept development with the involvement of relevant specialists and is transformed into a robust concept while a mul-

tidisciplinary team is assembled to develop it into a project. These teams enhance the initial idea by improving its market attractiveness, technical viability and strategic adequacy.

Some ideas may come from clients. Therefore, to ensure that these ideas are acted upon, the Application Engineering, Market Development and Commercial Management sectors are responsible for supporting clients and prospecting new business opportunities. Opportunities may also arise as a result of market needs as represented by third-generation companies or businesses at the final end of the production chain, where the items produced are effectively applied.

All projects make use of the Clarity software, a project management tool characterized by its role as a collaborative management device. The software allows for document generation and checking, the verification of pending issues, the execution of tasks and the management of project workflow.

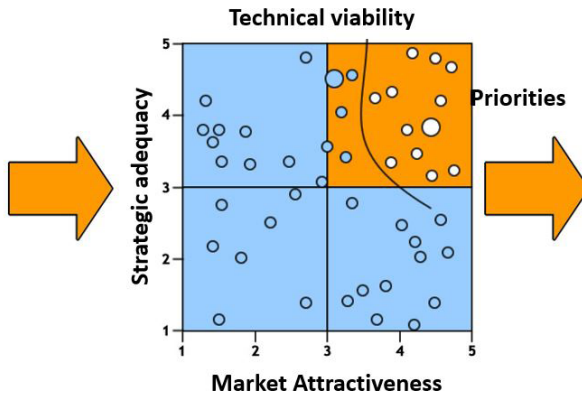
Any individual with access to the software can introduce ideas into it, or sign up members who have no direct access so that these individuals can also enter their ideas into the system. When entering an idea into the software, the user is asked to indicate whether it refers to a new product, new market, new technology, or involves of more than one product line or family, and to indicate whether it is a reactive or proactive idea, that is, an idea which came from a client vs. an opportunity for Braskem to anticipate market needs.

In the case of a new product, for instance, the idea is automatically sent to the employees responsible for product development and polymer science, who share the idea with the team-mate responsible for the type of the product in question as part of the first screening procedure in the process. This person is responsible for contributing to the idea by filling out a

questionnaire in the software itself, and sharing it with employees in other sectors of the company, such as the commercial and industrial area. At this stage of concept development, no laboratory resources are used.

The questionnaire yields three scores which refer to the technical viability, strategic adequacy and market attractiveness of the idea, as illustrated below.

Figure 3 – *Software* assessment of user ideas



Source: Braskem, 2014.

The ideas allocated to the orange quadrant are given priority. The concept development process is then ratified by the project team leader and a multidisciplinary team. The prioritized ideas are assessed by innovation committees, composed of the directors of the technology and innovation, commercial, industrial and business sectors, as well as the managers of the new products and markets, polymer science, pilot plants, laboratory, client accounts and innovation performance sectors. Meetings are segmented by topic and scheduled on a bimonthly basis, save for the PVC meeting, which is held trimonthly.

In this meeting, the committee assesses the projects at hand, approves resources, prioritizes deliveries and discusses which projects will be approved, which will be returned for further improvement as well as

which ones may be discarded. In summary, the goal of the committees is to classify projects according to specific organizational strategies, assess the development and results of ongoing projects and approve the continuation of projects into the next stage of the innovation funnel.

The projects are managed individually with the help of the Clarity software, which uses the PhaseGate project management method to identify ideas and projects with high potential value. This process was described by Innovation Performance Manager of Unpol in the following way:

To execute a project, we must manage people's creativity, especially in the innovation and development sectors, in which people are very creative. We must discipline people to ensure they perform all required economic analyses. This allows us to invest our resources into what will actually add value to our business at Braskem. This is why we have clearly defined all stages in the process, and the activities which should be performed at each stage.

The stages listed by the interviewee are structured in the following manner:

Figure 4 – Stages in the Braskem innovation funnel



Source: Braskem, 2014.

Stages are separated by gates, which consist of the innovation committees responsible for project decision-making. As projects advance through the stages, they are discussed in increasing detail and demand significantly greater financial investment. In the first stage, a preliminary business plan is outlined in an internal process known as a mini business case. This document contains preliminary information regarding the technical and financial viability of each project, the definition of each product or solution as well as project planning data.

A viability study is then performed and allows for the construction of a business plan. In this step,

a more detailed investigation of the technical and financial viability of the product is performed, including the definition of the product or solution and the development of a final project plan (AS QUOTED BY THE INNOVATION PERFORMANCE MANAGER OF UNPOL – interview).

The next part of the process involves actual project development. This is where the phases involved in application, production and supply are outlined in laboratories and pilot plants. The validation stage, in turn, involves laboratory testing, industrial-scale production and client testing to evaluate the applicability of the new product or solution. With that, large-scale production begins, and commercialization ensues. After the products are released, a monthly follow-up is performed to evaluate predicted sales and the percentage of the project which has actually been completed.

In some cases, risk management may omit review stages and group consecutive phases together to speed the process along. The projects selected to undergo such procedures are described by our interviewee as follows:

We refer to these as fast-track projects, due to their low complexity, low to nil investment, reliance on existing technical and management competencies, and possible dispensation of pilot plant tests. Our goal is to discontinue poor projects early on in the process so as to avoid unnecessary spending (INNOVATION PERFORMANCE MANAGER OF UNPOL).

Several advantages of the BIP were described by our interviewees and may be considered good practice in innovation management. The systemic way in which the BIP is approached increases the likelihood that an innovative initiative will yield satisfactory results. The BIP model also allows for item production and release in the market, and is in agreement

with authors such as Tidd and Bessant (2015), who state that search, selection and implementation stages are vital for strategic planning in research and product development.

The multidisciplinary committees create a structure which facilitates innovation and ensures that projects are aligned with the business strategies of Braskem. The resources are strategically invested in areas which provide greater return on investment (DAVILA, EPSTEIN; SHELTON, 2012). This allows for a better assessment of the risks involved in each innovative initiative (TIDD; BESSANT, 2015).

The fact that any member of Braskem can introduce an idea into the company software creates an internal organizational environment which is conducive to innovation (MATTOS; GUIMARÃES, 2005). This also helps higher-level management transform creative ideas into commercial realities (DAVILA, EPSTEIN; SHELTON, 2012). Additionally, the BIP is a transparent organizational innovation strategy which encompasses all members of the organization, and transforms innovation into a comprehensive organizational task which involves several areas of the company beyond the R&D laboratories (TIDD; BESSANT, 2015).

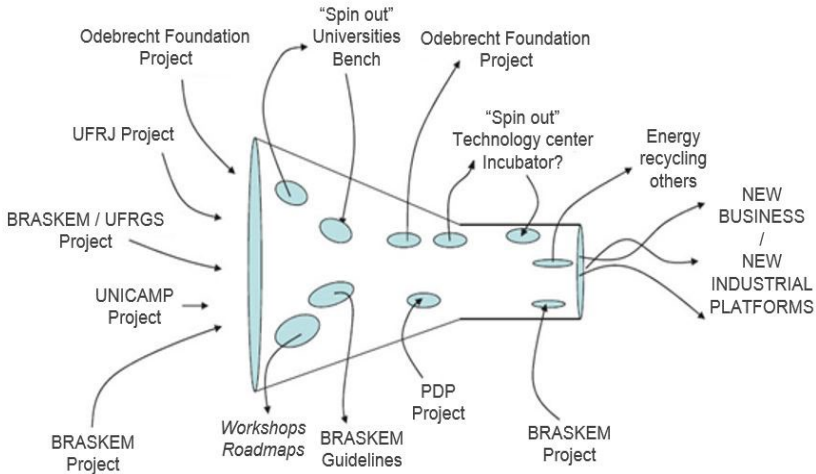
The BIP guides the actions which result from the company's innovation strategy, and helps identify the need to establish strategic alliances to fill in internal gaps in science and technology (CHESBROUGH, VANHAVERBEKE; WEST, 2015). As such, to ensure the success of its business plans for the year of 2020, which place Braskem as a world leader in sustainable chemistry, the company has established biotechnology research partnerships with several universities, such as UFRGS, Unicamp e UFRJ, and research centers in Brazil and overseas.

This research aims to develop economically competitive and sustainable products using raw materials from renewable sources. With the help of external collaborators, Braskem has been able to integrate innovation into its internal structure, acquiring several competencies for the creation of new

products (MILLER; MORRIS, 1999). In 2009, for instance, Braskem formed a partnership with Novozymes, a world leader in the production of industrial enzymes, to increase its research into sugarcane-based polypropylene.

With the help of other research centers, the scientific community and universities, Braskem is also a leader of advanced research in renewable products. This line of products has opened up a new area of business for the company, marking its transition from the fourth (MILLER; MORRIS, 1999) to the fifth (ROTHWELL, 1994) generation of innovation, with the company now basing its innovation management strategies on an *open innovation* model (CHESBROUGH, VANHAVERBEKE; WEST, 2015). Braskem made use of this concept, described in the theoretical section of this article, to create its own innovation model, depicted in Figure 5.

Figure 5 – The Braskem open innovation model



Source: Braskem, 2014.

The model presented in Figure 5 illustrates the company's choice to develop projects based on new technology and laboratory-scale R&D performed in universities or research centers. The model also entails greater

reliance on external competencies and an improved balance of innovation pipelines in the short-, medium- and long-term, ensuring the extension of the company's competitive horizons.

The development of industrial platforms which operate based on open innovation, the encouragement of new partnerships in Brazil and overseas, the administration of patents and technology contracts, assessments of competitiveness and the consolidation of innovation figures are under the responsibility of the Corporate Innovation sector. With the aim of perpetuating the innovation culture, December 2008 saw the founding of Ideom Technology, Braskem's own Innovation and Technology company which manages corporate innovation through consultancy.

Ideom was incorporated into Braskem in early 2012, with the aim of simplifying its corporate structure and reduce financial, administrative and operational costs. As an additional result of the unification of these companies, all Ideom activities were consolidated by Braskem, which took over the totality of its assets, rights and obligations. Ideom began its activities by implementing innovation management strategies and identifying new markets and business models for Braskem. Currently, all innovative ideas and proposals to be released over the next few years must pass through Ideom.

The corporate innovation structure of Braskem also includes a Directory of Knowledge Management and Intellectual Property, whose aim is to integrate knowledge across business sectors through technological platforms such as data mining, ERP, CRM, virtual and physical communities, data warehousing, intranet, extranet and the internet. Through the intranet, any member of Braskem can access the Braskem Knowledge Base (BKB), which contains articles from the several scientific journals to which Braskem subscribes, provides access to innovation forums and networks, and contains information about the company and websites with relevant market information.

The mapping of innovation resources is also a competency of the corporate innovation sector. Government funding is of major importance to innovation and, as such, Braskem is financed by Finep and BNDES and receives support from the CNPq. The capture of innovative ideas also extends to the relationship between the company and government agencies such as the National Innovation System, the Lattes Platform, the National Association for the Research, Development and Engineering of Innovative Companies (Anpei), and the Capes Journal Portal.

Braskem is therefore highly integrated with government agencies. These relationships show that the company is on the leading edge of scientific knowledge, as discussed in the Triple Helix model (ETZKOWITZ; LEYDESDORF, 2000). The data collected in our interviews and visits to the company suggest that the open innovation model is aligned with the company's values.

However, Braskem also believes in the potential of the ideas generated by their internal team, and as a result, created the Inventor Incentive Program to stimulate the production of intellectual capital through patents, utility models and industrial designs (MATOS; GUIMARÃES, 2005). Collaborators can contribute in a variety of ways, from innovations in products, processes and applications, to simple improvements in existing processes. In addition to their creative role, inventors are also responsible for disseminating the idea of intellectual property protection, encouraging colleagues to officially register their inventions. In 2011, 23 members of Braskem registered patents and could be considered inventors.

According to the information outlined in this article, the aims of the Braskem innovation management system can be checked in the following table.

Table 1 – Braskem Innovation Management

Analysis Category	Empirical Evidence	Authors
Strategy oriented to innovation	Braskem Innovation Program (BIP) – in order to provide a disciplined framework to ensure the efficacy of the creative processes involved in innovation; investment in technology and innovation, which, in 2011, reached R\$155 million, more than double that of the previous year.	Porter (1982, 1989), Scherer & Carlomagnano (2009), Davila, Epstein & Sheldon (2012).
Prospecting of ideas	Multidisciplinary teams composed of employees from different sectors of the company, as well as clients, technology licensors, universities and suppliers. The idea comes from an individual, goes through concept development with the involvement of relevant specialists and is transformed into a robust concept while a multidisciplinary team is assembled to develop it into a project. When ideas come from clients, Application Engineering, Market Development and Commercial Management sectors are involved.	Tidd and Bessant (2015), Roussel, Saad and Bohlin (1992), Specht (2002), Boeddrich (2004), Cooper (2005), Voigt & Brem (2009), Aeberhard & Schreier (2001), Kelley & Littman (2005), Stenmark (2000); Somech & Drach-Zahavy (2013), Davila, Epstein & Shelton (2012),
Selection of ideas	In the case of a new product, for instance, the idea is automatically sent to the employees responsible for product development and polymer science, who share the idea with the team-mate responsible for the type of the product in question as part of the first screening procedure in the process. Stages are separated by gates, which consist of the innovation committees responsible for project decision-making.	Specht (2002), Boeddrich (2004), Cooper (2005), Voigt & Brem (2009), Aeberhard & Schreier (2001), Kelley & Littman (2005), Stenmark (2000); Somech & Drach-Zahavy (2013), Davila, Epstein & Shelton (2012),
Implementing of ideas	The concept development process is ratified by the project team leader and a multidisciplinary team. The prioritized ideas are assessed by innovation committees, composed of the directors of the technology and innovation, commercial, industrial and business sectors, as well as the managers of the new products and markets, polymer science, pilot plants, laboratory, client accounts and innovation performance sectors. Meetings are segmented by topic and scheduled on a bimonthly basis, save for the PVC meeting, which is held trimonthly. Teams enhance the initial idea by improving its market attractiveness, technical viability and strategic adequacy.	Cooper (2005), Voigt & Brem (2009), Aeberhard & Schreier (2001), Kelley & Littman (2005), Stenmark (2000), Brabandere (2006)
“Market-Pull” R&D oriented	Application Engineering, Market Development and Commercial Management sectors are responsible for prospecting new business opportunities that may arise from market needs as represented by third-generation companies or businesses at the final end of the production chain.	Drucker (1986), Chesbrough, Vanhaverbeke & West (2015)

SPIN-IN	IDEOM Technology, that was incorporated into Braskem in early 2012, with the aim of simplifying its corporate structure and reduce financial, administrative and operational costs.	Chesbrough, Vanhaverbeke e West (2015)
SPIN-OFF	Spin-out university bench, Spin-out technology center incubator.	Chesbrough, Vanhaverbeke e West (2015)
External Technology Insourcing	In 2009, for instance, Braskem formed a partnership with Novozymes, a world leader in the production of industrial enzymes, to increase its research into sugarcane-based polypropylene.	Rothwell (1994); Miller & Morris (1999)
Triple Helix	As such, to ensure the success of its business plans for the year of 2020, which place Braskem as a world leader in sustainable chemistry, the company has established biotechnology research partnerships with several universities and research centers in Brazil and overseas.	Van De Vrande, Vanhaverbeke, Gassmann (2010); Guimarães (2011), Danell & Persson, 2003, Santos & Mello, 2010, Etzkowitz & Leydesdorff (2000), Roussel, Saad & Bohlin (1992)
Knowledge management	Through the intranet, any member of Braskem can access the Braskem Knowledge Base (BKB), which contains articles from the several scientific journals to which Braskem subscribes, provides access to innovation forums and networks, and contains information about the company and websites with relevant market information.	Scherer & Carlomagno (2009), Tidd and Bessant (2015), Stenmark (2000); Somech & Drach-Zahavy (2013), Davila, Epstein & Shelton (2012)
Products and processes innovation	Use of the Clarity software, a project management tool characterized by its role as a collaborative management device. The software allows for document generation and checking, the verification of pending issues, the execution of tasks and the management of project workflow. As projects advance through the stages, they are discussed in increasing detail and demand significantly greater financial investment. In the first stage, a preliminary business plan is outlined in an internal process known as a mini business case.	Drucker (1986), Scherer e Carlomagno (2009), Tidd e Bessant (2015)

Source: Prepared by the authors based on survey data.

Final Considerations

For Braskem, the aim of innovation is to attend to client needs and use experience and knowledge to propose solutions which increase the quality of the products offered to society (BRASKEM, 2011). With that in mind,

the company has implemented an open innovation model and established an interface with technological innovation centers, universities and research agencies in Brazil and overseas. These partnerships have allowed the company to anticipate market tendencies and opportunities, and stimulate new ideas and innovation.

Its innovation management strategy involves the use of a project management software program developed specifically for this purpose. The software in question assesses each project individually according to an innovation funnel model, classifying ideas according to their technical viability, strategic adequacy and market attractiveness scores.

According to our theoretical considerations, the company's method of innovation management appears to be able to involve all employees and homogenize the process in question. The need for such a strategy arose from the need for organizational restructuring which followed the incorporation of new companies into Braskem through fusion and acquisition. Main contributions of the study, it is evident the advantages of the triple helix model and methods aimed at encouraging internal innovation, as suggestions of employees and their selection using established scientific methods.

The limitation of the present study consists in restricted access to company information and the use only of a method of investigation, so, single case study with a qualitative approach, which prevents the generalizing these results, which are limited to the setting investigated in the present study.

References

AGÊNCIA BRASILEIRA DE DESENVOLVIMENTO INDUSTRIAL. Abdi. *Estudos setoriais de inovação*. Belo Horizonte, 2009. Disponível em: <<http://www.abdi.com.br/Estudo/Relat%C3%B3rio%20Complexos%20Industriais%20Ligados%20%C3%A0%20Energia.pdf>>. Acesso em: 3 jun. 2012.

ASSOCIAÇÃO NACIONAL DE PESQUISA, DESENVOLVIMENTO E ENGENHARIA DAS EMPRESAS INOVADORAS. Anpei. *Inovação tecnológica no Brasil: a indústria em busca da competitividade global*. São Paulo, 2006. Disponível em: <http://anpei.isat.com.br/wp-content/uploads/2008/08/estudo_anpei_2006.pdf>. Acesso em: 3 jun. 2012.

AEBERHARD, J.; SCHREIER, T. Ein erprobtes Verfahren zur Generierung und Beurteilung von Produktideen. *Management Von Innovationsprozessen*. 2001. Disponível em: <<http://www.innopool.ch/pdf/I-Ae-Schr-01-Innoprozesse.pdf>>. Acesso em: 25 nov. 2015.

BOEDDRICH, H. J. Ideas in the workplace: a new approach towards organizing the fuzzy front end of the innovation process. *Creativity and Innovation Management*, v. 13, n. 4, p. 274-285, 2004.

BRABANDERE, L. *O lado oculto das mudanças: a verdadeira inovação requer mudança de percepções*. Rio de Janeiro: Elsevier, 2006.

BRASKEM. *Relatório Anual*. São Paulo, 2011. Disponível em: <<http://rao2011.braskem.com.br/default.asp?topico=17>>. Acesso em: 17 aug. 2012.

_____. Disponível em: <<http://www.braskem.com.br>>. Acesso em: 21 aug. 2014.

CHESBROUGH, H. W.; VANHAVERBEKE, W.; WEST, J. *New Frontiers in Open Innovation*. USA: Oxford University Press, 2015.

COOPER, R. G. *Product Leadership*. Nova York: Basic Books, 2005.

DANELL, R.; PERSSON, O. Regional R&D activities and interactions in the Swedish Triple Helix, *Scientometrics*, vol. 58, n. 2, p. 203-218, 2003.

DAVILA T.; EPSTEIN M. J.; SHELTON R. *Making innovation work: how to manage it, measure it, and profit from it*. Upper Saddle River, NJ: FT Press, 2012.

DRUCKER, P. F. *Inovação e espírito empreendedor: prática e princípios*. São Paulo: Pioneira Thomson, 1986.

ETZKOWITZ, H.; LEYDESDORFF, L. The dynamics of innovation: from National Systems and 'Mode 2' to a Triple Helix of university-industry-government relations. *Research Policy*, vol. 29, n. 2, p. 109-123, 2000.

GUIMARÃES, S. K. Produção do conhecimento científico e inovação: desafios do novo padrão de desenvolvimento. *Cad. CRH*, Salvador, vol. 24, n. 63, 2011.

KELLEY, T.; LITTMAN, J. *The Ten Faces of Innovation: IDEO's Strategies for Defeating the Devil's Advocate and Driving Creativity Through out Your Organization*. Nova York: Currency/Doubleday, 2005.

LAKATOS, E. M.; MARCONI, M. A. *Metodologia científica: ciência e conhecimento científico; métodos científicos; teoria, hipótese e variáveis; metodologia jurídica*. 6. ed. São Paulo, SP: Atlas, 2011.

MATTOS, J. R. L.; GUIMARÃES, L. S. *Gestão da tecnologia e inovação: uma abordagem prática*. São Paulo, SP: Saraiva, 2005.

MILLER, L. W.; MORRIS, L. *Fourth Generation R&D: Managing Knowledge, Technology and Innovation*. Nova York: John Wiley & Sons, 1999.

PORTER, M. E. *Vantagem competitiva: criando e sustentando um desempenho superior*. Rio de Janeiro: Elsevier, 1989.

POLKINGHORNE, D. Validity issues in narrative research. *Qualitative Inquiry*, v. 13, n. 4, p. 471-486, 2007.

ROESCH, S. M. A. *Projetos de estágios e de pesquisa em administração: guia para estágios, trabalhos de conclusão, dissertações e estudo de caso*. 3. ed. São Paulo: Atlas, 2005.

ROUSSEL, P. A.; SAAD, K. N.; BOHLIN, N. *Pesquisa & desenvolvimento: como integrar P&D ao plano estratégico e operacional das empresas como fator de produtividade e competitividade*. São Paulo, SP: Makron Books, McGraw-Hill, 1992.

ROTHWELL R. Towards the fifth-generation innovation process. *International Marketing Review*, v. 11, n. 7, p. 7-31, 1994.

SANTOS, M. E. R.; MELLO, J. M. C. (Organizadores). *Seminário Hélice Tríplice na América Latina: Conhecimento para a inovação*. Anais eletrônicos. Dados eletrônicos. Porto Alegre: EDIPUCRS, 2010. 240.

SCHERER, F. O.; CARLOMAGNO, M. S. *Gestão da inovação na prática: como aplicar conceitos e ferramentas para alavancar a inovação*. São Paulo: Atlas, 2009.

SCHUMPETER, J. A. *Teoria do desenvolvimento econômico: uma investigação sobre lucros, capital, crédito, juro e o ciclo econômico*. São Paulo: Abril Cultural, 1982.

SPECHT, G. Kompetenz im Innovations management. *F&E Management*. Stuttgart: Schäffer-Poeschel, 2002.

STENMARK, D. The Role of Intrinsic Motivation when Managing Creative Work. In: *Proceedings of ICMIT*, Singapore, p. 310-315, 2000.

SOMECH, A.; Drach-Zahavy, A. Translating Team Creativity to Innovation Implementation: The Role of Team Composition and Climate for Innovation. *Journal of Management*, v. 39, n. 3, p. 684-708, 2013.

TIDD, J.; BESSANT, J. *Gestão da inovação*. 5. ed. Porto Alegre: Bookman, 2015.

VAN de VRANDE V.; VANHAVERBEKE W.; GASSMANN O. Broadening the Scope of Open Innovation: Past Research, Current State and Future Direction. *International Journal of Technology Management*, v. 52, n. 3, p. 221-235, 2010.

VOIGT, K. I.; BREM, A. Integration of market pull and technology push in the corporate front end and innovation management – Insights from the German software industry. *Technovation*, vol. 29, p. 351-367, 2009.

YIN, R. *Estudo de caso: planejamento e métodos*. 4. ed. Porto Alegre: Bookman, 2010.

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