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EXTERNAL SOURCES OF TECHNOLOGY: THE CASE OF A RED CERAMIC INDUSTRY

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ABSTRACT

Competitiveness is one of the main issues in business nowadays. The entrepreneur's economic environment requires the ability to leverage the productive resources available. This paper aims to study the stage of identifying external sources of technological information in a red ceramic industry. Initially, we made a comprehensive review of the literature about strategy, management and sources of technology. In addition, we made a contextualization of the ceramic sector in Brazil. Then, we applied a case study in a red ceramic industry in the state of Piauí through an interview with one of the directors of the company and the quality manager. The study of this case can be classified as exploratory because it increased the understanding on the phenomenon studied. The literature review indicated the existence of low technology content in the ceramic industry in Brazil. The sector of red ceramic industry is

not very dynamic with regard to the development of new products. However, the company studied seeks to improve the quality of the products offered and develop new processes, not only through incremental changes, but also through innovative projects. In order to be successful, the company systematizes the management of external sources of technological information.

Keywords: Technology content, Technology strategy, Sources of technology, Ceramics industry.

RESUMO

A competitividade é uma das grandes questões empresariais na atualidade. O ambiente econômico exige do empresário capacidade de potencializar os recursos produtivos de que dispõe. Esta pesquisa tem como objetivo estudar a etapa de identificação de fontes externas de informação tecnológica em uma indústria de cerâmica vermelha. Inicialmente foi feita uma revisão abrangente da literatura sobre estratégia, gestão e fontes tecnológicas. Adicionalmente, fez-se uma contextualização do setor cerâmico no Brasil. A seguir, foi aplicado um estudo de caso em uma indústria de cerâmica vermelha no estado do Piauí por meio de uma entrevista com um dos diretores da empresa e com a gerente de qualidade. O estudo deste caso pode ser classificado como exploratório, pois aumentou a compreensão do fenômeno estudado. A revisão da literatura indicou a existência de baixa densidade tecnológica no setor cerâmico no Brasil. O setor da indústria de cerâmica vermelha é pouco dinâmico no que diz respeito ao desenvolvimento de novos produtos. Porém, na empresa pesquisada, há uma procura em melhorar a qualidade dos produtos ofertados e em desenvolver novos processos, não somente por meio de mudanças incrementais, mas também por meio de projetos inovadores. Para obter sucesso

nesta procura, a empresa sistematiza a gestão de fontes externas de informação tecnológica.

Palavras-chave: Densidade tecnológica. Estratégia tecnológica. Fontes tecnológicas. Indústria de cerâmica.

1 INTRODUCTION

The market opening and the generation of new monetary policies transformed the Brazilian economy, requiring business actions aimed at the longevity of the companies. This new economic environment, which puts the search for competitiveness as necessary for the survival of the company in the long run, requires a more dynamic and responsive attitude to these changes from the entrepreneur, and especially the ability to manage and enhance their productive resources.

Therefore, it is essential to adopt business practices, and the management of innovation is one of the most important for the business success, which puts technology as one of the main competitive strategies. To guide this process, companies use sources of technological information, aiming to improve their technological routes. Kruglianskas (1996) points that companies need to be attentive to sources of innovation, whether internal or external to the organization.

Among them are suppliers, clients, competitors, companies in other sectors, the company's employees, the works produced in other institutions such as universities and/or research centers, among others. These sources can be found in the internal inspiration of one or more people, in the networking with external organizations, in the offers of technology licensors, in visits to trade fairs, in the participation in seminars and events, in the exchange with corporate and social associations, in technical visits to other companies, as well as in technical and marketing publications.

Sources of technological information, besides assuming an increasing importance to the corporate competitiveness, since they help to better define the company's technology strategy, are currently an emerging topic in academia (Gomes & Kruglianskas, 2005).

Thus, this paper intends to study the stage of identification and decision on the external sources of technological information, focusing on the practices adopted by a company in the red ceramic industry, located in the state of Piauí.

2 RESEARCH PROBLEM AND OBJECTIVE

The use of internal sources of technological information, traditionally explored, gives way to the use of external sources, despite the fact that it is not a new subject in the overall business activity. The novelty lies in the management of these sources and in the importance that the displacement from the internal to the external focus takes in the current business and technological context.

Despite the growth of the innovation activity, companies do not have a specific strategy to guide their management. Few companies have a strategy defined and few manage in an integrated and systematized manner the various sources of technological information to obtain more significant results.

The purpose of this paper is to study the stage of identification and decision on the external sources of technological information of a red ceramic industry in the state of Piauí. The details of the main objective allow the establishment of the following specific objectives:

- identify the company's technology strategy;
- Identify the external sources of technological information used by the company;

- present the criteria for identifying the external sources of technological information;
- analyze the relationship between technology strategy x external sources of technological information;
- analyze the decision to use the external sources of technological information used by the company.

3 THEORETICAL FRAMEWORK

The theoretical framework of this study aims at the conceptual understanding of the topics that support the clarification of the research problem.

3.1 TECHNOLOGY STRATEGY

For an organization, obtaining a competitive advantage results from the identification of the needs of a new market or the application of a new technology; thus, companies that have greater agility and aggressiveness to explore market opportunities stand out. However, according to Hamel and Prahalad (2001) few competitive advantages are durable, unless companies define strategies, that is, means to achieve their goals and objectives.

Strategies are seen as capable not only of providing market leadership to successful companies, but also of changing the market structures, even if they do not change their basic oligopolistic characteristic. The business strategy is understood as the pattern of decisions in a company that determines and reveals its objectives, intentions or goals, produces the main policies and plans for achieving these goals and sets the business scale in which the company must be involved. Among the business strategies, the technology element started being emphasized.

In the light of strategic thinking, technology is the means to achieve strategic goals, but it can also be the main strategy. The technology

strategy of a company not only directs the development and use of technology, but it also guides the company in the acquisition, development and application of the technological capability to achieve competitive advantage (Porter, 1989).

The adoption of any competitive strategy involves risks. Porter (1980) lists two of them. The first is to fail in achieving or sustaining the strategy. The second refers to the value of the strategic advantage to be worn with the evolution of the industry. Porter (1980, cited by Jussani, 2009, p. 42) says that it is important to make risks explicit in order to improve the company's choice between the three alternatives of generic strategies: cost leadership, differentiation and focus.

Thus, the main risks in the cost leadership strategy are: excessive reliance on manufacturing; the possibility of ending any chance of differentiation; the difficulty of establishing a cost control criterion; the emergence of a new competitor with a new technology, a new process that conquers a significant portion of the market; or the market starts to value the product through different criteria (Porter, 1980).

In the differentiation strategy, the main pitfalls are represented by the excessive differentiation between low-cost competitors and the company, causing difficulty for buyers to remain loyal to the brand; the buyers' need for the differentiating factor falls as buyers become more sophisticated; imitation narrows perceived differentiation, a common occurrence as industries mature (Porter, 1980).

In focus strategy, the risks are: the differences in desired products or services between the strategic target and the market narrow; competitors find submarkets within the strategic target of the company; the cost differential between broad-range competitors and companies that have adopted particular focus widens to eliminate the low cost advantages and the differentiation advantages achieved by focus (Porter, 1980).

3.2 TECHNOLOGY MANAGEMENT

Effective management is performed through the organization of routines, the definition of the strategic direction, the effective communication and the integration of efforts from the various teams involved. The company's strategies are defined from its objectives and the analysis of the internal and external environments. Figure 1 shows how the management of external sources of technology occurs.

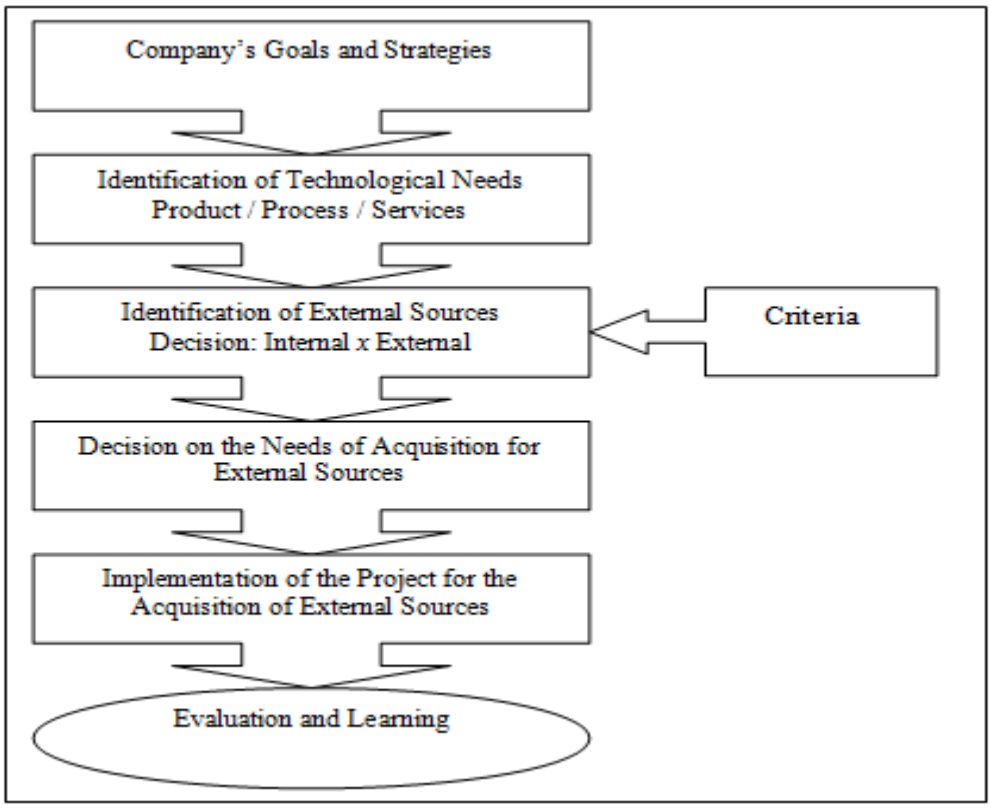

Figure 1: Management of external sources of technology
Source: Adapted from Vasconcellos (2006)

In the first stage – identification of sources of technological information and/or modalities of access to technology –, we seek to identify and coordinate the opportunities to ensure they are used effectively and systematically. In the stage of deciding which source to use, the company's needs are defined in relation to the use of external sources of information,

through criteria set by the company. Finally, we implement the project and the management of the sources occurs.

The technological factor, as well as its increasingly intense use by the industries, is present both in organizations that intend to be leaders in their business segments, and in the others, followers, or who wish to excel in a competitive market (Souza & Kruglianskas, 1994). The strategic orientation of the organization will guide the importance of the technological capability of the company, determining the emphasis and investments in Research & Development (R&D). R&D managers should seek to work seamlessly with other sectors of the company, as they will be the "connecting point for the identification and implementation of other changes" (Souza & Kruglianskas, 1994).

The company must manage this complex process, which requires a rigorous attention to the correct definition of which technologies to adopt as a competitive differential for the company. The technology management of a company can be briefly characterized as follows (Souza & Kruglianskas, 1994):

- strategic processes - insertion of technology planning in strategic planning, strategies for the acquisition of technology and the definition of priorities on research and areas to serve.

- tactical processes - identification and assessment of technological advances and identification of the competitive position.

Table 1 provides an integrated view of the process. Column 1 indicates the external sources of technology; column 2 indicates the mechanisms of acquisition of technology; column 3 indicates the ways for a better technology control within the firm; and column 4 indicates the various ways in which these technologies can be absorbed and transformed into competitive advantage for the company.

EXTERNAL SOURCES OF TECHNOLOGY	MECHANISMS FOR THE ACQUISITION OF EXTERNAL TECHNOLOGY	COMPANY	INCREASE OF COMPETITIVENESS
• Universities • Research Institutes • Clients • Suppliers • Competitors • Labor Market • Patent Database • Etc.	• Licensing • Joint Venture / Alliance • Research Consortium • Research Contracting • Acquisition of Company • Hiring of People • Purchase Equipment and Supplies • Copies • Etc.	• Technology Strategy / Audit • Structure of the Technological Function • Incorporation of Innovations • Assessment of the Technological Function • Internal R&D&E • Marketing • HR • Production • Finance	• New Products • New Services • Improvements to Current Products and Services • Cost Reduction • Patents

Table 1: Technology management in the company – integrated view
Source: Adapted from Vasconcellos (2006)

This paper will focus not only on external sources of technological information, but also on the mechanisms for the acquisition of external technology for the company to remain competitive in the market in which it operates, that is, the red ceramic industry.

3.3 SOURCES OF TECHNOLOGY

Within the technology management process, the company needs to try to select sources of innovation that will allow it to identify technologies that make or maintain it competitive and ensure its long-term survival. This can be done through applications that correspond to the consumers' needs. Despite being one of the major challenges within organizations, it is only after this stage that it becomes possible to prioritize or establish processes that increase the efficiency of these sources, aiming at better results and the company's competitiveness in the long run.

Innovation may result from technological research and developments held within the companies (R&D), new combinations of existing technologies, the application of existing technologies in new uses or the use of new knowledge acquired by the company (Pintec, 2005). The process of innovation within a company is driven both by technological stimuli and

market incentives. But how to obtain relevant information for the company based on these incentives?

The technological capability is one of the incentives that can be developed internally, through investments in human resources, equipment, laboratories and methodologies or advanced development projects. Technology can also be obtained outside the company through research contracts with universities, joint ventures, licensing or the purchase of technology packages. External forces do not produce innovation; they only generate the conditions for innovation and push the company to innovate. Therefore, the formation of alliances and technological cooperation are key aspects for the management of innovation opportunities in R&D.

Several studies have sought to identify sources of information for the generation of organizational innovation. In a study conducted by Hartman *et al.* (1994), sources of innovation were identified, such as the observation of the customers need; problems of products, services and processes; competitors; interaction with suppliers, with family and friends, with the organization's employees and trainees; reading of newspapers and magazines; publications; government; reflection on mistakes; personal imagination.

Another research that sought to identify the various existing sources of information was the Economic Activity Survey in the state of São Paulo - PEAP (1996) presented in the article of Gomes and Kruglianskas (2005), which identified the following sources: department of R&D, suppliers, clients, competitors, universities, research institutes, patent licenses and trademarks and trade fairs and exhibitions. The most used were: clients, suppliers, competitors and department of R&D. This same survey indicated the low level of interaction between universities and research institutes (Gomes & Kruglianskas, 2005).

São Paulo Research Foundation (FAPESP, 2005, quoted by Sbragia, 2006) indicates that all these sources of innovation mentioned above can be grouped into four distinct groups:

1. sources within the company: sources from the various departments of the company, with special mention to the departments of R&D, Engineering and Marketing.

2. sources related to markets for inputs and products in which the company operates: suppliers, clients, competitors, acquisition of equipment and reverse engineering of competitors' products.

3. public sources: articles published in scientific journals, theses, fairs and exhibitions, scientific conferences.

4. other sources: sources of transactions with companies, which may be predominantly public (universities, research institutes and training centers) or private (consulting firms and companies for patent licensing and acquisition of know-how).

In the same survey, FAPESP (2005, cited by Sbragia, 2006) listed the sources of innovation both with the industry in which companies operate, and with the size of the company. The result shows that the sectors that showed, on average, a greater use of sources of innovation were Instrumentation, Chemical, Automotive, Machinery and Electrical Materials, where clients are their most important sources of innovation. At the other extreme are industries that manufacture of Rubber and Plastic Products, Metal Products and Textiles, where suppliers are the main sources of information.

It is worth it to point out that fairs and exhibitions have a great relevance to both extremes. Whereas universities and research institutes are not significant sources in the innovation process for a significant majority of the industrial sectors, with the exception of Instrumentation, Chemical and Basic Metallurgy. Regarding the size of the company, it can be seen that the larger the size of the company, the greater the diversity in the use of sources of innovation.

Fleury and Fleury (1997) conducted a study with 18 leading companies in different sectors in the state of São Paulo, which analyzed the importance that these companies applied on sources of information. It was identified that this process is extremely important to better characterize the process of technological innovation in the company.

The survey indicates that the leading companies heavily rely on publications, which characterizes not only the search for standardized solutions, but also for innovation through visits and consultancies. The search for the first shows a process of change, as companies must adapt what they have learned to their reality. In the second option, it shows the need for synergy between the companies, in a mutual learning process.

Thus, it is clear that the high-tech sectors are those that prioritize the external sources of technology, significantly using not only the internal department of R&D and the information obtained from clients, but also fairs and exhibitions. A small portion of these companies also seeks to establish closer relationships with universities and research institutes. On the other hand, the sectors with low technology content seek to use the following external sources for technology: suppliers and fairs and exhibitions.

One of the main ways of establishing relationships is through cooperation, that is, the desire to avoid the duplication of research efforts, to share fixed costs and achieve economies of scale in R&D, update the know-how on the existing advanced technologies, gain access to complementary knowledge and to new technologies. As the main cooperation partners, Tidd, Bessant and Pavitt (1999) mention universities, research consortia, licensing, consumers and suppliers, acquisition of companies and internal transfer within the company (research laboratories and R&D division).

4 METHODOLOGY

According to Yin (2005, p. 22), the essence of the case study is "the attempt to illuminate a decision or set of decisions: why they were taken,

how they were implemented and with what result." The choice of using the case study should occur when it requires the analysis of contemporary events, on situations where relevant behaviors can not be manipulated, but only allow making direct observations and systematic interviews. Questions such as "how" and "why" stimulate the use of case study, experiments or historical research. The method, as described by the author, still indicates characteristics such as the no requirement for control over behavioral events and the primary focus on contemporary events. These assumptions support the decision to adopt the case study methodology.

The case study in this work can be classified as exploratory, because it seeks to increase the slight understanding on the phenomenon studied (Yin, 2005).

In the aspect relating to the primary research data, we conducted two interviews, one with one of the founders of the company and the other with the quality manager, who has been working in the industry for 10 years. Each interview lasted approximately two hours and they were conducted on the premises of the company in Teresina. Secondary data were obtained from the Internet, specialized magazines in the sector, scientific articles and a dissertation on the subject.

5 CERAMIC INDUSTRY BACKGROUND

In Brazil, the ceramic industry accounts for approximately 1.0% of the Gross Domestic Product (GDP). The segments that comprise it are distinguished by the products obtained and more precisely by the markets where they are involved, which are listed in Table 2.

Segment	Production Value (1,000 US$ / Year)
Structural Ceramics (Red)	2,500,000
Coatings (floor and wall tiles)	1,700,000

Natural Raw Materials	750,000
Refractories	380,000
Technical, Special, Other Ceramics	300,000
Toilets	200,000
Tableware and Adornment	148,000
Frits, Varnishes and Dyes	140,000
Synthetic Raw Materials	70,000
Electrical Ceramics	60,000
Equipment for Ceramics	25,000
Abrasives	20,000
Total	**6,293,000**

Table 2: Production value of each segment
Source: Bustamante and Bressani (2000)

The segment studied, the red ceramic industry, has a great importance for the country, as it is a background activity that enables the construction, through the production of hollow bricks, solid bricks, slabs or flagstones, sealing and structural blocks, tiles, shackles and rustic floors. The industries, approximately 5,500 (Anicer, 2007), are all over the country, spread out in micro and small enterprises, often with a simple and familiar organization. In addition, these companies have a fragile financial structure, which makes them dependent on market fluctuations, especially in civil construction (Mafra, 1999).

Monthly, approximately four billion blocks and bricks, and about 1.3 billion ceramic tiles are produced in the sector, generating a consumption of more than 10 million tons of clay, its main raw material (Anicer, 2007) and it generates 400 thousand direct jobs. The pieces not only supply the regional markets, but they can also be found in the neighboring countries of Brazil and other countries who know the Brazilian red ceramic. Many factories already export their tiles to Europe, South America and Africa.

A survey held by the National Industrial Training Service - Regional Department of Piauí (Senai-DR/PI), in 1998, indicated that in the state of Piauí there are 38 companies in the industry that have a monthly production of 30 million pieces, with 25 million sealing bricks and five million tiles; they use, on average, 81 tons of clay per month and thus provide 2,000 direct jobs.

In order to remain competitive, the red ceramic industries are looking for increasingly efficient ways of survival, starting with the organization of the companies, the adoption of quality programs, either by certifying their product and/or production process, or by implementing improvements capable of driving the increase of competitiveness. As a result, programs such as the QSP (Quality Sector Program) were created, aiming to ensure the implementation of specific mechanisms to combat non-compliance in the manufacture of products in the ceramic sector.

Below we present a case study of a red ceramic industry located in the state of Piauí, Northeastern of Brazil.

6 THE CASE OF A RED CERAMIC INDUSTRY

Based on the conceptual basis of reference, we analyzed a company in the red ceramic segment, named here as Alfa. The fictitious name was used to maintain the confidentiality of information.

The company originated in Teresina, capital of Piauí, started its operations in 1979, motivated by the need to serve the contractor belonging to the group with tiles and bricks. The strong performance of the group, offering materials of excellent quality and wide acceptance in the domestic market and other regions, stimulated the decision making process for new investments in the ceramic sector and the subsequent installation of other industries.

With the knowledge gained through practice, in courses, exhibitions, events, specialized magazines and technical visits to companies that already had the know-how, and through informal surveys conducted by the company, the opportunity to develop its market was noticed. Then, Alfa started producing a new line of products, the pressed tiles, in 2005. Until that moment, these products had not been previously developed by other companies in the state of Piauí. The production line of the company is innovative, consisting of machinery and equipment that were not used by

other companies in the North and Northeast regions of Brazil. Figure 2 shows the production process phases involving technology in the new company.

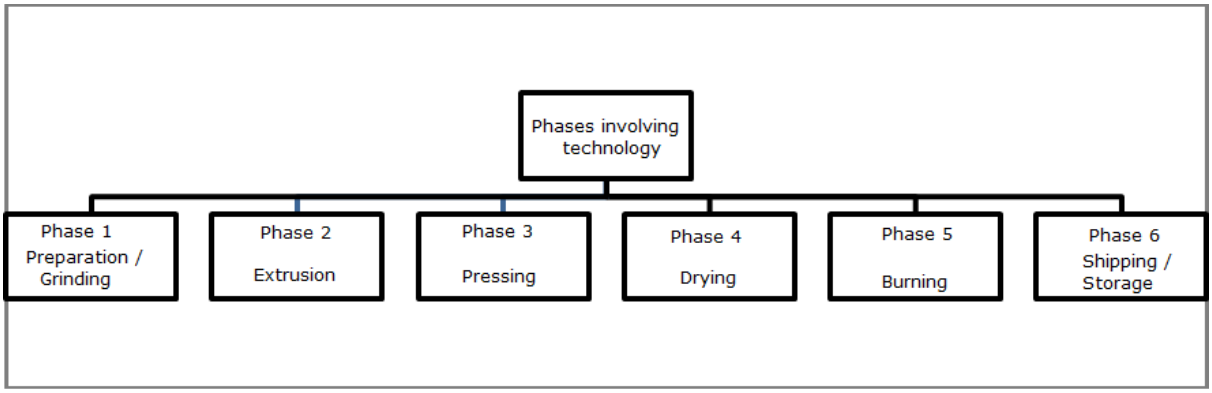

Figure 2: Production Process of Alfa
Source: Alfa

According to Kruglianskas (1996), "the knowledge possessed by a company that does not contribute for it to act competitively should not be regarded as 'technology'." The strategic technologies are those that are essential for the business success, even if the change is not unprecedented in terms of universal knowledge, but is being adopted for the first time by the company.

An example of key technology at Alfa is the grinding process (Figure 2, Phase 1), used by few companies in Brazil and until then by no other red ceramic industry in the North and Northeast regions. This process prepares the clay and grants a differential to the whole production system, allowing a higher quality in the pressing, drying and burning processes, thus achieving a high quality production. Another example is the pressing process (Figure 2, Phase 3), phase in which the mass is processed into tiles. The burning process (Figure 2, Phase 5) is also considered by the company as a key technology. In this case, the furnace was developed by an Italian consultant, specialized in the development of furnaces, with a modern technology that provided a 30% reduction in the monthly use of fuelwood.

In view of what was presented, it can be seen that the company applies a differentiation strategy (Porter, 1989), making use of new technologies with the purpose to offer products of superior quality. This differentiation does not allow it to offer low-cost products, nor does it make the company place itself at a great distance from low-cost competitors, but it allows a position in which buyers remain loyal to the brand.

Another risk that the company could take is the issue of product imitation, which would reduce the difference perceived; but for this to be possible, competitors will have to acquire technology and similar raw material. However, Alfa informed that it has a new differentiation strategy to face the approximation of potential competitors, thus proving Porter's model (1989).

For acquisition of these key technologies, there is a stream of innovation, but it is not very well defined, which follows three basic steps. In the first, the main technological goals of the company are defined, looking for innovations in products, processes and materials. In the second step, the process of identification of the possible sources of technology begins. If there is no technology available within the company, it defines ways to gain knowledge and information from external sources of innovation. In the last step, the results are presented based on the provision of technology. This process is performed by the company's technical team, especially by the directors.

In the company's mission, it is possible to notice its concern with technology: "Our mission is to develop, produce and sell materials intended for construction, with appropriate technology and superior quality, aiming to meet new clients and partners, contributing to the increase of productivity and construction safety, respecting the Human Being, Society and the Environment." However, the company does not have a technology strategy set, or a technology plan.

Over the past five years, the company demonstrated to have given priority to strategies for the development of new products, new product lines, new organizational models, production capacity expansion, new production processes and more aggressive marketing strategies. However, it has devoted little importance to strategies focused on Research, Development and Engineering (R&D&E).

6.1 SOURCES OF TECHNOLOGY

Based on its strategy, the company could define more accurately the external sources of technological information that it could use. However, before presenting the sources used by the company studied, it is necessary to identify the modalities of access to technology.

6.1.1 Modalities of access to technology

Table 3 presents the modalities of access to technology most used by Alfa.

Modalities of Access	Alfa
Purchases by specification	X
Partnership with suppliers	X
Universities	
Hiring of consultants	X
Partnership with other companies	X
Special interest forums	X
Subcontracting	
Purchases by catalog	X
Partnership with competitors	
Acquisition of license	
Venture capital	
Investment of venture capital	

Consortium of companies	
Licensing	
Joint Venture	
Acquisition of companies	
Acquisition of patents	
Subcontracted R&D	
Cooperation networks	X
Strategic alliance	X

Table 3: Modalities of access to technology
Source: Adapted from Gomes (2007)

The purchase by specification is widely used by the company due to the possibility of adapting the technology to previously established standards, which provides an improvement in product quality. Partnerships with other companies, hiring of consultants and special interest forums are also widely used. The purchases by catalog are still widely used by the company, but only for processes and products with lower influence in the differential of the final product, which demonstrates a level of maturity of the company in selecting the type of modality that should be used in every situation.

The modalities consortium with companies, partnership with competitors and cooperation networks are not used by the company, which confirms the limited use of these modalities in the market as a whole, as shown by Gomes (2007). Some modalities - such as venture capital, joint venture, investment of venture capital, among others - are not present on the day to day of the company due to the lack of knowledge about their benefits and risks.

Gomes (2007) indicates in his research that smaller and larger companies use the same modalities, which does not happen in the case of the company studied, which does not use joint venture, subcontracting,

acquisition of companies, patents and licenses or the consortium of companies. The common modalities are purchases by specification, partnership with other companies and suppliers.

6.1.2 External sources of technological information

There are several sources used by Alfa for different objectives. The acquisition of technology is the most common practice, as can be observed with the acquisition of the dry grinding process. The company got to know this technology during a technical visit to another red ceramic industry, a competitor located in the state of São Paulo. The manufacturer of the equipment provided a trip to Ceramitec, world's largest ceramic fair, held in Italy, which is also the location of its headquarters, where its technicians had the opportunity to know in detail the equipment and have opted to purchase this set. The source used in this case were visits to other companies (Table 4), which can reflect a profile of search for standardized solutions.

Another source frequently used by Alfa was fairs and exhibitions, which reinforces the demand for standardized solutions. The acquisition of the presses by the company studied took place during a fair held in São Paulo, where the company's technicians had the opportunity to visit the manufacturers and get to know the equipment in operation. It is worth noting that these are the first automatic presses installed in the North and Northeast regions of Brazil. This shows the importance that companies assign to the participation in events of technical-scientific nature and the participation in associations, as presented in the survey conducted by Gomes (2007).

Given the aforementioned acquisitions, it is already possible to notice some of the sources used by the company, such as technical visits and trade fairs and exhibitions; however, there are still a large number of external sources of technological information used by this company. Table 4 presents the most commonly sources used by Alfa.

External Sources of Technological Information	Company
1. Acquisition of technology	
Suppliers	X
Clients	X
Competitors	X
Licensing	
Commercial laboratories	X
Outsourcing	
Acquisition of companies	
2. Investment in technology	
Strategic alliances	X
3. Development of technology in partnership	
Universities and educational institutes	X
Government research organizations	
Other public and private institutes	
Private research institutes	X
Partnership with competitors	
Partnership with suppliers	X
4. Use of community sources	
Leading users	
Community Networks	
Community of practices	
5. Acquisition of external resources	
Hiring of external talents	X
Consulting firms	X
6. Miscellaneous	

Scientific and professional conferences	X
Scientific, business and professional associations	X
Trade fairs and exhibitions	X
Technical and scientific publications	X
On-line databases	
Visits to other companies of the group	X
Visits to other companies or licensors	X
Networking (scientists and engineers from other organizations)	X

Table 4: External sources of technological information
Source: Adapted from Gomes and Kruglianskas (2005)

The company seeks to acquire technology through various external sources. With regard to the acquisition of technology, the following sources stand out: suppliers, competitors and commercial laboratories. Strategic alliances are held for the development of projects in partnership with universities and educational institutes, private research institutes and suppliers. The acquisition of external resources is accomplished through the hiring of external talents and consulting firms. The following sources are also used: professional and scientific conferences; scientific, business and professional associations; trade fairs and exhibitions; technical and scientific publications; visits to other companies of the group; visits to other companies and networking.

The research confirms that low-tech firms use more often the source "suppliers", while high-tech companies make more use of the source "universities and research institutes." Moreover, it also confirms that trade fairs and exhibitions are essential for the generation of innovation within all types of companies, high tech or not.

Another source frequently used by the company studied is the technical visit to other companies, which is characterized as a process of

search for change, due to the need to adapt to the technology found in the competition. It also makes an intense use of the source "magazine articles", which leads to the search for standardized solutions.

Given the sector in which the company operates, the industry of construction materials, and the company's size, small, the management of external sources of innovation appeared to be poorly formalized. The company does not have an explicit management of external sources for innovation, but it has consciousness for identifying new technologies. Without a clear and well defined technology strategy, the management of this process becomes less efficient and reduces the possibilities for a more efficient use of the sources.

Two determining factors for the development of technological strategies were identified in the company studied, and the link between innovation and the market was identified as one of the flaws of its process, because the company did not perform a structured research of the new market where it was going to operate, that is, it did not use the source "clients", one of the most used by the leading companies in the market (Fleury & Fleury, 1997).

The search for technological sources takes place according to the needs of each development project and to the clients needs, involving a large number of sources. According to the study of Gomes (2007), the sources that are most used by smaller companies are: other companies of the group, suppliers, consumers, consulting firms and independent consultants, hiring of external talents, R&D of other companies, contractors and outsourced companies, universities and higher education centers and research institutes, professional training centers, community networks, communities of practice and networking, which is confirmed by the survey conducted in this paper. However, the most used source is trade fairs and exhibitions, both by large and small companies (Gomes, 2007).

7 CONCLUSION

The sector of red ceramic industry is not very dynamic with regard to the development of new products. However, in the company studied in this paper, there is a strong demand not only for developing new processes that provide some level of automation, but also for improving the quality of the products offered.

The purpose of this paper was to study one of the stages of the process of managing external sources of technological information, the stage of identification and decision (Figure 1) of a red ceramic industry in the state of Piauí.

The company surveyed stands out in its market, as it seeks to continuously improve its production process, not only through incremental changes, but also through innovative projects, at the state and regional level. It uses the differentiation strategy, focusing on improving the production process. However, there are limitations in the study, since only one case was studied, making it impossible to generalize the findings.

Thus, it was clear that the company is aware of the importance of a proper management of the external sources of innovation, but it has no organizational structure responsible for this activity. This role falls mainly to directors and managers, because they are people who are in direct contact with the modalities of access and with the external sources of technological information. Sbragia (2006) suggests a possible explanation for this situation, "because they are institutions with completely different philosophies, cultures and goals, the interaction really needs to be well managed in order to produce results."

The conclusion of the study revealed the existence of a correlation between the management of external sources of technological information and the innovative performance of the company studied. It was possible to conclude that the company, despite belonging to a low-tech sector, needs a

systematic way for the management of the external sources of technological information to leverage the innovative efforts.

It was found that the company - despite not having a technology planning defined, not using a wide variety of external sources of technological information or having a formalized structure - has consciousness for innovation, which allows it to identify and carefully define the source that will be used for each context (Table 3), taking into account the costs involved in the process, the quality and image that is associated with a particular source and the expertise of the company when entering a new market or niche.

It can be concluded that, although the sector has low technology content, there are initiatives that demonstrate the need for better structuring the process of managing the sources of technology, which can provide an improved process for identifying and defining which source is the most appropriate for each situation.

As a suggestion for future studies, in order to allow the improvement of the process, it is necessary to conduct this same research with a larger number of companies.

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