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# Prospecting of Opportunities in Innovation Networks for Technology Transfer

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**Abstract.** Studies present the importance of networks for SMEs, but few of them show the opportunities for technology transfer. The paper systematizes the goals that involve innovation networks as tools for prospecting opportunities for technology transfer in SMEs. It was conducted a case study in a high-tech company located in the state of São Paulo - Brazil. The goals were organized based on the objective model of the EKD (Enterprise Knowledge Development) methodology. As a result, it was possible to identify the problems, causes, constraints and opportunities influencing the environment and the collaboration. The paper contributes to future research to improve the network management.

**Keywords:** Prospecting of opportunities. Innovation networks. Technology transfer.

## 1 Introduction

The discussion on Collaborative Networks Organizations (CNO) has been gaining attention in the literature because of the importance that this phenomenon has presented the experiences of socioeconomic development in many countries over recent decades. This phenomenon is justified due to shorter development cycles, product research, requiring universities, research centers, businesses, government agencies and professionals, greater dynamism and flexibility in the production of goods and services. So, the term collaborative networks have been used to describe an alliance consisting of geographically distributed and heterogeneous agents in relation to their operating environments, cultural capital, but who see in collaborative work, a way to increase revenue, competitiveness, and share resources and knowledge [1].

Thus, innovation becomes a differential, which can ensure standards and rules that only later other companies should take in order to participate in the competitive environment. With innovation a key variable for achieving and sustaining competitive advantage, it becomes difficult development within the borders of small businesses, because competing directly with multinational corporations and, in most cases, has deficiencies such as lack of capital, scarcity of marketing, vulnerability to macroeconomic instability and lack of managerial training. The purpose of this paper therefore is to systematize the goals that involve innovation networks as tools for exploring opportunities to transfer technology to small and medium enterprises.

## 2 Literature Review

### 2.1 Opportunities on Collaborative Networks Organizations

The more traditional definition of opportunities concerns the chance to introduce products, services or processes on the market [2]. There are two types of opportunities in a network [3]: (a) opportunities which may arise through the company or market: fruit of the relationship between members of the CNO with the external environment the market or society; (b) opportunities which may arise within the network of collaboration between the entities involved, by sharing lessons learned and expertise.

Different authors report on "Opportunities ", describing some phases:

- Perception: involves looking at the market in relation to their needs and trends; Discovery: involves the selection of a promising slice of the market, through a critical analysis before starting a new business or expand an existing market, based on perceived opportunity; Creation: involves the redirection of resources in order to create or improve a product /service already available [4].
- Preparation: involves a concise effort to develop expertise in a particular field of interest; Incubation: involves the maturing of an idea or problem, based on lessons learned; Insight: when there is actually identifying the opportunity; Evaluation: involves checking whether the concepts developed in the discovery phase are feasible. It may involve feasibility analysis of the opportunity identified, which are put to the test through various mechanisms, such as test marketing or financial analysis; Development: involves the establishment of the business from the viable opportunities. Whereas the business idea is feasible after the evaluation stage, the stage of development includes the detailed planning of activities in order to reduce uncertainty [5].
- Discovery: it involves the interpretation of opportunity recognized. It is a dynamic phase that depends directly on the sources of opportunities and lessons learned; Evaluation: involves applying a set of criteria to critically examine the feasibility of the chance discovery; Exploration: involves the management of resources for achieving the goals of the chance discovery [6].

One must consider that some of these opportunities are the result of a process where the solitary entrepreneur conceives an idea and give it its proper meaning. These authors believe that entrepreneurs and managers who prospect opportunities, are well-informed, strongly influenced by previous experiences and also by environmental conditions that surround them [7].

### 2.2 Innovation Networks

According to the Oslo Manual, the term innovation is defined by the implementation of products (goods and services) and processes technologically new or significantly improved [8]. Is characterized by constant evolution and incorporation of knowledge

processes and products, innovation has become the main ingredient for competitiveness. There are five main forms of innovation [9]: (a) introduction of a new asset: a well that consumers are not yet familiar with, or a new quality of a well; (b) introduction of a new production method, a method that has not yet been tested by experience in the manufacturing industry itself, in any event must be based on a discovery scientifically new; (c) opening a new market: that the particular branch of manufacturing industry in the country concerned has not yet come, whether that market has existed or not; (d) gain a new source of supply of raw materials or semi-manufactured goods; and (e) establish a new organization of any industry, such as creating a monopoly or fragmentation of a monopoly position.

The innovation networks is a linkages between enterprises, research organizations, universities and government, working together with the common goal of creating, acquiring and integrating the different skills and knowledge required to develop complex technologies and product or process and bringing them to market [10]. This reduces the chaos in the innovation process and increase the likelihood of developing a successful innovation [10], [11].

Among the reasons for a network is being formed: (a) access to knowledge and information, (b) organizational learning, (c) reducing technological uncertainties, and risks of individual investments in the development of new knowledge, (d) exploitation of complementarities and synergy by merging of different skills, (e) seeking economic scales of production, (f) reducing the difficulty of market entry, (g) reducing the development time of new products, (h) unfamiliarity with the pace at which technology is considered of strategic importance for business [12].

Studies indicate that the collaborative networks for innovation are common in technologically intensive sectors, which dominates the complexity of knowledge and high uncertainty [13]. Recent researches are placing the topic of innovation networks in the context of SMEs, highlighting its importance for these firms [14], [15].

The networks offer advantages for SMEs, such as the sharing of skills in technology transfer, technological expertise, know-how, on regulatory issues, reduces the resource constraint, limiting the ability to innovate [16].

Sharing the same idea [17], [18] identified important relationships between inter-firm cooperation with intermediary institutions, cooperation with research organizations and the innovation performance of SMEs. The study also showed that the vertical and horizontal cooperation with customers, suppliers and other companies have a distinct role in the innovation process of SMEs compared to horizontal cooperation with institutions research, universities and government [19].

### 2.3 Technology Transfer

The term technology is used for various areas of knowledge, with different meanings [20]. In general, technology is regarded as something tangible, for example, machinery, equipment and intangible assets like skills and knowledge [21].

Definitions of [22] and [23] discuss the technology as the body of knowledge, tools and techniques, product or process, physical equipment or method of action arising out of or creation science or practical experience, which are used in the development, design, production and application of products, processes, systems and services.

In this work, we adopt the concept presented by [24], who consider technology as a technical knowledge or know-how that can be applied to a physical artifact improving the company's ability to offer products and services. The process of managing the acquisition, handling and incorporation of technology between entities is called technology transfer [25]. Entities can be countries, company, or individuals [26], [27]. This is an iterative process that not only transfers existing knowledge, but also facilitates the creation of new knowledge and product solutions [28].

Networks help to reduce insecurity in the development and use of new technologies. Therefore, SMEs should relate to other organizations, forming a dense network of innovation, possibly sharing knowledge and skills to improve their performance in technology transfer [29]. The transfer of network technology, the collaborative effort of learning seems most effective when SMEs participate [30].

### 3 Research Methodology

This research was conducted in three stages. The first, a survey was conducted in bibliographic databases to find articles in journals related to the objects of this study.

The databases used were the Web of Science, Science Direct, and Emerald. The keywords considered to start the search were innovation networks, technology transfer and prospecting of opportunity. The papers were selected based on the analysis of the impact factor of the journals that is published in the Journal Citation Report (JCR) indexed by the Institute for Science Information (ISI) and the abstracts to identify the main articles that could contribute to this research.

In the second stage, it was carried out a case study with a high tech firm. The use of this method is appropriate when seeking a greater understanding of contemporary facts researched [31], which in this case refers to the networks. As an instrument of data collection it was used the semi-structured interview with open questions. It was interviewed the project management office manager allocated in the department of research and development. The questionnaire aimed to understand the characteristics of the company, the difficulties and benefits of conducting collaborative activities which allowed the development of a model to systematize the goals that involve innovation networks as tools for exploring opportunities for technology transfer.

The last stage was the development of an organizational modeling based on the EKD (Enterprise Knowledge Development) methodology. The EKD provides a clear vision of how the business functions, facilitates learning and organizational communication, provides a structured description of the business, allows us to identify changes and assess the impact of the decision making. This is possible because the six models that consist of this methodology, as follows: concepts model, goals model, business rules model, actors and resources model, business processes model, requirements and technical components model [32].

Considering the purpose of this study, it was represented only the goals model that describes the goals of the enterprise along with the issues associated with achieving these goals. This model is related to the organization and its reason to exist. The components of the goals model are: (a) goal: refers to the desired state of the business to be achieved and is expressed through visions, directions, goals, intentions, needs,

requirements, among others; (b) problem: it expresses that the environment is or may be in an undesirable state that hinders the achievement of goals; (c) cause: it expresses explanations or reasons for the problems. Causes are usually states or situations outside the control of the project, process, or organization; (d) restriction: it expresses business constraints, laws, rules or policies of the external world; (e) opportunity: it expresses resources that can make certain goals easier to achieve.

## 4 Case Study

It was carried out a case study with a technology based firm that operates in the field of optoelectronics in the state of Sao Paulo who is 25 years in the market. Besides the plant, the company has commercial and technical department in the state capital and laboratories in Sao Paulo, Fortaleza, Porto Alegre and Brasilia and overseas units.

The product lines are directed to the medical, industrial and defense areas, which the main products are the laser for ophthalmology, camera, satellite and defense equipment. The firm is considered medium-sized has according to the criteria of [33] with 450 employees. The capital is of domestic origin and primarily serves the domestic market, with approximately 90% of sales destined for the Brazilian market.

The firm has partnership with universities to develop sub-modules for software, research centers for technology development of materials and processes, and with companies that provide technologies and sometimes they are co-development partner. However, their relationships with other companies are to a lesser extent due to concerns about intellectual property. The Fig.1 presents the motivations for firm to collaborate represented by the goals model.

One of the main objectives of the firm is to grow and development innovations (Goal 1) in order to be competitive, becoming knowledge and high technology into benefits for society. Thus, to achieve these objectives, the firm needs to lower costs (Opportunity 1), managerial qualification (Opportunity 2), and to establish collaborative activities (Goal 2), with Universities (Entity 1), Research Centers (Entity 2), and Enterprises (Entity 3). In addition, laws enacted by the government as the Law of good (Policy 1), the Innovation law (Policy 2), and the Informatics law (Policy 3) has encouraged the firm to seek partners to develop new products and processes because they offer tax incentives and facilitate interaction between universities, research institutions and industry.

The company faces some difficulties with the cooperation (Goal 2) as the different development time (Problem 1) between universities and industry that result in delays in the project (Problem 4). Furthermore, it is difficult to establish the first contacts (Problem 2) to carry out a partnership because there is no trust between the people.

The establishment of a collaborative relationship aims to get closer to suppliers (Goal 5), allowing to solve the problem of restricted supply (Problem 3). Furthermore, it is possible to acquire know-how (Goal 4) by means of complementary competences and technology transfer (Goal 3), which may be in the form of information, knowledge or hardware. In the case of information and knowledge, this transfer can be supported by software such as CATIA (Computer Aided Three-dimensional Interactive Application), PDM (Product data management), among others.

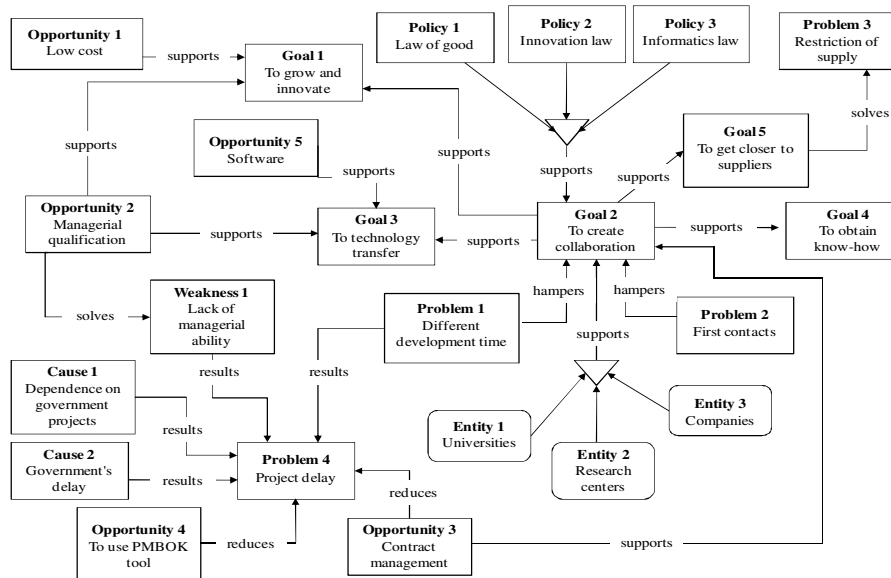


Fig. 1. Goal model.

The technology transfer (Goal 3) is supported by managerial qualification (Opportunity 2), because it allows the firm to identify and exploit opportunities to deepen their knowledge of science and technology when in contact with the external environment. With qualified staff (Opportunity 2), the firm reduces the lack of managerial capacity (Weakness 1) that often interferes with the progress of the project resulting in delays (Problem 4).

Late projects (Problem 4) occur as a result of internal forces such as lack of managerial capacity (Weakness 1) and also by external forces that are beyond the control of the organization as dependence on government projects (Cause 1) or delays government (Cause 2). Two solutions to avoid delays (Problem 4) are identified. The first refers to the application of a tool that assists in managing projects that is known as a manual of good practice PMBOK (Opportunity 4). The second is the contract management (Opportunity 3), because if the contract is clear, accompanied by control procedures, record and documentation of tasks and incidents becomes an important tool to avoid potential problems, and become a support to establish the collaboration (Goal 2).

It was noted that the firm knows the benefits of collaboration, but it has resistance due to intellectual property issues and problems in conducting projects. This occurs because of different social, cultural, organizational and economic characteristics [34].

To overcome these differences [35] points out the need to adapt the way of working with network needs, aligning different strategies to create a common vision of problem solving, acquiring competence in accordance with the individual capabilities of the partners, among others. The networks help to reduce insecurity, but since it is structured and managed properly.

## 5 Conclusions

Innovation is a key variable to achieve and sustain competitive advantages, its development is difficult within the borders of SMEs due to the scarcity of human and financial resources, vulnerability to macroeconomic instability and lack of managerial training. Thus, one of the mechanisms used to overcome these challenges is through the collaborative work with universities, research centers, companies and customers. This collaboration with various actors allows the sharing and transfer of knowledge, skills and information that contribute to the development of new technological solutions. This happens mostly when the company participates in a net horizontal and vertical. This work has contributed to the companies to understand factors that influence and help in the process of exploring opportunities in technology transfer and that reflects the innovations developed in networks. As ideas for future work should be noted that once the economic lever of Brazil is represented by small and medium enterprises, an issue to be undertaken by networks of innovation might involve the socio-economic aspects of the country. The problems of national industrial network can help in the training of human resources with a more realistic view of the market with a clear understanding of the business itself, with the field of information technologies and communication and increased power to generate innovations.

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