

THE UNIVERSITY-FIRMS INTERACTION PROCESS IN A UNIVERSITY INCUBATOR: THE CASE OF THE VALE DO RIO DOS SINOS UNIVERSITY'S INCUBATOR

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Abstract:

Business incubators is one of the strategies adopted in Brazil for the creation of small technology-based firms. In the incubators, a process of interaction is established among the government, the university and the firms that should benefit, either directly or indirectly, each of the participants. The article is based on a research that departing from an evaluation model seeks to assess the impact of an incubator on the development of the resident firms and on the university. Data was collected from the incubator's seven resident firms by means of a questionnaire applied to each one of the entrepreneurs and from documents. To describe the impact of the incubator on the university the data came mainly from documents. The analysis of the data reveals that the incubation process is having a positive effect on the firms, since six of the seven firms analyzed are following a path considered adequate in the sense that they are entering in the market with innovative skills, solid finances and well prepared managers. However, the effect of the incubators on the University was found to be insignificant in what is concerned with teaching, research and extension. But the incubator brought a new image for the university and lots of space in the media.

Key-words: Innovation, Incubator, University-Industry Interaction

THE UNIVERSITY-FIRMS INTERACTION PROCESS IN A UNIVERSITY INCUBATOR: THE CASE OF THE VALE DO RIO DOS SINOS UNIVERSITY'S INCUBATOR

Introduction

The development of scientific and technological knowledge by universities and firms, either through joint collaboration or by transfer of technology, is fundamental for the creation of a solid scientific and industrial base. On one hand, universities have an important role in economic development especially in the generation of knowledge to be transformed into economic activity and in the formation of highly qualified personnel and researchers. Technology-based firms, on the other hand, are responsible for the creation and the adoption of new technology and in the absorption of human resources. Although these companies, like any others, go through a process of birth, growth and maturation, they will have greater chances of survival and success if they can count, during the earlier phases, on the partnership of institutions such as business incubators.

Business incubators are defined as physical spaces set up to shelter mainly nascent technology-based firms, providing a favorable environment for the interaction between the university and usually have the government at support. In Brazil, most incubators were established during the 1990s and now there are 183 active incubators. [1] Being a recent phenomenon, the benefits for stakeholders of the incubators are not yet a frequently studied subject. This article describes how the incubation process affects especially two of the stakeholders: a university that hosts an incubator and the resident firms. The research was conducted at a knowledge-based incubator located in a Southern Brazilian University and draws a major part of its data from Wolffenbüttel. [2]

It tries to evaluate university-firm interactions occurred by analyzing the impacts on the firms as well as on the university. It is expected that the results will contribute for the discussion on the effectiveness of the technology-based incubator in its function to support the development of new businesses in the high-technology sectors, while also influencing the scope of the university functions and of the government as stimulator of development.

1. Sábato's Triangle, the *Triple Helix* and the University-Firm Interaction

In 1968, Jorge Sábato and Natalio Botana [3] described the role of university-firms cooperation in technological innovation and its relevance to economic and social development in Latin America. Beginning with prospective studies having as horizon the year 2000, the authors defended the idea that the region could and should participate in scientific and technological development. In that sense, the insertion of science and technology was an essential condition for the process of development to occur. This process would result in multiple and coordinated actions of three fundamental elements: the government, the productive structure and the science and technology infrastructure. This relationship was represented graphically by a triangle, with the government occupying the uppermost point and the productive structure and the science and technology infrastructure occupying the lower two. In this triangle, there are three types of connections: intra-relations (among the components of each point), inter-relations (those that are deliberately established between pairs of points) and extra-relations (those that are created between one triangle and its environment). Plonski [4] mentions that, “the inter-relations appear as the most interesting to be explored”, mentioning the “fundamental character of the horizontal-type inter-relations – between the productive structure and the science and technology infrastructure”. For the author, these relationships constitute the base of the triangle and are the most difficult to be established.

Etzkowitz [5] proposed a model to describe the linkages among government-university-industry emerging at various stages of the innovation process. Called the Triple Helix, the model seeks to integrate science, technology and economic development. In contrast to the Triangle, in which the flow of knowledge was described as occurring only from basic research to innovation, the new model is based on the conception of a spiral in which a reverse flow, from the industry to the academy, also occurs. As a result of this interactive effect, in which industrial innovation brings new challenges for research, the Triple Helix predicts that the involvement of the university with industrial innovation may improve the performance of basic research as well as of teaching. On the other side, governmental policies establishes directions for research and for the opening of new enterprises. [see also 6]. As Santos and Fracasso pointed out, the Triple Helix is a more dynamic model than Sábato's Triangle to describe the relationship among those three main actors. [7]

The university-firms interaction process in a university incubator:
The case of the Vale do Rio dos Sinos University's incubator

Etzkowitz [8] considers four possible levels of performance for the model. The first level of performance refers to the fact that the relationships between university, industry and government are accompanied by internal transformations in each one of these actors. The second level of performance presents the influence of one helix upon the other. The third level considers the emergence of bilateral and trilateral relationships in the process of interaction. The fourth level of performance refers to the recursive effect of three levels over social institutions such as science itself. In addition, a new role for the university is presented in Etzkowitz's model. The author associates the second academic revolution to the Triple Helix, in which the university begins to assume a pro-active role in economic development, as a result of the transformation of research into economic activity.

The two models described above indicate the relevance of the university for the economic development in particular and for the whole society in general. Maculan and Merino present the university-firm interaction as a complex process, with the following objective:

“The whole development of new knowledge presents diverse dimensions, of difficult conception, that go from the generation of advanced theoretic knowledge or from technological knowledge designed for the resolution of specific problems, to the transmission at the inter-organizational borders, up to the propagation and use of this knowledge inside of the productive organization”. [9]

The analysis of this relationship shows that the university-industry interaction allows firms to receive knowledge and human resources from the university. Yet it also allows the university to receive, from firms, data, experiences, insights and demands that will contribute to the evolution and the development of knowledge. The process is seen as a constant interaction in the exact sense of the word, since the action is provided by all the participants of the process.

According to Plonski, university and firms can establish varied types of interactions such as: sponsorship of graduate thesis; university chair sponsorship; extension courses; specialization and subsidized master's degree programs; support and participation of businessmen in events organized by universities; product tests and analyses; technical and management consulting and joint technological development. [10]

It is in the improvement of education that the university can achieve the greater benefits from the interaction with firms. In this perspective, Carvalho and Kovaleski mention that, normally, the benefits that more frequently are referred in the literature are: the participation of the research professor in projects, the increase in revenues for the university due to these projects, the proximity of the firms to current scientific knowledge and the possibility to better equip university's laboratories and offices. In the authors' understanding, these benefits are considered only in a quantitative perspective, without taking into consideration qualitative aspects: "you can't lose sight of the primary objective of the university and of the professor, which is the efficient teaching-learning process, the efficient classroom, the student-citizen prepared to deal with and to dominate the available technologies" [11]. Therefore, the qualification of education is considered to be the greatest benefit obtained by teaching institutions in the university-industry cooperation process.

The above arguments reinforce the importance of interaction mechanisms between university and firms in providing mutual benefits for the creation of knowledge. Mendes affirms that these mechanisms make viable the integration between knowledge and new technologies generated at the university level and the productive processes of the firms. These mechanisms constitute a "strategy to leverage the competitiveness of firms and to materialize and give visibility to the academic activity for the society". [12]

Governments usually provide financial support to all the above mentioned endeavors and even have special programs to stimulate university-industry interaction. Governments expectations are that investments made in university-industry relations will result in a greater number of high technology firms, in more qualified jobs, in breakthrough innovations, in more qualified research and education at the universities, and in tax returns. In other words, the governments' objective have is to increase social and economic development.

Figure 1 is a simplified representation of the incubation process. It indicates the relationships that take place in a perspective of short, medium and long terms. Since the main interest of the research concerns the impacts of the incubation process on the participant actors, the model exposed in Figure 1 essentially considers the evolution of the relationship from the objectives set by the university to the social-economic results. The next section will explore in more details the model and will deepen the discussion concerning the evaluation of the impact of one university-based

The university-firms interaction process in a university incubator:
The case of the Vale do Rio dos Sinos University's incubator

incubator on the three main actors involved in this endeavor: the firms, the university and the local and state government.

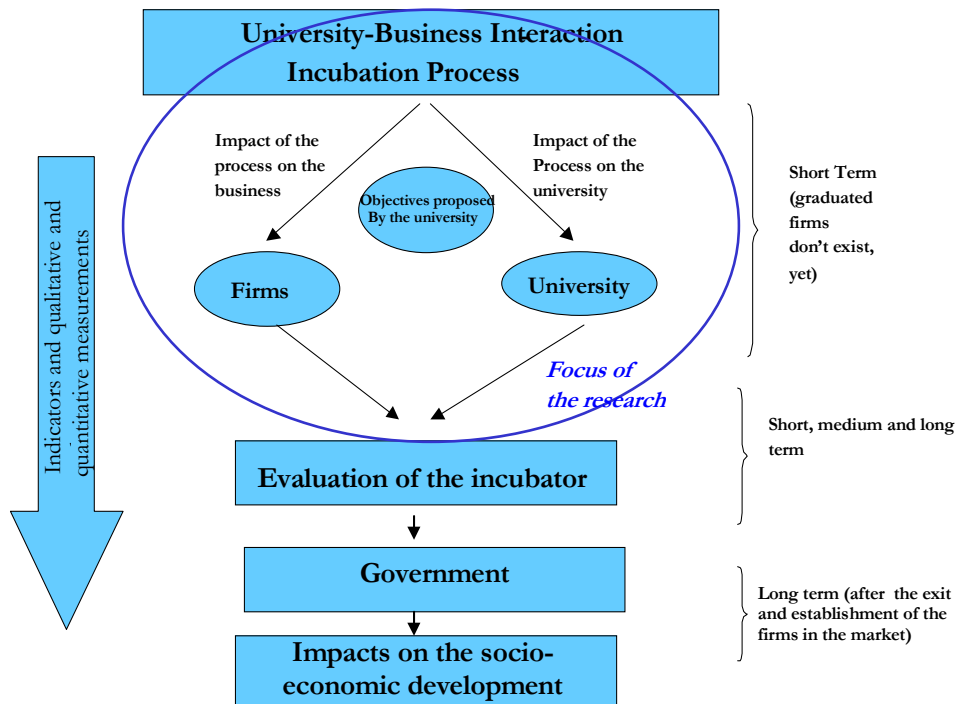


Figure 1 - Evaluation Model of the Incubation Process

2. The Evaluation Model of the Incubation Process

The incubation process has a direct impact on the firm and on the university, and, in the long-term, it also will impact on the government and, ultimately, on the socio-economic development of the whole society. The current investigation is concerned with the impacts caused by the incubation process on the university and on firms during the period of incubation of these firms. It considers: the impact of the incubation process on the firms and the impact of the incubation process on the university. These two different aspects are analyzed below. It is intended that the result of the evaluation will allow the visualization of the path that the resident firms are taking in order to become capable of confronting the market. It is expected that the results will allow

the improvement of the incubation process in order to reach its primary objective: to promote the access to the market of healthy, innovative and well-managed organizations.

Fonseca developed two different sets of indicators for the evaluation of the incubation process. The first group focuses on the activities performed by the incubator as a provider of services to the resident firms. In this sense, there is a flow of knowledge and services departing from the university and from the incubator towards the resident firms. The second set is concerned with the results achieved by the firms, especially after their entrance in the incubator. For this purpose, the author proposes three indicators: the innovations adopted, the formal and informal jobs created and the strengthening of the firms considering the increase of revenues or the consolidation of market shares. [13]

Another alternative was proposed by Peter Bearse of the National Business Incubation Association. The author considers two levels of analysis. At the internal level the actors involved in the incubation process evaluate the performance of the incubator with regard to its own objectives. At the external level, independent agencies evaluate the impacts of the incubator on the community and on social-economic development. [14]

The approaches proposed by Fonseca and Bearse combined provide the possibility of analyzing both effects of the interaction: on the firms and on the university. The impact of the incubation process on the resident firms could be analyzed considering three dimensions: innovation (is the firm an innovator?), strength (is the firm financially strong?) and managerial capability (are the entrepreneurs and managers able to administrate?).

With respect to the innovation dimension, Santos [15] and Bignetti [16] refer to the main characteristics of knowledge-based firms:

- operate processes, products and services that make use of new or innovative technologies;
- have a large proportion of highly qualified personnel compared with traditional firms; [17]
- dedicate a larger portion of expenditures to R&D activities; [18]
- develop products that have a short life span and that make existing products obsolete; [19]
- can potentially grow at very high speed;

- present technological dimensions that are significantly important for competitive advantage.

Therefore, when analyzing the innovation dimension, it is important to consider the technological content of products being developed and how the process of development is conducted. Furthermore, since development of technology requires high levels of investments and is a complex task, it is convenient to evaluate the relationships established with other firms and institutions in the creation of knowledge. These relationships provide complementary capabilities and indicate a tentative to increase the learning process and to upgrade technical abilities. An additional aspect to be considered in the analysis is the proportion of revenues that comes from recently developed products, indicating the capacity of turning new technologies into market successes. The indicators considered above are coherent with those proposed by Colombo and Delmastro. [20] The authors analyze growth and innovative performance of firms and their propensity towards networking.

With respect to financial strength, there are two main indicators to be analyzed: financial situation and commercial relations established by the firm. It is important to note that resident firms are small and some of the traditional financial indicators do not apply. Also, accounting records are simplified and less structured when compared to those of larger established firms. The financial situation, therefore, should take into account the specific characteristics of resident firms and should be evaluated considering data obtained from revenues, expenses, investments and debts. It is important to note that some of the revenues of resident firms might come from old products, developed previously to the entrance in the incubator. An analysis of revenues should then take into account the origin of the revenues. Commercial relations established by the firms consider the number and the nature of clients, and the type of products and services provided. Participation in fairs and workshop might also indicate the nature of commercial relations.

The third dimension refers to the managerial capability of entrepreneurs and managers. To measure managerial experience and capability, following Colombo and Delmastro [21] and Fagundes [22], the indicators to be used are undergraduate and graduate degrees, training during the stay in the incubator, previous experiences in management activities, and the entrepreneurs and managers perceptions of their own leadership abilities and managerial skills.

The impacts on the university are reflected on the main functions of the institution: teaching, research and extension activities. The teaching dimension can be decomposed into three main levels: undergraduate and graduate courses, professional training and final papers from undergraduate students. The presence of an incubator can promote the creation of new courses or the modification of existing ones. Several disciplines, like business administration, entrepreneurship, engineering and information technology, could benefit from the discussions and from the flow of knowledge that permeates through firms and university teachers and students. At the professional level, firms can hire trainees and graduates and help to increase practical experience of students. Alumni and teachers are also potential entrepreneurs that could start up firms or participate in spin-offs from the university. With respect to the production of final papers from undergraduate students, business plans and proposals are potential products to be explored by senior undergraduate students.

The presence of an incubator and of knowledge-based firms is an incentive for the development of research projects in the university. Demands from the firms and initiatives from researchers might induce the development of new technologies. The presence of the incubator could also serve as a research site for masters and doctoral students and help them in the completion of their theses.

Another dimension to evaluate the benefits of the incubation process is the inducement of new extension services, like courses and consultancy activities. The different capabilities developed by the university throughout the years could be used to promote the growth of the firms and the transfer of knowledge to them.

An additional indicator not mentioned in the previous studies revised reflects the benefits obtained by the university with the incubator is the enhancement of its public image. The presence of knowledge-based firms and of the incubator helps to consolidate an image of an institution that promotes state-of-the-art activities and that stimulates the creation of new knowledge. The incubator is also a source of news for the media creating a flow of information concerning the activities and results of tenant firms. It is important to note that the evaluation model described in this section refers only to the short term, that is to a period of three years of effective operation of the incubator. As a consequence, the firms analyzed are still residents of the incubator.

The model also proposes an evaluation of the impact of the incubation process on the social-economic environment, especially on the government. As already mentioned, these impacts refer

mainly to tax returns, to the creation of qualified jobs, to the development of breakthrough innovations, to a greater number of high technology firms and, in general, to the social and economic development. Evidently, these are impacts that will become evident in the long term and whose analysis is beyond the scope of this article.

3. Method

This article aims to describe the impacts of an incubator on the resident firms and on the host university. For this purpose it was used the case study method as proposed by Yin [23]. The unit of analysis is the impact of the incubation process, and for each of the different sites in which the impacts were felt a different research strategy of data collection was used, as described bellow.

3.1 The impact of the incubation on resident firms

The incubator under scrutiny is the technology-based firm incubator (UNITEC) located in the campus of the Universidade do Vale do Rio dos Sinos (UNISINOS), São Leopoldo, Southern Brazil. The incubator facilities were financed by UNISINOS and the state government. The resident firms received tax-exemptions from the local government.

Since its inauguration in 1999, around 50 firms applied for vacancies in the incubator, of which eight have been selected. Two of them, during the course of the incubation process, merged to become a single enterprise. The regular length of residence of each firm is 30 months, extendible for more six. Table 1 presents the main characteristics of the firms being researched. In order to maintain the confidentiality of the sources, the firms have been denominated by initial letters of the alphabet.

TABLE 1 – Characterization of the firms researched

Firms	Months of incubation	Number of partners	Number of Employees	Products and services
A	24	2	4	Development of home pages. Solutions for the Web
B	24	1	3	Computerization of hospitals and of health institutions
C	10	4	1	Business management systems - ERP
D	23	2	2	Program development for <i>hand-held</i>
E	14	2	10	Video assembly line inspection
F/G	19	3	4	Media and graphic design
H	24	2	2	Customized management systems and Web applications

Source: Wolffenbüttel [2]

To evaluate the impact of the incubation on the firms the analyses considered three dimensions: innovation, financial strength and managerial capability. The following variables were considered in the dimension of innovation: number of new products developed, percentage of products with patents, percentage of revenues coming from new products, average time of development of new products, percentage of products with new versions, number of relationships with academic institutions concerning new products, number of relationships with other institutions concerning new products.

For the dimension of financial strength, the variables were: revenue and expenses ratio; debt and revenue ratio, percentage of revenues coming from new products, number of clients originated by new products, number of service relations concerning new products and number of participations in fairs.

The managerial capability dimension comprehended the following variables: number of partners with graduate and undergraduate degrees, average professional experience, average number of hours of managerial training and average hours of managerial consultancy received by the firm.

The leadership assessment was performed taking into account a self-evaluation in which the entrepreneurs graded their knowledge in the different administrative functions: Marketing, Finance, Human Resources, Information Technology, Quality Management and Legal Issues.

3.2 Impact of the incubation on the university

The university-firms interaction process in a university incubator: The case of the Vale do Rio dos Sinos University's incubator

For the evaluation of the impact of the incubation process on the university four dimensions of analysis were considered: impact on teaching, impact on research, impact on extension courses and impact on the image of the institution.

The following variables were considered for the dimension of impact on teaching: number of students in graduate and undergraduate courses; number of courses created or modified due to the incubator; number of teachers and alumni that are partners of the firms, number of final papers written by undergraduate students.

The impact on research was evaluated considering the number of research projects related to the incubator, number of masters and doctoral thesis published; number of papers and articles generated by university researchers concerning the incubator, general publications generated.

The dimension impact on extension courses considered the number of hours of participation of firms' personnel in training courses at the university; consultancy hours performed by teachers and researchers and number of contracts for other services delivered by the university. Finally, for the dimension impact on the image of the institution the variables were: perceived image, according to the entrepreneurs, and number of media insertions by vehicle (TV, radio and newspaper) generated from news about the incubator.

Data collection was primarily concentrated on university's documents, web sites and records from the marketing division.

4. Discussion

The analysis of the impacts on the tenant firms was performed considering the three dimensions discussed in Section 2 - innovation, financial strength and managerial capability – with the operationalization presented in the Section 3. With respect to the innovation, it was observed that all firms developed software and information technology products. The majority of the firms uses enterprise resource planning and develops web solutions. Three of the firms integrate also other types of technology, like image processing (firm E), digital media (firm F/G) and mobility technology (firm D).

During the period of incubation, all firms developed new products, indicating that they are actively pursuing new knowledge and are able to transform ideas into technologies. The period of development of products ranges from three months (firm F/G) to two years (firm C). Four of the firms (B, C, F/G and H) have all revenues coming from products developed during incubation; the other firms have the following percentages of revenues coming from new products: firm A, 40%; firm D, 65%; and firm E, 35%. With respect to the development of new product versions, 20% of revenues of firm D; 100% of firm F/G and 75% of firm H come from these modifications on prior products. Tenant firms have very few relations with other academic institutions concerning the development of new products: only firm E established a joint program with another university. The relative evaluation of the innovation of resident firms indicates that two firms, D and F/G could be classified as the most innovative firms of the incubator while firm C could be considered as the least innovative.

When the financial strength dimension is analyzed, it can be seen that all firms have a stable financial situation. However, three firms present particularities that deserve to be mentioned. Firms B and C have strong ties with larger enterprises and develop products for them. Firm E is the only one that received venture capital. From the data collected in the research, it is perceived that firm E used these resources to develop innovative products, preparing itself to enter the market. The other firms already have regular revenues that cover all their expenses, and the debts (when they exist) are in amounts perfectly adequate for their conditions.

The commercial relationships already established by the firms are indicators of the strength of the firms. With the exception of firm C, the newest firm, which has only one client (its own partner firm in the development of the product), all have already contracts with clients for their products or their services. In some cases, the developed products have already been submitted to market tests and have prospective clients. Another relevant aspect in the financial strength dimension is the participation of incubating firms in trade fairs. From the comments of the interviewees, the extreme importance of participation in trade fairs for the incubating firms was made clear, especially with reference to commercial aspects. Firms F/G and A have a good number of participations (ten and eight, respectively), firms B and E are in an intermediary situation (four and three, respectively), and the others had a reduced participation level in these events, whereas firm C has not participated in any trade fairs.

The university-firms interaction process in a university incubator:
The case of the Vale do Rio dos Sinos University's incubator

Regarding to managerial capacity, the analysis focused on the abilities related to administrative aspects. In general, the members of the firms have an adequate formal education profile. Only in two of the firms (A and C) entrepreneurs have not completed an undergraduate program. In firm E, one of the members already has a Master's degree, and another is in the process of achieving it. In all of them, with the exception of Firm C, the members have received some type of training in the area of Administration. In relation to consultancy in the administrative area, also an important learning tool for incubating firms, only Firm B did not make use of this service made available by the incubator in partnership with SEBRAE (a small business assistance organization).

The impact of the incubation process in the managerial capacity of the entrepreneurs is expressed by their self assessment. The entrepreneurs rated their capability by giving one of the following answers: no capability (zero points), low capability (one point), medium capability (two points) or high capability (three points). The results reveal that, in general, the entrepreneurs feel they are relatively capable. The lowest rated item was the knowledge entrepreneurs have about legal issues. Three other items that had a below two average (medium capability) were: marketing and sales, costs and finances and human resources management. Items with the highest average were: personal characteristics for managerial duties, information management and strategic planning.

In summary, it could be noticed that, in relation to the impacts of the incubation process on firms, six of the seven firms (the exception being firm C) that entered into the incubator are on an adequate track for the post-incubation period. Three characteristics were noticed in these firms: they are generally innovative, or rather, they deal with products whose technology is new; they are solid, that is, they have an adequate financial situation and well-established commercial relationships relative to the new products developed; and their managers are capable of conducting the business through the competitive environment in which the firms are inserted. Among these firms, four were considered to have a high potential for entrance into the market, with medium to high performance in all of the dimensions of analysis evaluated in the research (firms D, E, F/G and H). In two of them (A and B) a medium potential for entrance into the market was attributed. Only one firm (C) was considered to present low performance in all of the analyzed dimensions and, as a result, a low potential for entrance into the market. It must be considered, however, that this firm has been in the incubator for just 10 months. In general, it can be affirmed, from the data, that the incubation process has been successful and benefits the tenant firms.

If the results concerning the impacts of the incubation process on the firms indicate that they profit from the incubation, the benefits for the university are scarce. In fact, in teaching, research and extension activities little contact was established with the resident firms.

In the teaching dimension, the interactions are rare. Not one undergraduate thesis related to the incubator was completed, and the graduate and undergraduate teaching activities were restricted to a few visits and lectures in the incubator. Only in professional training the returns for the university could be considered positive. Eleven students are trainees in the firms and seven students or alumni of the university are partners in the firms.

In the research dimension, the interactions are incipient. The incubator could be a fertile field for studies of researchers and professors in areas such as information technology, computer science, entrepreneurship and innovation, among others. However, in practice, just one research project was identified and yet was indirectly related to the incubator. Three articles about the incubator were written by professors of the university.

With respect to the extension dimension, none of the university programs was especially designed for any of the resident firms. Furthermore, courses were directly contracted by the firms, but with other universities and SEBRAE (Brazilian Assistance to Small Business) . With respect to consultancy, all 1208 hours contracted came from outside the university.

Only in the dimension impact on the image of the institution can the benefits obtained by the university be considered satisfactory. A large space in the media was opened for the institution as a result of the Incubator Project, without costs to the University.

In the data collected in the research there is no reference to the relationships between the firms and the University with respect to the development of new products and, as a consequence, not one innovation was generated in the firms from these relationships. Considering that this may be the most significant of the roles performed by an interaction process the flux of knowledge in both directions should be improved. The limited interaction between university and incubated firms has been pointed out in previous studies by Medeiros and Atas [24] “about half of the incubators interviewed are loose, poorly integrated with the dynamic of the institution’s process of technological innovation that anchors the business venture and have a reduced articulation with the other partners”.

Therefore, the business incubator is contributing to the formation of new business ventures that are adequately structured. However, the returns to the University are still very poor.

Conclusion

Brazil is attempting to improve its position in the world scene by developing high technology industries. The promotion of knowledge-based incubators constitutes one of these attempts. The conception of these incubators includes the university as one of the actors directly involved in the creation and in the transfer of new knowledge. The article analyzes a business incubator located within a university in Southern Brazil. It is intended to evaluate the incubation process that results in benefits for the resident knowledge-based firms and for the university. Three indicators are considered in the model developed to evaluate the impact on the firms: innovation, financial strength and managerial capability. With respect to the university, the effects considered were on teaching, research and extension activities and on the institutional image.

The incubator lodges seven firms that operate in the information technology sector. Data from the firms were collected through questionnaires and through interviews with entrepreneurs and managers from all the firms. Data from the university were gathered through interviews and documental research performed by one of the authors.

The main results show that the firms benefit from the incubation process acquiring capabilities that enable them to future competition in the market. All the residents were able to develop new products and some of them succeeded in developing new versions of the products initially conceived. They hold adequate financial conditions and only one captured venture capital in the market. The analysis performed and the assessment made by the entrepreneurs showed that they have been able to acquire managerial capabilities and that they consider themselves as prepared to face future challenges.

If the results indicate that firms are collecting benefits from the process of incubation, the university has not yet seen fruits from the investment and from the relationship with the incubator. Teaching, research and extension programs developed by university do not profit from the proximity and from interactions with the firms. Conversely, residents are not used to demand services from the

university, preferring to maintain contact with official agencies of development and, even, with more traditional universities.

The evaluation of the incubation process brings about interesting points for a further debate. For example, what is the cost-benefit of such endeavor? In the incubator studied, seven firms benefit from investments made by the university and by the government. What is the return? A first evaluation conduct to the conclusion that it is a highly expensive initiative. However, it is expected that many others firms, especially spin-offs from the university, will emerge in the future. Furthermore, it is convenient to consider that knowledge-based firms permeate through several industries, promoting positive impacts on other sectors of the economy. They also can influence over the knowledge transfer from the university and can contribute to the formation of centers of high technological capabilities. In addition, the role of the university proposed by Etzkowitz [25] in his Triple Helix induces the university to be part of economic development through the transformation of knowledge into economic activities.

Even if the results of this research show that interaction mechanisms are still deficient in the incubator evaluated, the indicators developed in the model may be a contribution for understanding the relationship between the university and knowledge-based firms within an incubator. Obviously, further research is necessary to improve measurement instruments and theoretical approaches to the subject.

Notes

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