Analysis of the relationship between academic spin-offs and their parent organization[1]

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Abstract

How spin-offs access resources from their parent organization along the process of setting up of the new venture? This is the main question explored in this article. We use an institutional perspective and the resource based view to analyze resource endowments received for 30 spin-offs from the Federal University of Rio de Janeiro, in Brazil. Our findings show that the spin-offs studied have accessed a set of resources from the parent organization, physical space, human and technology resources are the main ones. With the evolution of the entrepreneurial orientation of this academic unit, social capital, finance and organizational resources were available for the spin-offs in their process of setting up. We could identify different configuration of resource endowments, in different institutional and organizational contexts.

Key words: spin-offs; academic entrepreneurship; resource endowments

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1. Introduction

The analysis of the relationship between academic spin-offs and their parent organization has been studied by several authors, with different points of view. Special attention was paid to the analysis of how the parent organization can influence the number and type of the spin-offs created and it's propensity for growth. In this paper we have used the resource based view to shed a light in this issue, analyzing the resource endowments that the spin-offs receive from their parent organization. The analysis is performed from 30 case studies of firms created between 1994 and 2010 by researchers from a particularly academic unit in a Brazilian university, the Federal University of Rio de Janeiro.

Mustar et al (2006) presented an extensive review of the literature on the creation of research based spin-offs, and identified a set of studies whose focus is the relationship between the spin-offs and their parent organization, called the institutional perspective. These authors sought to correlate the institutional context and the organizational profile of the parent organization with the number and the type of spin-offs created. The institutional perspective is based on the recognition that spin-offs are typically embedded in a parent organization, although the nature of the embeddedness may vary.

Strategic choices made by the parent organization might have a lasting effect on the spin-offs that are created. Debackere (2000) notes that universities can stimulate the creation of spin-offs, managing their academic R&D as a business. The author argues that universities can take advantage of the economic

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opportunities of their R&D programs using the appropriate strategies, organizational structures and management processes. Lundqvist & Hellsmark (2003) performed a similar study, describing the entrepreneurial university support system of Chalmers University in Sweden. Rasmussen & Borch (2010) analyzed how the university context impacts the entrepreneurial process. The authors identified a set of university capabilities that facilitate the venture formation.

Moray & Clarysse (2005) argue that each organization has its culture, system of incentives and specific rules and that these characteristics affect the type of spin-offs created. The authors concluded that the level of formalization of technology transfer affects the resource endowments of science-based entrepreneurial firms. The work is based in a useful framework that combines an institutional perspective with the resource based view. According to this study there is an interconnectedness of institutional context and resource endowments to spin-offs from public research organizations. The institutional context is formed by the characteristics of the social and economic environment including funding and law systems. The universities are embedded in this institutional environment.

Resource based view is widely used in studies about the creation and development of academic spin-offs (Mustar et al 2006). The works based on this approach focuses its analysis on resources identified in the creation and development of spin-offs that gives them a competitive advantage. The authors that pursue this conceptual approach define resources broadly, encompassing all tangible and intangible assets and competences linked to the firms in a "semi-permanent" way. Moray & Clarysse (2005) consider human, financial and technological resources in their analysis. Other works use a widely view considering technology, human, social capital, financial, physical and organizational resources (Brush et al 2001; Landry et al 2006).

As argued by Moray & Clarysse (2005), although different authors have proposed stage models providing insight into the dynamic interrelated activities connected to spinning of ventures (Vohora et al 2004, Clarysse & Moray, 2004), few have looked into the specifics of internal strategies enacted by universities and how these can influence the commercialization of research results by setting up ventures.

Our case study was held in the Coordination of the Graduate Programs in Engineering (COPPE) from UFRJ. The university campus houses the research center of Petrobras (CENPES) and recently starts a technology park that attracted important companies like Schlumberger, Halliburton, Siemens, BG Group and Genral Eletric. This is the biggest infrastructure for teaching and research in engineering in Latin America.

Our findings show that the spin-offs studied have accessed a set of resources from the parent organization in their process of setting up and development. The main resources accessed by the spin-offs were physical space, human and technology resources. With the evolution of the entrepreneurial orientation at COPPE, social capital, finance and organizational resources gradually start to be available for the spin-offs. In our research it was observed that in the recent years resource endowments to spin-offs was intensified, there is a growing formalization of this process. We could recognize different generations of spin-off creation with different resource configuration.

The paper is structured as follows, the section 2 presents the research methods, in section 3 we present the academic entrepreneurship context in Brazil, an overview about the organizational transformation in COPPE/UFRJ and the resource endowments to spin-offs created from 1994 to 2006. We analyze the relationship between COPPE/UFRJ and it's spin-offs from the perspective of the institutional context and the resource based view. In section 4 we present the conclusions.

2. Research design: data collection and methods

The approach taken to data collection for this study has been qualitative. A longitudinal case-study was chosen to key into resource endowments available to spin-offs along the period of setting up and development. This approach provides a richer contextual insight and an in-depth understanding of this dynamic and complex analysis.

The study attempted to answer the following questions: Do spin-offs access resources from the parent organization? Witch resources do the spin-offs access? How the spin-offs access resources from the parent organization?

2.1 Case selection and sample

Select COPPE/UFRJ as a single case is appropriate for different reasons. First, the analysis proposed in this study requires a detailed intra organizational understanding of the process involved. With this perspective we can raise data from organizational level at the university and in the firm level in their spin-offs. Second, COPPE is the biggest infrastructure of teaching and researching of engineering in Latin America. The specialized literature recognizes that there is a stronger impetus of spin-offs formation at Universities that perform science of excellence. The fact that this academic unit focuses on one field of knowledge, engineering, enhances the unit of homogeneity in the case design. Third, other researches have successfully used single site studies to increase understanding about particular issues related to technology transfer and spinning out ventures (Shane & Stuart, 2002, Jacob et al. 2003, Moray & Clarice, 2005).
The data we have analyzed includes the population of 57 innovative firms that were created between 1994 and 2010 with the support of the business incubator from COPPE/UFRJ. The definition of spin-offs used in this study is a new venture created to exploit a technology or technical skills developed in research activity inside the academic environment. We used the professional background of founder's team to identify those that were involved in research activities in UFRJ. We have found 35 companies that fit in this definition. These companies were created by researches (Post-doc, PhD students, MSc students, researches and professors). In 2010, 30 spin-offs from COPPE/UFRJ were active in the marketplace; those were analyze in this study. From the five remain; two pass trough market mergers and three decide to close the business.

2.2 Methods and research steps

Primary and secondary data were used to develop the case studies (Yin, 1989). Data triangulation including several sources of data was used to map out the situation and critical events that influence the resource endowments available for the spin-offs. From 2004 to 2010 people from various positions were interviewed, including company founders and entrepreneurial team members, researches, university managers and staff involved in the commercialization process.
Our study starts with data collection in secondary sources about the university and its spin-offs. In this phase we analyze the web sites of the university, the business incubator, the technology transfer office and the technology park. In addition we also checked the web sites of the 57 companies. In the database of the business incubator we could find a small brief of each company and the name of the founders.
We have interviewed the three key persons from the management team of the business incubator and the coordinator of the technology transfer office. In these interviews we could identify the 35 companies that fit in our concept of spin-off and we had an overview about each one of these companies. We have used a narrative approach, were the interviewer ask the informant to describe his or her view about the spin-offs and the entrepreneurial process at COPPE/UFRJ.
From the 35 spin-offs identified we collect data and analyze 30 cases. We conducted interviews with the founders of 25 spin-offs, had access to 20 business plans and 17 funding applications for Brazilian government agencies. Archival data from other sources like magazines, newspapers, and websites were widely used. This material covers all the 30 cases.

3. Data and findings

3.1 Academic entrepreneurship context in Brazil

In fact, only in the 90's is that the creation of academic spin-offs emerges in the Brazilian innovation policy as a relevant topic. Until then the emphasis was on training of highly qualified human resources to work in existing companies. Most of the science and technology infrastructure in Brazil is concentrated in public universities; academic entrepreneurship is one strategy to promote technology transfer. From 1996 to 2008 around 87.000 of PhD were formed in Brazil, 90% in public universities, 12% in engineering. The biggest part (71%) work in educational activities, only 2% work in the industry and other 4% work in the scientific consulting sector (CGEE, 2010).
The change in the Brazilian innovation institutional environment has been very intense over the decades of 1990 and 2000. The law that regulates intellectual property was approved in 1998 and in 2004 it was approved the innovation law, that regulates the public and private interface regarding to science, technology and innovation activities. The Brazilian innovation law has three central pillars: (i) all federal universities must establish a technology transfer office that is responsible for managing intellectual property in the academic context; (ii) sharing of infrastructure, physical and human resources, between public universities and private enterprises is allowed; (iii) public agencies can grant investments for R&D activities in private companies.
In 1999 comes into operation a new funding policy for science, technology and innovation activities, the "sectoral funds". These are funds focused on specific sectors such as petroleum, electricity power, telecommunications, and mineral resources, among others. The resources that feed these funds come from taxes paid by companies in each sector. There is a commission formed by members from the industry, university and government that defines the guidelines for the investments. There is also one fund that promotes cross sector projects in cooperation between universities and companies. This new funding system is a milestone of the Brazilian innovation policy because it links the science and technology within industrial policy. The annual budget for science and technology activities in Brazil have significantly increased between 2000 and 2009, from U$ 5 to U$ 15.8 billion (MCT, 2011).
In 2002 the Brazilian government starts a new funding program aiming to stimulate R&D activities in technology based small and medium enterprises (SMEs). Nowadays there are four different grant programs focused in SMEs. Every year some 300 technology based SMEs all over the country receive grants that vary from U$ 70.000 to U$ 300.000. The government is also stimulating the creation of seed capital funds, since 2006 seven funds were created with total capital of some U$ 100 million.
In this context Brazilian universities are passing trough organizational transformations such as the establishment of business incubators, technology transfer offices and technology parks (Etzkowitz et al 2005). The case of COPPE/UFRJ is a successful one and illustrates the change of an academic institution towards an entrepreneurial model (Etzkowitz, 2002).

3.2 Organizational transformation in COPPE/UFRJ: towards an entrepreneurial model

The Coordination of the Graduate Programs in Engineering (COPPE) is one of the academic units of the Federal University of Rio de Janeiro (UFRJ). The UFRJ is the largest federal university in the country with 28 teaching units, offering 145 courses to 33,300 undergraduate students. It has about 3,800 teachers of whom approximately 2200 have a doctorate degree. The scientific activities are part of the routine of the university with 85 graduate programs that offer 85 MSc and 74 PhD courses. All these research activities degree 1500 MSc and 720 PhD per year (UFRJ, 2009).
COPPE is the largest academic unit of UFRJ with 13 graduate programs in engineering: Civil, Chemical, Electrical, Computer, Polymers, Metallurgy / Materials, Nuclear, Chemical and Biochemical Processes, Mechanical, Biomedical, Transportation, Production and Oceanic. Six of these courses are evaluated with

the highest grade awarded by the Ministry of Education, grade 7, four are evaluated with a grade 6, four with grade 5 and one with a score of 4 (CAPES, 2009). This is the biggest infrastructure for teaching and research in engineering in Latin America, with about 3,000 graduation students (MSc and PhD), 300 teachers and over 100 laboratories. Each year about 150 PhD and 300 MSc are degree at COPPE.
This academic unit (COPPE), has a foundation called COPPETEC that currently manages some 600 projects totaling in the year 2008 revenues about U$ 250 million (Coppetec, 2009). Mechanisms such as the business incubator, the technology transfer office and the technology park were formed gradually over the years 90s and 2000s. The Business Incubator of COPPE was founded in 1994, since then supported the creation of 57 companies with innovative products and services. The incubator now has 1900 m2 of built area and there are 15 companies incubated. The operational model used in the incubation process involves the provision of physical infrastructure and consulting services in the areas of marketing, financial, accounting, legal and design.
The technology transfer office of UFRJ was created after the incubator. In 2001 it was created the Division of Intellectual Property and Technology Transfer - DPITT in UFRJ, which in 2007 was replaced by the Innovation Agency of UFRJ. Currently the agency has a portfolio of four licensed patents, out of 140 assign to the technology transfer office (UFRJ, 2009). In 2008 the university starts a technology park on campus, important companies like Petrobras, Schlumberger, Halliburton, Siemens, BG Group and Genral Eletric.

3.3 The relationship between COPPE and its spin-offs: resource endowments

We have analyzed 30 spin-offs that were created from 1994 to 2010. We could identify three key elements of the entrepreneurial model of COPPE/UFRJ that affect the resource endowments to its spin-offs: (i) incubation process; (ii) funding; (iv) technology transfer. The evolution of each of these four elements impacts in the resource endowment configuration available for the spin-offs. The resource framework used in the analysis considers technology, human, social capital, financial, physical and organizational resources (Brush et al, 2001).

3.3.1 Incubation process

In the early 90s, when starts the debate of establishing a business incubator at COPPE, the entrepreneurial culture was very weak. In order to find innovative start-ups the business incubator staff had to be very active, searching inside and outside the university. In these early years there was a big part of the companies supported by the business incubator that was originated outside the university. From 1994 to 2002, 24 innovative start-ups were supported by the business incubator, 11 were spin-offs. From 2002 to 2010, there were 24 spin-offs out of 33 ventures supported by the business incubator. In 2009 the business incubator receives more then 20 proposals out of witch 5 were selected for the incubation process, 4 were spin-offs.
Among the research laboratories from COPPE, there are few that have an entrepreneurial orientation, every year new proposals for spin-offs flourish from this research environment. In 2008 the business incubator starts a technology foresight program, in cooperation with the technology transfer office. Around 30 technologies with market potential were indentified. The incubation process at COPPE in the last two decades have evolved from a model centered in the provision of physical space to one that is centered in consulting and coaching services focused in the development of the innovative start-ups.
With this evolving approach the business incubator starts to provide stronger resource endowments for the start-ups. Among the 30 cases studied it was possible to indentify that in the early phase the main resource that the business incubator provides for the companies was the physical space. With the evolution of the incubation process, consulting services start to be provided in 2002, there was an increase of organizational resources. In 2008 the business incubator starts to promote network activities

among the spin-offs and companies installed in the technology park, government agencies and venture capital investors. This activity increases the social capital resources endowments for the spin-offs.

3.3.2 Funding

In 2002 the Brazilian government starts a funding program focused in innovative small and medium enterprises (SMEs). All the spin-offs created at COPPE after this have received government grants. From 2002 until 2006 the funding program available was focused in the financing of human resources working as researchers in R&D projects carried by innovative SMEs. The national research and development council (CNPq) grants scholarships for MSc, PhD and postdoc students to develop their research inside companies. After 2006, with the innovation law, government starts granting finance resources direct for the companies. Also in 2006 the first seed capital fund starts to operate. There was a significant increase of the finance resources.
In this context, the business incubator starts a sort of activities to help incubated companies to access finance resources. They launch courses about funding opportunities and start to support the development of funding proposals for government agencies and for venture capitalists. The business incubator starts promoting meetings between the spin-offs and venture capitalists (seed capital and business angels), in 2010 the first spin-off from COPPE was invested by venture capitalists. In 2009 the business incubator starts a partnership with the Brazilian innovation agency (FINEP) that grant to the incubator U$ 8.7 million to invest in innovative start-ups. Four of the spin-offs studied have received investments from the university in a grant basis.
The funding process of the spin-offs at COPPE evolves from a scenario with scarce resources to one where there were significant changes in the finance system, with abundance of financial resources. The business incubator moves from a passive profile to a more proactive one, helping the development of funding proposals and acting as an investor itself.

3.3.3 Technology transfer

From the analysis carried in this study we could realize that the human resources are the main technology transfer channel at COPPE. Every year some 500 MSc, PhD and postdoc students that participate in research activities in the university laboratories go to the market, bringing with them the scientific knowledge available at the university environment. Some of these students decide to start companies; this was the case of most of the spin-offs studied.
In 2001 the university establish a department of intellectual property that was responsible for manage the protection of the knowledge produced in its research activities. In 2007 it was created the innovation agency, with a wider scope of action. In addition to the protection of the knowledge, the agency also cares about its transfer to the market and with the promotion of an innovation culture inside the university. The shift in the technology transfer policy in the university increases the formalization of the relationship between the spin-offs and the university laboratories.
The technology transfer policy at COPPE moves from a passive strategy centered in the flow human resources to the market to another one focused in intellectual property and in the formalization of the relationship between the university and companies.

3.4 The interconnectedness of institutional context and resource endowments

Analyzing the 30 spin-offs created from 1994 to 2010 we could identify different configurations of resource endowments over time. There is an interconnectedness of institutional context of academic entrepreneurship in Brazil, the organizational transformation faced by COPPE towards an entrepreneurial

model and the resource endowments to its spin-offs. We could identify two different generations of spin-offs.

3.4.1 The first generation (1994 - 2002)

In the first generation the three key elements of the entrepreneurial model of COPPE were immature. Business incubation process was centered in the provision of physical space close to the university laboratories. The funding system was very week, there wasn't funding programs focused in innovative start-ups. The scientific policy wasn't connecting with industrial policy. The technology transfer process was centered basically in human resources that flow to the market. All the relationship between the spin-offs and the university was informal.
The spin-offs in this generation recognize the physical space close to the research laboratories as an important resource endowment received in their process of setting up. All the 11 cases of spin-offs in this generation were created by MSc and PhD students, witch considered important to be close to the university in this phase of their career that they were studying and starting a new venture at the same time. None of these 11 spin-offs had the direct involvement of their research laboratory. At the time of the research, in 2010, none of these companies have kept their links with their parent research laboratory. All the technology transfer process was informal, there wasn't any intellectual property involved. The three most successful cases from this generation had the university as their first client; what shows that the social capital was restricting to the academic environment.

3.4.2 The second generation (2003 - 2010)

The second generation presents a different stage of the three key elements of the entrepreneurial model of COPPE, the incubation process starts to provide consulting and coaching services that increase the availability of social capital and organizational resources. The funding system change in quantitative and qualitative terms, the business incubator develops a fund attractiveness capability that increases the finance resources for the companies. The business incubator moves from a passive profile to a more proactive one, helping the development of funding proposals and acting as an investor itself. The technology transfer process moves from a passive strategy centered in the human resources flow to the market to another one focused in intellectual property and in the formalization of the relationship between the university and the spin-offs.
In this phase the spin-off formation process at COPPE was intensified, there were 24 spin-offs out of 33 start-ups (in the first generation there was 11 out of 24). The spin-offs created at this phase considered social capital and funding attractiveness as key resource endowments. All the spin-offs from this generation have received research and development grants from the Brazilian government agencies. One spin-off has been invested by venture capitalists. One case from this generation involves formal technology transfer of intellectual property assign to the university. The social capital starts to involve venture capitalists and important global companies located at the technology park (Petrobras, Schlumberger, Halliburton, Siemens, BG Group and Genral Eletric).

4. Summary and conclusion

In this study we shed a light in the analysis of the relationship between spin-offs and their parent organization. We have used a framework that combines an institutional perspective with the analysis of organizational transformations at COPPE towards an entrepreneurial model and the resource endowments for its spin-offs.
We have identified an institutional context of the academic entrepreneurship in Brazil where most of the science and technology infrastructure is concentrated at universities. New laws were approved in 1998

and 2004, creating a legal framework for intellectual property inside the public universities and regulating the public and private interfaces in science, technology and innovation matters. In 1999 a new fund system that links science, technology and innovation with industrial policy was launched.
In this institutional context COPPE have been passing trough organizational transformations toward an entrepreneurial model. These transformations include the establishment of the business incubator, the technology transfer office and the technology park. Three elements of the entrepreneurial process at COPPE influence the resource endowments to their spin-offs: (i) incubation process; (ii) funding; (iii) technology transfer. From the analysis of the evolution of each of these three elements in connection with the institutional context we could recognize two generations of spin-offs with different resource endowments.

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