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PROMOTING INNOVATION THROUGH THE INTERACTION BETWEEN UNIVERSITIES AND BUSINESS INCUBATORS' TENANTS – SOME PERSPECTIVES AND LIMITS EMERGING FROM THE BRAZILIAN EXPERIENCE

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ABSTRACT

The interaction between universities and enterprises (U-E) and business incubators have generated an increasing interest in several social segments, including policy-makers, development and financial agents, entrepreneurs, and academic and research community, from both developed and developing countries. Based on empirical evidence, this paper seeks to observe how business incubators have contributed to the strengthening of the U-E interaction, taking into consideration a policy rational usually stated for justifying incubators' implementation: that the physical proximity between academic and entrepreneurial worlds may accelerate the process of diffusion and transfer of information, knowledge and technology, improving, consequently, the competitive performance of the productive sector.

1. CONTEXT: FRAMEWORK OF THE DISCUSSION

The interaction between universities and enterprises (U-E) and business incubators have generated an increasing interest in several social segments from both developed and developing countries. As part of a broader national infrastructure, the U-E interaction entails other public and private higher education institutions, research centres, technological institutes, and enterprises, strongly engaged in the generation, transfer and use of knowledge, information and technology. Even building up a relationship involving different social actors – universities and research institutes, entrepreneurs and the so-called academic-entrepreneurs, government, authorities and development agents, financial supporters and venture capitalists - with their different sets of mission, vision, objectives, forms of rewarding, the U-E interaction has still been considered as an under-utilised scientific, technological and innovative resource.

Business incubators, on the other hand, seem to be a possible policy instrument for supporting the productive sector, in particular the small and medium-sized enterprises (SMEs) segment, in its attempts of becoming more innovative, dynamic and competitive in the global market.

Incubators have been implemented all over the world, putting together several social actors (again, one has universities and research institutes, entrepreneurs and the so-called academic-entrepreneurs, government, authorities and development agents, financial supporters and venture capitalists) and their specific purposes and objectives. There is no single model that may be applied to all incubators since they present a huge diversity and heterogeneity in relation to the environment in which they have been implemented, such as different levels of firms' technological development and support policies driven to the enterprises (EIMS, 1996).

Amato Neto (2000), for example, emphasises that business incubators may be understood as inter-institutional arrangements provided with adequate physical infrastructure and logistics, aiming at, among others, to stimulate and facilitate the establishment of synergies. These synergies may be established between incubators' tenants and universities/research institutes, or between these companies and supporting organisations (such as private and public financial agents), or even between the firms themselves, independent of the level of relationship (for example, competitors). So, incubators, usually, house in an unique physical space a set of SMEs (linked or not to the so called high tech sector) that may share not only that physical space but, and maybe more important, competent management and operational infrastructure in a very pro-active environment for the birth, development and consolidation of small and innovative new businesses.

The OECD (1999) shares the same line of thoughts and emphasises that in spite of the great variety of possible institutional arrangements for the establishment of business incubators, some common operational aspects still remain to all of them – more or less important according to the context in which they are set up. Among these operational aspects, the strengthening of synergies among the several participant agents – such as interaction between enterprises and academic institutions – seems to be a valuable asset.

Summing up the context, it is possible to observe that this mix of distinctive actors, objectives, environment and arrangements that surrounds the U-E interaction and business incubators has, as a consequence, provoked a high level of political and economic expectations in relation to both the U-E interaction and the incubators' performance, making any process of evaluation a very difficult one (Vedovello 1995, 2000).

Besides this short contextualisation, this paper intends to present a set of empirical data emerging from the Brazilian experience in terms of business incubators. The focus of analysis is on the interactions that may be established between incubated firms and academic institutions. So, in addition to scrutinise the main characteristics of incubators'

tenants based on four well-established Brazilian technological business incubators, the paper analyses the U-E interaction occurring through them and a sample of 25 of their tenants. It is important to mention that the results achieved through this research may validate, or not, the policy rationale usually stated for justifying the implementation of incubators – mainly those exhibiting a strong technology-based approach – that is the physical proximity between academe and entrepreneurial world may accelerate the process of diffusion and transfer of information, knowledge and technology.

In terms of methodology, the work concentrates on empirical evidence. A detailed fieldwork was carried out during the period of December 2000 and March 2001, taking into consideration four well-established technological incubators: COPPE/UFRJ (Federal University of Rio de Janeiro) and Genesis Institute (Catholic University of Rio de Janeiro), both located in Rio de Janeiro; Biominas Foundation, located in Belo Horizonte; and CIETEC (São Paulo University), located in São Paulo, plus a sample of 25 of their tenants. The research made use of pre-designed questionnaires that were applied through personal interviews with owners and R&D managers of the sample of incubated firms. As it will be seen, the focus of the incubators' firms approach considered aspects such as firms' dimension, productive sector, sources of innovation and R&D activities, financial aspects and the difficulties firms face in accessing this crucial input. Then, a taxonomy of links that may be established between incubated companies and universities was presented (Vedovello, 1995). This taxonomy was built up taking into consideration two main pre-requisites: (1) the formality of linkages between the partners through the existence of a formal contract, and (2) the execution of R&D activity performed by the collaborators. As a result, this methodology allows (some) measurement of the U-E interaction through informal links, human resources links and formal links. Besides identifying the nature of the U-E relationship, it was also possible to observe its frequency, and outputs.

2. THE CHARACTERISTICS OF THE BRAZILIAN BUSINESS INCUBATORS TENANTS

This work seeks to deepening the knowledge about the synergies that may be set up between incubated enterprises and universities and research centres within the Brazilian context. The fieldwork was based on a set of 25 SMEs incubated in four well established Brazilian incubators. It is worth noting that the chosen incubators present different institutional models. Two incubators located in Rio de Janeiro State made part of this study: the Incubator of the Genesis Institute, linked to the Catholic University of Rio de Janeiro (private university) and the Incubator of the COPPE/UFRJ, linked to a public university. From São Paulo State, it was chosen CIETEC, an incubator linked to the University of São Paulo (public university but within the State sphere) plus two Research Institutes: IPEN (Institute for Nuclear and Energy Research) and IPT (Technological Research Institute). From Minas Gerais State, the Incubator from the Biominas Foundation took part of the fieldwork. Table 1 shows a short profile regarding the fieldwork.

Table 1 – Incubators and incubated enterprises studied

Incubator	**Location**	**Nº Incubated Enterprises**	**Sample Size**
COPPE/UFRJ	Rio de Janeiro	10	3
Biominas Foundation	Belo Horizonte	14	5
Gênesis – PUC/Rio	Rio de Janeiro	18	9
Cietec	São Paulo	14	8

Tables 2, 3 and 4 provide the reader with information concerning the profile of the incubated firms that took part of this research. In sum, it is possible to observe that the majority of

this set of firms is made up of new businesses (64% of new enterprises plus 20% spin-offs); all of them are independent in terms of capital control; 60% have been incubated for a period between one and three years. Besides being very young, this group of firms is made up very small firms, since 76% of them have up to 10 employees. In relation to the productive sector these companies operate, it is not possible to say that there is a dominant area. What is clear is that the majority of firms have been involved with the so called high-tech sector. In terms of gross revenue, the data confirm that incubated firms are, generally, small ones: 84% of the sample have up to US$ 70.000,00/year in terms of financial return.

Table 2 – Origin, Capital Control and Incubation Period

Origin of Enterprises	**Capital Control**	**Incubation Period**
20% (Spin-off)	100% (Independent)	32% (less than 1 year)
64% (New Enterprises)		60% (1 to 3 years)
8% (Relocation of Firms)		8% (3 to 5 years)
8% (Other)		

Finally, as shown in Table 4, 88% of the interviewed enterprises declared the existence of R&D activities within their organisational structure. However, 68% of them perform this activity in a partial basis and only 36% of the sample stated that R&D might be considered as their main activity as an incubated company. It is important to highlight that this R&D activity has been linked to the satisfaction of the firms' clients and not to the constitution of an innovative portfolio of products, processes and services. Development of a new product plus improvement of existing ones are the two main categories of R&D activities undertook by the firms, followed by processes development. Basic research, a kind of R&D activity with strong connection to universities and research institutes, has been performed for only 4% of the sample.

Table 3 – Enterprises' Dimension, Productive Sector and Gross Revenue

Dimension	**Productive Sector**	**Gross Revenue**
52% (less than 5 employees)	4% (Communication)	84% (up to US$ 70.000)
24% (6 to 10 employees)	20% (Software)	12% (US$ 70.000 to US$ 200.000)
12% (11 to 15 employees)	8% (Other Electronics)	4% (US$ 200.000 to US$ 343.000)
12% (16 to 25 employees)	36% (Health and Medicine)	
	4% (Genetics and Biotechnology)	
	4% (Energy)	
	24% (Other)	

Table 4 – R&D Activities

Existence of R&D Activity	**Main Activity**	**R&D Activities Categories**
20% (full time)	36% (R&D)	4% (Basic Research)
68% (part time)	24% (Software development)	28% (Strategic Research)
12% (no R&D activity)	4% (Design/product engineering)	52% (Product Development)
	16% (Production)	36% (Process Development)
	8% (Consultancy/analysis + tests)	44% (Product Improvement)
	8% (Sales and distribution)	20% (Process Improvement)
	4% (Other)	12% (New Managerial Tech)
		4% (Other)

In relation to the sources of innovation used by the incubated firms, Table 5 – subdivided into internal and external sources - shows that for 84% of the sample internal R&D activities are the

most important source of innovation, followed by technological development monitoring (68%). On the other hand, for 52% of the firms collaboration with clients and suppliers and scientific publications constitute the leading external sources of innovation. Collaboration with universities and research centres and acquisition of technology developed by third parties granted 48% and 36% respectively.

Regarding the firms activities financing, it was possible to observe that for 88% of incubated enterprises the main source is made by their own capital. However, 40% and 20% of firms has employed government funds such as grants and support from special programs. On the other hand, commercial bank loans and venture capital have been modestly used by these small incubated companies: only 16% of them made use of bank loans and 4% of venture capital. Among the difficulties for getting financial support, the firms listed the conditions imposed by the financial agents such as the cost of resources, firms' guarantee and reciprocity. It was also mentioned that the lack of agility and adequability of financial resources, the bureaucracy, the lack of consistent information, the risk of firms' activities and, in some cases, the informality of the firms hinder the access of financial support.

3. LINKAGES ESTABLISHED BETWEEN INCUBATORS TENANTS AND UNIVERSITIES[1]

Aiming at exploring the nature of links that may be established between tenants of incubators and universities in a more rigorous way, it was necessary to establish a taxonomy of links. It was considered several possible links that were grouped into informal, human resources and formal categories, taking into consideration two basic aspects: (1) the formality of links in terms of commitment of the involved agents and (2) the payment of fees for having the links set up. Table 6 presents this taxonomy.

Table 5 – Sources of Innovation

Enterprises Internal Sources	**% Usage**
Internal R&D activities	84
Top management	12
Engineering	24
Production	28
Marketing	28
Incentives by Government	12
Technological development monitoring	68
Human resources	16
Other	4
Enterprises' External Sources	
Innovation public supporting programmes	24
Government contracts	-
Acquisition of technology developed by third parties	36
Training	32
Collaboration with other incubated enterprises	20
Collaboration with clients and suppliers	52
Collaboration with competitors	12
Collaboration with consultants	24
Collaboration with universities and research centres	48
Sub-contracts	4
Fairs and thematic meetings	24
Scientific publications	52
Technical (commercial) publications	24
Patents	20
Legislation, standardisation	16
Other	4

In a more specific way, the informal links relate to the initial contacts, the exchange of information and knowledge, the availability of expertise and equipment in universities that may be

[1] Due to the constraint of time and space, this paper will concentrate its analysis in the establishment of links between incubated firms and the host universities. In other words, data concerning the links established between incubated firms and other universities and research institutes (located elsewhere) as well as those crossing characteristics of firms and the establishment of links will not be presented here. In this circumstance, the experience of Biominas will not be included in the analysis because even though having the support from universities, this incubator does not have a host university by its side.

of interest to firms in technical and scientific terms. Human resources links regard the improvement, the training and the recruitment of specialised human resources. The implementation of both informal and human resources links does not imply the establishment of formal contracts between the partners even though small fees may be charged in an *ad hoc* basis. Formal links, on the other hand, relate to the exploration and use of technical and scientific information and knowledge, the available expertise and equipment in universities, presupposing the existence of formal contracts between the partners (previously established).

This research seeks to capture not only the nature of the links established between incubated firms and universities but also some of their operational aspects such as frequency of links, number of projects set up and the outputs emerging from the interactions. Some criteria were also designed and presented to the interviewees, always giving to them the possibility of adding any other alternative they considered relevant. Table 7 shows the criteria adopted in this study.

Table 6 - Taxonomy of Links[2]

Informal Links
1. Personal contact with university academic staff
2. Access to specialised literature
3. Access to university department research
4. Attendance at seminars and conferences
5. Access to university equipment
6. Attendance at general education/training programmes

Human Resources Links
1. Students involvement in industrial projects
2. Recruitment of recent graduates
3. Recruitment of more experienced scientists and engineers
4. Formally organised training of firm's personnel in university

Formal Links
1. Engagement of university academic staff for consultancy
2. Analysis and testing in university department
3. Establishment of research contract
4. Establishment of joint research

Source:- Based on Vedovello (1995).

Table 7 – Criteria for Frequency and Outputs

Frequency of Linkages	**Outputs**
Twice a year or less	Verbal advices
Between 3 to 6 times a year	Information
Once a month	Reports
Once a week or more	Implementation of specific programmes
Other frequency	Design specification
	Prototypes
	Patents
	Other results

As already explained, this paper will consider in its analysis the establishment of links between incubated firms and the host universities. The experiences that will support the data are the

[2] It was given to the interviewees the possibility of adding any other links they considered important.

COPPE/UFRJ, Genesis Institute (both in Rio de Janeiro) and CIETEC (in São Paulo), totalling 20 firms.

Through Table 8, it is possible to observe that from the sample of 20 firms (100%), 14 of them (70%) have established some of the links classified as informal, human resources and formal links: 13 firms (65%) have been involved with informal links, 9 firms (45%) with human resources links and only 6 firms (30%) with formal links.

Tables 9, 10 and 11 show some aspects of the links that have been consolidated, including, in each category, the set of links presented to the interviewees. Then, Table 9 (Informal links) give an account that personal contact with university academic staff, access to specialised literature and attendance to conferences and seminars occur in a higher proportion that any other informal link. In other words, inside the informality of links, the more informal the link, the higher the possibility of its occurrence. The frequency of informal links is not so strong if one considers the physical proximity between the incubated companies and their host universities. The weekly frequency observed for attendance at general education/training programmes may be justified by the fact that several interviewees – very young entrepreneurs – are still finishing their under-graduation or graduation courses. Verbal advises and provision of information are the most common outputs emerging from informal links.

Table 8 – Incubated enterprises and host universities (summary of links)

Summary of Links	**Nº Enterprises (n=20)**	**% Enterprises**
Enterprises that have links	14	70
Informal Links	13	65
Human Resources Links	9	45
Formal Links	6	30

Table 9 – Informal links between incubated enterprises and host universities

Informal Links	**Nº + % of Enterprises**	**Frequency**	**Outputs**
Personal contacts	13 (100)	Weekly	Verbal advises
Specialised literature	11 (85)	3-6 times/year	Information
Univ. Research	7 (54)	Monthly	Information
Seminars and Conf.	10 (77)	3-6 times/year	Information
Lab. Equipments	6 (46)	3-6 times/year	Information + Design
Specific programmes	6 (46)	Weekly	Verbal advises + info
Other informal links	1 (8)	3-6 times/year	Information

In relation to the human resources links, Table 10 shows that only 9 firms (65% of the sample) have established any of these links and, among them, the involvement of students in industrial projects is the most frequency in this group. Recruitment of recent graduates, recruitment of more experienced scientists and engineers and formally organised training of firm's personnel in university have a very modest level of occurrence.

Table 10 – Human Resources links between incubated enterprises and host universities

Human Resources Links	Nº + % of Enterprises (n=9)	Number of Projects
Students in industrial projects	8 (89)	3
Recently graduates	4 (45)	3
Scientists and Engineers	4 (45)	1
Training programmes	2 (22)	1
Other human resources links	-	-

Table 11 refers to the set of formal links. These links, for the sake of their nature, are much more related to the firms' R&D activities as well as to the universities/research institutes profile. Only 6 firms (30% of the sample) established any of the formal links with their host universities. Within this restricted "universe", the establishment of joint research, involving expertise and equipment from both partners, is the link with the highest level of occurrence. For this group of links as a whole, the number of projects is not high and the outputs emerging from these interactions refer to the provision of information, design specification and prototype (in the case of a consultancy partnership). The firms' timidity in relation to the establishment of formal links may be a result of their restricted R&D agenda, still very much focused on the demand of their clients. The constitution of a more dynamic R&D agenda is not, so far, among the main worries of these incubated companies. A substantial part of these enterprises develops R&D activities in a partial basis and considering their dimension (size) as enterprises, it is evident that they do not have enough critical mass for undertake activities that demand major breath. On the other hand, it is important to highlight that when formal links are established, their outputs are promising.

Table 11 – Formal links between incubated enterprises and host universities

Formal Links	Nº + % of Enterprises	Number of Projects	Outputs
Consultancy	2 (33)	4	Prototype
Analysis and Tests	3 (50)	3	Info + Design
Research contract	-	-	
Joint research contract	5 (83)	3	Information
Other formal links	-	-	

4. CONCLUSION

The results that emerge from this research point out to some specificity of the U-E interaction and the business incubators and their housed companies that require special attention. The level of interaction between these partners is quite limited even considering the existent physical proximity. Universities and incubators, for example, should demonstrate pro-activity in terms of expanding synergies between each other as well as to other partners. Incubators, in particular, should supersede their activities as a provider of logistics and physical support to the firms to those more pro-active in relation to the enlargement of their tenants' interactions. On the other hand, incubated firms, in general very small and operating in specific niches of the market, should surpass their limited capacity in terms of R&D activity as well as their limited knowledge in relation to the academic world. Financial support is critical and in need of adjustments taking into consideration the financial reality of these undertakings. These few results here stated may influence, and even determine, the possibilities of interaction between incubated companies and universities. In conclusion, adjustments are necessary in order to contribute to a better adequacy of incubators as a policy instrument aiming at strengthening of incubators' tenants' performance and

their linkages with important providers of information, knowledge and technology. In sum, adjustments are necessary in order to help this set of specific SMEs to face a more agile, dynamic and “globalised” economic scenario.

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