

# **Nurturing Entrepreneurs, Creating Enterprises: Technology Business Incubation in Brazil**

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## **INTRODUCTION**

Business incubators, evolving from experiences with other business development services, have the purpose of assisting the new venture creation process. Their numbers world-wide have increased from 200 a decade ago to about 2,500 today. Due to the significance of technological innovation and entrepreneurship in shaping the future, this paper looks at *technology business incubation centers* (which have common features with the 'innovation centers' in Europe) as a means of commercializing technologies and developing high value-added products, processes and services.

### **Objectives and method of study**

The paper presents a case study of two Brazilian technology business incubation programs. The first of these is the Incubadora de Empresas de Base Tecnológica (Incubator of Technology-based Enterprises) in Belo Horizonte, Minas Gerais State, sponsored by the Biominas Foundation. The second is sponsored by the ParqTec Foundation in Sao Carlos, Sao Paulo State and houses two programs under one roof: CINET - Centro Incubador de Empresas Tecnológicas (Incubation Center for Technology Enterprises) and SOFNET, a facility with computer lab for enterprises in the computer software field.

Ventures incubated by Biominas and ParqTec are generally knowledge-based, requiring well-educated and trained staff, many of whom are faculty and students at local universities. They also require special attention in raising venture capital, sourcing technology, protecting intellectual property and marketing, nationally and internationally. The two programs were selected because they represent a range of experience, one being the oldest (ParqTec) and the other among the newest (Biominas) in Brazil. They are comparable in their public-private sponsorship and location in cities with sound technical infrastructure. In addition, the managements of both were agreeable to participating in this study.

The purposes of the study are two-fold: First, to gain an understanding of the technology incubation system in Brazil through the experience of Biominas and ParqTec; second, to field test a rapid assessment approach to the evaluation of technology incubation programs, looking at their practices, effectiveness, sustainability and stakeholder satisfaction. While incubators are designed for specific situations, it is useful to identify good practices and actions in the Brazilian experience, for adaptation to help enhance the performance of technology incubators elsewhere.

The work for this study involved several elements: (1) a literature review of previous incubator evaluations, (2) a comprehensive survey questionnaire completed by the managements at both incubators, (3) participation in September, 1998 at the annual meeting of ANPROTEC, the Brazilian association representing business incubators and technology parks, (4) visits and on-site interviews in Belo Horizonte and Sao Carlos with sponsors, managers, tenants, graduates and other stakeholders, and (5) follow up by telephone, facsimile and Internet. This study was informed as well by the first-hand experiences of the authors in planning and establishing incubators and other business development service (BDS) mechanisms in 25 countries.

In general, assessment studies of this type are handicapped by the lack of industry-wide sets of measures and definitions of BDS success as well as by the poor availability of data. Few programs have established systems

for compiling information and assessing the performance of their tenants and those graduating (or dropping out).

## **BUSINESS INCUBATORS IN THE GLOBAL CONTEXT**

Incubators appeared in the industrial countries in the early 1980s, where they are now seven years old on average and reaching maturity. In contrast, those in industrializing countries are of even more recent origin. Their numbers are growing rapidly in China, Brazil, Turkey, South Korea, Taiwan and Indonesia as well as in many of the countries in transition to more open market systems.

### **Business incubation concepts**

Incubators generally provide affordable work space, shared facilities, counseling, training, information and access to external networks for entrepreneurial groups, thereby helping promote venture creation and economic development. Some incubators target clusters of knowledge activities, such as biotechnology and computer software, but most have mixed tenants. This focused help to selected early-stage firms has been shown to increase their chances of survival (three to four-fold in the U.S. compared to those starting outside the incubator), providing benefits to the entrepreneur, enterprise, community and state.

The 1998 survey of incubation by the National Business Incubation Association (NBIA) indicates that current tenants and graduates at north American incubators have added some 19,000 viable companies and 245,000 jobs. The average incubator occupies 36,000 sq ft, with 24 tenants, and has graduated 20 companies in about 6 years. Average residence time in the facility is 2.3 years. The majority in the U.S. are sponsored by state and city governments while around 15 percent are private, for-profit units. Many take equity in tenant companies and also serve affiliates outside the incubator. About one-fourth have a technology orientation.

A recent study of impacts at 50 incubation systems (*Business Incubation Works*, 1997. NBIA) showed that about 80 percent of the programs received some sort of operating subsidy. On an average annual operating budget of \$ 278,240, the subsidy was at \$ 86,254. Capital investment subsidy was estimated at \$ 25,000 per year, taking depreciation on 20-year basis. The average number of jobs created over a seven year period was 702, including indirect employment of one-half job for each direct job in the incubator. This resulted in a public subsidy cost of \$ 1,109 per job. The tax revenue generated was \$ 4.96 per dollar of subsidy.

The UNDP-UNIDO-OAS-sponsored assessment of incubators in seven industrializing countries indicated that around 26,000 jobs had been created by the 78 incubators studied (*Lalkaka and Bishop 1996*). Developments in some industrializing countries are summarized in annex-1.

### **Incubators in Brazil**

Incubators began in the mid-1980s through an initiative by the National Scientific and Technological Development Council (CNPq), and growth accelerated after 1993. Brazil now has 74 business incubators, most in the South and South-east, with the objectives of economic development, technology commercialization and employment generation. Some 614 small enterprises are located in the incubators and employ 2,700 persons, of whom 29 percent are women. The tenants are in computing software (33 %), services (17 %). Electronics (14 %), biotechnology and chemistry (9%), mechanics (8%), food products (5%), and other categories. The incubators have 407 affiliated companies who work in their own premises, and have graduated 226 companies.

The incubation industry is well supported by the Service for Support to Micro and Small Business - SEBRAE, with the National Association of Institutions Promoting Advanced Technology Ventures –ANPROTEC- serving a networking role. The program for human resources for technology development (RHAE) as well as

the Studies and Projects Financing Agency (FINEP), the National Bank (BNDESPAR) and state funds such as FAPEMIG also provide finance. Further, Government agencies support “bolsistas” – student interns assigned to work with incubator firms.

More than 30 universities in Brazil, covering one-fifth of total college students, participate in incubator projects, mainly in technological fields. Among the largest sponsors of incubators are federal-state agencies (52 percent) and private not-for-profit/for-profit organizations (40 percent of total). For instance, the Federation of Industries Sao Paulo (FIESP) runs a dozen business incubators as its contribution to entrepreneurial venture development.

## **FRAMEWORK FOR PERFORMANCE ASSESSMENT**

The Foundations ParqTec and Biominas are integral parts of larger regional economic development initiatives supported by state, city and national governments. They are providing information as well as public relations and marketing services that help the state governments promote their development goals.

### **Incubator impact, effectiveness and sustainability**

The majority of incubation programs worldwide can be characterized as “public-private partnerships” in which initial (and often continuing) financial support is received from the government bodies. Many governments consider them as part of the business infrastructure, and the evidence indicates that the annual taxes and other benefits from new economic development more than offset the capital and operating cost subsidy. The private sector participates when it sees that the program will lead to greater business opportunities and promote spin-offs.

The ability of a BDS (such as an incubator) to replace the resources it consumes and become *financially sustainable* can be shown by an analysis of the flow of funds in and out of the system over at least 5 years. The *effectiveness* can be expressed in terms of all the benefits derived at the whole system in relation to the use of all resources and the overall satisfaction of those involved. *Outreach* depends on the replicability of the embodied concept and the means of reaching larger numbers of enterprises. Further, the concept of *sustainability* implies the ability to continue achieving positive cash flows and the durability of the benefits achieved. From the perspective of sponsors and donors, it is the ability to perform effectively after the external support has declined to stipulated levels or ceased. This depends on many factors, especially the local skills to manage numerous opportunities and threats, many of them unpredictable.

### **Evaluation of incubation programs**

As business incubation programs are a fairly recent phenomenon, the history of incubator evaluation is similarly short, beginning in the late 1980s with studies by Campbell and Allen (1987), Allen and Weinburg (1988), and Campbell (1988). These initial studies evaluated incubation largely in terms of the number of new jobs created and the success or failure rates of incubated businesses.

Early attempts to evaluate incubation in terms of costs and benefits include a 1990 study in the State of Michigan by Thomas Lyons and a 1992 Ph.D dissertation by Mark Rice. In 1996, Markley and McNamara published an analysis of the economic and fiscal impacts of two US incubation programs on their local and state economies, taking into account the economic activity generated (sales, payroll, cost of goods, taxes paid, etc.) as well as secondary benefits in terms of jobs and income as a result of multiplier effects in the economy.

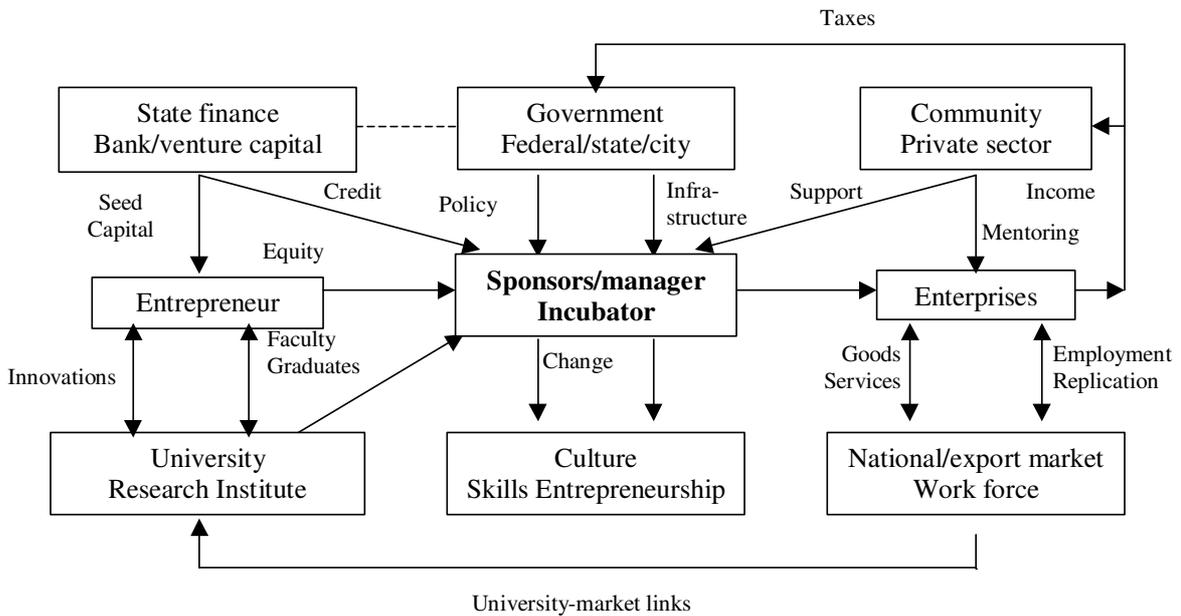
A study by the Southern Research Council focused on best practices and tools from 50 incubator programs (Tornatzky, etc 1995). Safraz Mian (1997) has proposed a model for assessing university technology business incubators in terms of an “integrative framework” that examines program sustainability and growth, tenant

firms' survival and growth, and contributions to the sponsoring university's mission. Incubator managers cite the most important measures in evaluating performance as: numbers of jobs created, clients served, and companies graduated (NBIA 10<sup>th</sup> Anniversary Survey, 1996).

**Approach to benefit-cost assessment**

Good measures of performance of an incubation system are the medium-term benefits accruing to small businesses, sponsors, local community, region and nation, Figure 1. The overall system benefit-cost assessment requires that donors make provision for – and pursue --the collection of the needed information by the management team, on firms in the facility and those leaving.

**Figure-1: Assessment of Incubator Impacts, Effectiveness and Sustainability**



I. Impact/Outreach	II. Effectiveness	III. Sustainability
1. Enterprises created	7. Employment per net \$ subsidy	13. Revenue surplus (6 years)
2. Survival rate of enterprises	8. Taxes paid per net \$ subsidy	14. Services cost recovery
3. Jobs generated (6 years)	9. Income, sales & exports generated	15. University-business relations
A. in incubated/affiliated firms	10. Research commercialized	16. Stakeholder satisfaction
B. in graduated firms	11. Disadvantaged groups addressed	17. Tenant/graduate satisfaction
C. indirect jobs	12. Incubator expansion	18. Changes in culture
4. Entrepreneur/enterprises reached		19. Enhancement of skills
5. Replication of "pilot" model		20. Leveraging state policies
6. 'Extra-curricular' activities		21. Enhanced self-esteem

**INSTITUTIONAL ANALYSIS OF BIOMINAS AND PARQTEC**

The locational, implementation, governance and management factors of the Biominas and ParqTec incubators are reviewed below. The main characteristics are summarized in Table 1.

**Table-1: Characteristics of Biominas and ParqTec incubators**

	<u>Biominas</u>	<u>ParqTec</u>
<b>Start of operations*</b>	<b>1997</b>	<b>1990</b>
Building	Custom-built	Renovated
Gross area, sq m	2,850	1,417
Rentable area, sq m	1,080	550
<b>Tenants, numbers</b>		
Resident	5	15
Affiliates	30	33
Graduates	1	21
Business survival rate	100%	82%
<b>Tenant concentration, %</b>		
Biotechnology	60	-
Informatics	-	20
Mechanical	-	47
Others	40	33

\* Both incubators began “virtual operations” a few years earlier

### **Location**

Business incubators need to be sited where there is a strong business infrastructure with availability of scientific talent, good living conditions, and positive government and community support. On these counts, both the Biominas and ParqTec incubators have good locations. Both plan major technology parks linked to the incubators.

**Biominas:** Minas Gerais (MG), the second largest industrial state with its capital at Belo Horizonte, has traditional strengths in minerals, mechanical and automotive manufacturing, and now in biotechnology. MG has an impressive technical infrastructure, with universities such as UFMG, Vicoso, Ouro Preto and Uberlandia; research institutes Rene Rachou, FUNED and CETEC; support agencies such as FAPEMIG and SEBRAE; and a vibrant private sector with BIOBRAS as a world-class insulin producer. MG now has seven incubators.

The Biominas incubator in Belo occupies a prime site of 10,000 sq m land adjacent to the publicly-funded, multi-disciplinary research laboratory - CETEC. It is a custom-built, modern functional, building with excellent biochemical laboratories and computing services for shared use.

**ParqTec:** The city of Sao Paulo in Sao Paulo state (SP) is Brazil’s major business hub. Some 230 km to the north-west is the city of Sao Carlos, population 200,000, which has the distinction of having the highest density of PhDs in science/ engineering -- one for every 230 inhabitants. Industry is concentrated on consumption goods and mechanical appliances. It has two public universities and private learning centers, laboratories for cattle and animal protein development, and over 70 enterprises in aeronautics, informatics, new materials and robotics.

Fundacao ParqTec de Alta Tecnologia houses the CINET incubator and the SOFTNET incubator together with related support facilities.

### **Business planning and implementation**

**Biominas:** The sponsors began operations in 1994 in vacant laboratory space provided by CETEC while the new facility was being planned. This was a good move as it helped prepare both the prospective tenants and future incubator staff while giving advance promotion. During this period five biotech-related companies were assisted. Three of these are now tenants in the new incubator and the others are affiliates

The new building layout was designed by local architects and business plan prepared by an expert mission under UNDP auspices. Thereafter, advice was provided by Prof. Adelaide Baeta of UFMG. The driving force has been Dr Guilherme Emrich and Ms Patricia Mascarenhas of the Biominas Foundation, and Mr Mauricio Borges, Planning Secretary of the Municipality.

The main delay was in mobilizing the significant funds needed for new building construction. Operations were started in the custom-built facility in June 1997. It currently has 5 resident members occupying about 40 percent of available space and 30 affiliates. It is planned to serve 15 to 20 tenants in the future.

**ParqTec** began operations in 1984 as a “virtual incubator” by nurturing tenants in the physics laboratory of UFSaoCarlos. Then, a house was rented down-town, and in April, 1990 the incubator moved to its present site in a industrial area close to downtown Sao Carlos and equidistant from the universities. The time from virtual operations to new site was about five years, but the move to renovated building took only six months. The champions driving the process have been Prof. Sylvio Goulart Rosa and Prof Milton Ferreira de Souza.

The investment in Biominas (about US\$ 1.9 million) is high because of the new construction and the extensive, common bio-tech lab facilities being provided. ParqTec began is in a renovated space, costing under \$ 400,000. The alternative approaches were warranted by the nature of businesses being incubated. Both need to review their space allocations in order to increase the rentable space in relation to the gross building areas.

### **Incubator sponsors and objectives**

Biominas and ParqTec are sponsored through partnerships with Government at the city, state and federal levels and with local universities, research institutes and private business. Both were developed on local initiatives with significant national support. The sponsors have contributed financially and continue to be actively involved in supervising the operations and mentoring the tenant-businesses. Such involvement is not usual in other industrializing countries.

**Biominas** incubator’s specific objectives are:

- Creation of new business opportunities, employment and products with high added value, and
- Developing entrepreneurship in technology-based businesses.

In accordance with the wider vision of promoting investment and technology transfer in Minas Gerais and linking up to international issues in biotechnology, Biominas works closely with the MG State Government, Belo Horizonte municipality, and agencies such as FAPEMIG, CNPq, SEBRAE and EMRAPA.

**ParqTec** has the official mission “to offer the means for the creation of world-class technology-based companies”. Its objectives are:

- Creation of a pro-business environment that allows the businesses to concentrate their efforts on the technological development of their products,
- Organization of training programs and service to facilitate the marketing of their products,
- Transfer of technologies generated at the universities (USP - UFSCar) and at research centers.

Again, Fundacao ParqTec has overarching responsibilities for its incubators as well as technology promotion for Sao Carlos city. While enterprise development is the primary purpose, job creation and technology commercialization are significant concerns.

### **Governance and management**

**Biominas** incubator is a unit of Biominas Foundation, headed by a Superior Council with members representing SEBRAE, university community, state Government, incubated companies and the Foundation. An interesting function of Biominas is to help procure imported equipment and supplies for its member companies, at an average service charge of 5 percent. It derives an income stream while the companies avoid bureaucratic delays and benefit by a tax deduction on a temporary “gift”, as the equipment stays nominally on Biominas books until it is fully depreciated.

The management team comprises the Executive Director with overall responsibility for the Foundation, and the manager who supervises the incubator. A laboratory coordinator oversees the use of the shared lab facilities. The management was trained by interactions at incubators in Brazil and through participation in conferences of Program BOLIVAR, ANPROTEC and International Association of Science Parks (IASP).

**ParqTec** incubator is also not a separate legal entity, being part of several programs organized by Fundacao ParqTec. A High Council oversees an Executive Board which manages the incubator, business school, business modernization center, Research and Advisory Center. The High Council, advised by an Advisory Committee, formulates policies, elects the Executive Board and approves the annual budget.

Management consists of 5 persons: general manager, technical manager, computer specialist, and two librarians. Again, the team was trained through participation in seminars and visits abroad. In both incubators, remuneration is comparable to salaries paid in the private sector.

### **Support networks**

In our interviews, the managers rated the levels of their relationships with local Government as “very cooperative”, with universities as “cooperative”, and with private sector as “neutral”. They claim that their *competitive advantage vis-a- vis other business development services* in the region is in providing affordable space, conference rooms, computing facilities, better inter-actions among the tenants/affiliates, and ready access to Government agencies, finance institutions and external networks of professional services. These linkages and facilitation services contribute, in large measure, to the success of technology incubation in Brazil.

**Biominas** sees its main challenges as finding growth-potential biotech entrepreneurs as tenants, paying back the FINEP loan starting in 1999, helping the tenants succeed, persuading them to adopt the International Standard Practices in use of biotech facilities, and moving towards financial sustainability.

**ParqTec** has consolidated its operations in the last decade. Its challenges are to generate income for enhancing services and to attract seed and venture capital for its companies. Both incubators seem buoyant about their future, provided that the global economic situation does not seriously depress Brazil’s economy – a development which would impact the markets for tenant products and the levels of public support.

## **SERVICES AND CLIENT BASE**

While the Biominas and ParqTec incubators differ in their facilities, history and the types of enterprises incubated, they share a professional, comprehensive approach to SME development. The process of incubation starts with entrepreneurial groups applying for admission. Following a screening process, those who meet the selection criteria are admitted. Some are required to leave when their space and service needs ‘out-grow’ those being provided, or when there is evidence that they will not develop a viable business.

### **Services Provided**

Many of the individuals entering Biominas and ParqTec are university faculty, graduate students and researchers who have no prior business experience. The personalized services provided by the incubator management help raise their confidence and reduce their isolation. Both incubators offer a range of counseling, training and support services as well as shared facilities such as use of reception, meeting and exhibition rooms, parking, security, telephone and messaging. Their seminars and promotion efforts reach beyond the incubators to large numbers of scientists and entrepreneurs in the communities.

**Biominas'** services most used are help in business plan development, technology sourcing and securing licenses and permits from Government agencies for pharmaceutical products. Facilities provided on a cost recovery or fee basis include: fax, photocopying, electricity, long distance telephone, wet lab space and equipment, temperature-controlled storage for raw materials/products, and special areas for washing and sterilization.

**ParqTec** covers, in the base rent paid, use of common facilities, electronic and computer laboratory, Technical Information Center, and mechanical workshop.

Counseling services are offered (at subsidized rates) in the areas of accounting, legal issues, marketing, financial and tax administration, registering of trademarks and patents, and visual communication. Services for which ParqTec charges separately are fax, photocopies, long distance telephone, electricity, access to Internet.

To the larger business community, ParqTec offers technological and marketing services, and assists in organization of trade fairs, commercial networks and participation in the CCT - Centro de Comercializacao Tecnica of SEBRAE - Sao Paulo.

**To summarize**, essentially the types of support provided to tenants in both cases are as follows:

- help in translating concepts to business plans, accessing finance and tackling government regulations,
- access to external professional networks, and linkages to the academic and business communities,
- assistance in commercializing research from universities and research institutes,
- supportive environment to build confidence and synergistic relationships among the tenants,
- work space, shared services, common lab, Internet access and telecommunications facilities,
- the credibility created by the incubators' reputation.

Most incubator managements would like to have the resources and time to better assist start-up companies in developing their innovation for the market, and not have to spend time in raising funds for operations.

In addition, Biominas and ParqTec assist the city and state agencies in promoting their development goals.

### **Markets served**

Both have a number of women beneficiaries: owners of two tenant firms (out of five) and the F. Biominas executive director are women. At ParqTec incubator, the manager is a woman, and there are two women-owned enterprises and at least two among graduated firms.

**Biominas** has focused on the incubation of firms in the fields of biotechnology and fine chemistry. Current tenants and the graduated enterprise are involved in the development and marketing of diagnostic kits for uroculture, production of hydroxyapatite for bone repair, specialized packaging for pharmaceutical products, and consulting in biotech commercialization. The alliance with Biominas has helped DIAMED, a Swiss-based, medium-sized company in medical diagnostics, to adapt and enter local markets (*Judice and Diniz, 1998*).

**ParqTec** has assisted tenants in incorporation, patent application, trademark registration and proposal writing. Its tenants and graduated firms are involved in the production of opto-electronic products, digital sound processing technology, industrial process controllers, chromatography columns, time delay switches for safety and energy conservation, automotive alarms, software applications, process simulation training, internet/intranet networks, low wattage transmitters, microterminals for automation, test equipment for automatic braking systems, and consulting services in ecology, environmental management, medical equipment, computer security applications.

Profiles of a tenant at Biominas and a graduated from ParqTec outline the kind of support provided, Box-1.

### **Box-1: Biominas Incubator Tenant: CEPA Biotecnologia**

CEPA Biotecnologia entered Biominas in February, 1995, at which time it had six employees and no revenues. Utilizing technology licensed from Suma Laboratories, a Cuban firm, CEPA produces diagnostic kits for uroculture and distributes a variety of medical supplies. It entered the Biominas incubator in order to scale up its production process, and to get assistance in licensing and registering its products with the Brazilian Health Ministry. By mid-1998, CEPA had a payroll of 30 employees and average sales of 150,000 reals/month, (about US\$1.54 million/yr).

The CEO indicated that the availability of certifiable laboratory facilities in the incubator had accomplished two things: First, it greatly reduced the initial capital investment needed by CEPA, which otherwise would have had to build its own facilities elsewhere. Second, the excellent infrastructure of the incubator made it possible to get new products to market more quickly. No disadvantages were mentioned.

### **ParqTec Incubator Graduate: Opto Eletrônica, S.A.**

Opto Eletrônica (Opto) is one of Brazil's outstanding examples of a successfully incubated enterprise based on technology transfer from the university community. Today, São Carlos - based Opto employs 100 persons and, during 1997, had revenues of US\$ 9.1 million from the sale of optical and electro-optical products. Opto mirrors are widely used in commercial laser scanners, and Opto has captured a 30 percent share of the world-wide market for "cold light" reflectors used in dental chair lamps. In addition, it produces and markets patented laser measuring and positioning systems, microscopes for ophthalmologic surgery and anti-reflective coatings for eyeglasses.

With assistance from the ParqTec program, Opto was founded in 1985 by members of the faculty of the Institute of Physics at the University in São Carlos. The CINET incubator provided legal assistance for incorporation and the filing of patents, and a convenient initial business location. After about one year in the incubator, Opto "graduated" and now occupies a 7,200 sq. m. site not far from the ParqTec Foundation. Opto's first customers were labs at Brazilian universities which were having difficulty in acquiring optical equipment due to import restrictions and cost. Opto products today are exported to the US, China, Italy, Korea, and many countries in Latin America. In addition to its facilities in São Carlos, Opto has a commercial office in São Paulo and a subsidiary in the U.S. at Northbrook, Illinois.

### **Sources of seed capital and venture financing**

Most of the seed capital used by incubated enterprises comes from the personal savings of entrepreneurs, supplemented by government grants, subsidized technical assistance, and loans or investments from relatives and friends. There is no established venture capital in Brazil.

**Biominas Foundation** is now actively involved in trying to develop new sources of private venture capital. It expects to gain access in 1999 to seed capital funding through the BID Development Bank. Current sources of financing include **FINEP** (Financeiro de Estudos e Projetos) for equipment backed by loan guarantees from SEBRAE, and **FAPEMIG** (Fundacao Amparar a Pesquisa do Estado de Minas Gerais) for R&D, funded through a 1 percent rebate of social security taxes paid to the federal government from Minas State.

**ParqTec Foundation** reports that the major sources of funding for its incubated enterprises are the entrepreneurs' own resources and seed grants from the State of Sao Paulo under the RHAE and PIPE programs. ParqTec is working to establish a revolving loan fund utilizing credit from the Interamerican Development Bank. For the longer term, SEBRAE-Sao Paulo is working on the establishment of a \$30 million venture capital fund.

The RHAE program, funded by the State of Sao Paulo, provides research and development grants of up to R120,000 over a 3 year period to enterprises to hire technical personnel. A new program of small business innovation research grants, begun in 1997, is patterned on the SBIR program in the United States. It is funded by the Sao Paulo Science Foundation and administered by SEBRAE São Paulo.

### **Relationship to other SME support programs**

**Biominas and ParqTec** Foundations, along with their respective incubators, are well integrated with major SME support programs in Brazil. There appears to be a consensus at all levels in support of business incubation as a tool to promote economic development through the cultivation of tech-based SMEs.

EMBRAPA, (Brazilian Enterprise for Agribusiness Research) is a research and SME development arm of the national Ministry of Agriculture and Food Supply. It has major research facilities near Belo Horizonte and Sao Carlos, with relationships with both the Biominas and ParqTec programs.

Sources of support for Brazilian incubators are SEBRAE (40% of respondents) followed by city governments (17%), CNPq (14%), FINEP (8%), FAP's (8 %), and others (Guedes and Filartigas, 1998 survey).

Funding for SEBRAE comes from a set aside portion of federal payroll taxes, through privately-managed state organizations. Its mission is to support SMEs through activities that include regional development initiatives, research studies and assessments of geographic regions and economic sectors, business training and roundtables, and funding for incubation programs. According to SEBRAE-MG: *"We subsidize the operating costs of the incubators and monitor their performance in our role of a social and economic accelerator. The return expected is that the incubator be successful in providing the conditions for small enterprise development."*

## **FINANCIAL VIABILITY AND OUTREACH**

### **Estimates of income and expenses**

**Biominas:** Due to limitations on leasable space, it is unlikely that the incubator could become financially viable solely on the basis of tenant rents and fees for services in the near-term. After one-and-half year of operation, about half of the rentable space remains vacant as management is being selective in its choice of tenants. Repayment is scheduled to begin in 1999 on the \$540,000 loan from FINEP used in the construction of the new facility. Although the support by SEBRAE to Biominas is relatively lower than at ParqTec, there is a reasonable prospect of operational break-even in the coming year.

Interviews with stakeholders point to continuing support for Biominas on the part of the Municipality, State and federally funded programs. Biotechnology is an economic development focus for Belo Horizonte, and Biominas serves as a visible "flagship" for this. Under normal conditions, state agencies would continue their funding; it is problematic whether they could continue present levels in the face of a severe economic crisis.

**ParqTec:** Estimates of income and expenses for the last three years are shown in Table-2 below.

The ParqTec annual revenue from services (in relation to total) is considered low. Support through the partnership with SEBRAE constitutes about half of revenue, on average. While an operating subsidy is not unusual, particularly for incubating technology-based enterprises the world over, the level is high.

**Table - 2: Pro forma income and expense ParqTec Incubator**

All figures in US \$ '000. Rate R/US \$ =0.84

	<b>1996</b>	<b>1997</b>	<b>1998</b>
<b>REVENUES</b>			
Rental Income	24.4	38.6	39.4
Fees from Tenants	2.1	2.1	2.5
Utilities Cost Recovery	9.2	18.5	18.5
Partnership with SEBRAE	139.4	62.2	239.4
<b>TOTAL REVENUE</b>	<b>175.1</b>	<b>121.4</b>	<b>299.8</b>
<b>EXPENSES</b>			
Manager	27.7	38.6	32.9
Admin Assistant	0.0	0.7	4.5
Receptionist/Secretary	0.8	2.5	4.2
Other Professionals	22.8	26.8	33.4
Fringe Benefits	5.9	8.4	10.9
<b>SUB-TOTAL STAFF</b>	<b>57.3</b>	<b>77.0</b>	<b>85.9</b>
Building	31.9	70.6	70.6
Maintenance/Cleaning			
Utilities/Telephone (net)	18.5	24.4	23.5
Travel & Promotion	1.3	0.8	20.2
Supplies	0.7	1.3	0.7
Audit & legal	9.1	9.1	20.2
Insurance	5.0	3.8	4.7
Publications			56.3
<b>TOTAL EXPENSES</b>	<b>123.7</b>	<b>187.0</b>	<b>282.1</b>
	<b>51.4</b>	<b>(65.6)</b>	<b>17.7</b>
<b>OPERATING SURPLUS (DEFICIT)</b>			

*Source: ParqTec Foundation*

The Foundation plans to achieve greater financial self-sufficiency through the development of the São Carlos Science Park on a 172,000 square meter property that it owns in a prime industrial location. Planning and design for the first 3,500 square meter building has been completed along with a master plan for the balance of the property. The first structure will house the ParqTec headquarters as well as incubator modules for 64 additional tenant enterprises. The master development plan also includes industrial sites for lease to technology-based enterprises as well as two multi-tenant buildings and a convention center.

The incubator is just one of seven ParqTec Foundation integrated programs designed to establish São Carlos as the "Capital of Technology" in Brazil. ParqTec has organized a week-long technology fair in Sao Carlos every year since 1986. It has demonstrated an entrepreneurial approach to technology-based SME

development that maximizes the use of volunteers, public and private sector resources, local universities, and intensive networking with civil society.

### **COST EFFECTIVENESS AND STAKEHOLDER SATISFACTION**

The evaluation methodology in this study uses a combination of qualitative description, quantitative analysis, and stakeholder perceptions. The stakeholders interviewed for this purpose were the public and private sponsors as well as the incubated enterprises themselves.

#### **Businesses incubated and jobs created**

An approach to evaluating the effectiveness of incubation programs is to look at the number of businesses incubated, the success rate, and the number of jobs created by incubated firms. As noted, both incubators have to aggressively recruit more tenants and affiliates as well as increase the throughput of graduating businesses.

The figures in Table-4 below should be considered as preliminary, as it is often difficult to get data from privately-held firms on sensitive topics such as sales, payroll and taxes. At ParqTec, the tenant firms have 69 employees while 17 (of the 21) graduated firms have 168, making a total of 237 jobs.

**Table-4 : Jobs and taxes, 1997 (approximate), US \$**

	<u>ParqTec</u>	<u>Biominas</u>
Jobs (tenants and graduates)*	237	92
1997 payroll	\$1,854,000	\$1,030,040
1997 sales	\$9,846,990	\$2,558,320
1997 payroll taxes payable	\$463,500	\$258,510
1997 corporate taxes payable	\$590,820	\$153,500
Total taxes	\$1,054,320	\$412,010
Initial Investment in incubator	\$383,000	\$1,940,000

\*This includes current tenants plus the one graduate tenant at Biominas and 17 graduated firms at ParqTec for whom information is available. Taxes are estimated at 25% on payroll and 6% on sales

As ParqTec has been in operation at its present location since 1990, it has more results to evaluate in compared to Biominas which has been operating only since July, 1997 in its new permanent facilities. The 1997 estimate of public capital and operating subsidy for ParqTec and the personal and corporate taxes payable would be approximately as follows, based on the data available:

Total jobs (with employment multiplier of 1.5)	357
Capital cost subsidy per year (20-year straight line depreciation)	\$ 19,150
Operating subsidy per year (average of last 3 years)	\$147,000
Capital and operational subsidy per year	\$166,150
Total subsidy over 7 years	\$1,163,050
<b>Subsidy cost per job (excluding jobs in affiliates)</b>	<b>\$ 3,258</b>
Estimated payroll & corporate taxes by tenants & graduated firms	\$ 1,054,320
<b>Return on public investment as taxes per year</b>	<b>\$6.34 per \$ subsidy</b>

The subsidy per job should decline at ParqTec as more technology-based firms graduate and continue to expand, and as additional incubator space becomes available. For mixed-use incubators, which typically have much larger areas and less services for tenants, the subsidy cost per job can be much lower.

A point to note is that while the investment is made once, the jobs continue, and it is useful to think in terms of “job-years” in the stream of benefits.

1997 taxes realizable from sales and payroll of ParqTec tenants and graduates are about six times the subsidy.

### **Stakeholder perceptions of program effectiveness**

**Biominas:** Interviews were held with stakeholders serving on the Superior Council, representing the MG State, Municipal Prefecture of Belo Horizonte, and SEBRAE. They expressed satisfaction with the progress of the program, and felt that it is meeting their expectations. One person was particularly pleased with the speed with which enterprises making pharmaceutical products were able to get licenses from the Health Department.

In their view, the challenges facing Biominas are as follows:

- **Formalization of Policies and Procedures:** There is a need to establish formal internal rules and operating procedures for tenants as well as for the relationship with non-tenant “associated enterprises”.
- **Raising Operating Revenues:** For the future, Biominas needs to take steps to insure that the incubator will have more tenants and increase its operational income. Further, Biominas has to develop private sources of venture/seed capital for its tenants.
- **Establishment of a Biotechnology Park :** Belo Municipality is very interested in establishment of a biotechnology-focused “technology park” on land adjacent to Biominas, to provide graduating enterprises with the opportunity to relocate to new facilities close to the incubator
- **Pre-Incubation Program Using University Facilities:** Develop a program for the “virtual incubation” of commercially-promising technologies that would make use of university research labs.

**ParqTec:** The four institutional stakeholder representatives interviewed expressed satisfaction with the progress of the ParqTec program to date. They said that it is meeting their expectations, but that faster growth is required for it to realize its potential. The challenges, listed in order of frequency, were cited as most important:

- **Expand through development of the São Carlos Science Park** to include an innovation center, incubation space for 64 ventures, a rapid prototyping center, ceramics lab, and convention center. The bulk of funds will have to come from public stakeholders, private sector investors, and international donors.
- **Develop Better Access to Early-Stage Venture “Seed” Capital:** The lack of a Brazilian venture capital community and a traditionally low savings rate make it difficult for enterprises to attract private venture capital. A priority of ParqTec is to establish a venture capital “seed” fund.
- **Maintain and Strengthen Regional Support:** ParqTec-CINET must strengthen public - private support in the region for incubation, as well as for important collateral programs such as the High Technology Fair, Octobertech, and the “São Carlos: Capital da Tecnologia” trademark program—all initiated by ParqTec.

### **Performance evaluation by incubator tenants and graduates:**

**Biominas:** Representatives of 3 of the 5 present enterprises and the one graduated were asked to evaluate the effectiveness of the incubator as well as the advantages and disadvantages in being tenants. All persons interviewed felt that the program is of value to them. The major benefits expressed were as follows: Help in dealing with bureaucracies resulting in faster permits; Valuable assistance in marketing and faster time to market for new products; Excellent infrastructure and labs; Interaction with other tenants; and Legal assistance.

**ParqTec:** The incubator tenants and graduates interviewed expressed satisfaction with their experiences. The major benefits cited were its: Good location for a startup venture, Access to facilities such as labs., telephone, internet, and fax service, Valuable marketing assistance received, Legal assistance for incorporation and patent development, and Business training on site.

A few disadvantages were mentioned: Two graduates said that some large industrial customers mistakenly assumed that incubated firms are fragile. For these customers, having one's independent location makes a better impression. Another commented that it was hard to keep projects confidential when several competing firms are located within the same facility.

**To summarize,** the ParqTec and Biominas incubators studied have had impacts on their respective city and state economies in nurturing entrepreneurs and creating sound enterprises with good survival rates. ParqTec has generated employment with public subsidy of around US\$ 3,258 per job, without including jobs in affiliates. The estimated return in the form of taxes could be about \$ 6 per dollar of public subsidy.

The linkages to universities and research institutes have resulted in commercialization of some technologies. The sponsors and tenants at both incubators have expressed satisfaction with the results achieved, particularly the help in marketing, business planning, and securing government permits. Both are helping their government sponsors in promoting technological development together with other social aspects such as reinforcing the cultures of entrepreneurship and university-research-business cooperation.

That being said, Biominas and ParqTec have the major challenges ahead of enhancing their operational effectiveness through innovative activities and creative financing, increased occupancy and higher fees for quality services, and more affiliate companies and anchor tenants, in order to reduce dependence on state subsidies. They need to continuously raise the skills of their management teams through interaction with ANPROTEC and, on a selective basis, with the international incubator community. They have to implement information systems which will provide the data required for monitoring, bench-marking and evaluating performance. To move towards self-sustainability, both should also press forward with establishing their technology park.

## **SUCCESS FACTORS AND LESSONS LEARNED**

The business incubator is a meso-level platform for delivery of support services to selected growth-potential businesses. While difficult to quantify, its social and economic impacts are now becoming manifest in the transition and industrializing economies. Nevertheless, the quality of these systems show variations from country to country and even within the same country. Due to the imperatives of culture and context, good practices and success factors in Brazil are not necessarily applicable in another situation. They can however be identified and adapted for use elsewhere.

### **Pre-requisites at national level**

The threshold requirements for success are a stable macro-economic environment, relatively open markets and government policies friendly to technological entrepreneurship and small enterprises. The Brazil incubator program began to expand rapidly only after the country's economic situation was stabilized after 1993.

Political, business and technology leaders have to agree on bold articulated goals for the creation of knowledge-based enterprises, and move to expand the incentives for research, innovation and risk-taking. The regulatory

framework has to stimulate markets for new goods and services, based on plans prepared in consultation with local communities and small businesses. Commensurate investments are required in transport and communications infrastructure, technical education and entrepreneurship development from school onwards, engineering and management consultancy, quality assurance and environmental preservation.

### **Donor interventions**

There have been significant inputs by OAS, UNDP, IDB and the World Bank to support industrial technology development in Brazil, but little direct technical assistance to the incubator programs. These have been initiated at local business and city levels, and sustained by the national SME development and financing agencies. These domestic sponsors have hitherto provided the “patient money” towards incubator planning, capital investment and operations.

As contributions toward building the national infrastructure for technological entrepreneurship and innovation, governments in industrializing countries (with participation by international donors, as appropriate) should help secure the vacant building space, renovation and preparatory costs of the incubator. Further, the working capital for initial operations (on a declining scale over 3 to 5 years) also needs to be earmarked up-front, in order that the incubator managements can properly run the facility and pro-actively assist the tenants.

This pattern of donor intervention has been adopted in Uzbekistan and Indonesia. In each country, UNDP supported the preparation of business plans for three pilot incubators, mobilization of matching government contributions, hands-on training of local managers at incubators abroad (and some supplements to their remuneration), selective inputs of international expertise, deployment of UN Volunteers, and monitoring of progress at field levels. In both countries, based on the pilot experiences, the Governments have now established nation-wide programs of over 20 incubators.

### **Good incubation practices**

The ten good incubation practices emerging from the Brazilian experience are outlined below.

1. **Identifying strong sponsors and a clear mission:** Both Biominas and ParqTec have pro-active promoters and wide-ranging political and financial support from federal, state, and city agencies as well as private sector, university, banking and civil society. In return for state support, both are being utilized to promote innovation and investment in their respective cities and states, to mutual benefit.
2. **Selecting good locations and planning functional buildings:** The Belo and Sao Carlos locations provide the business infrastructure in proximity to knowledge centers. Both started as “virtual incubators”. Then, the ParqTec facility was renovated and Biominas built the special facilities for biotech enterprises. The buildings are of good quality to attract international/national tenants.
3. **Building a dedicated, trained management team:** Success depends to a significant extent on the business experience and networking capabilities of carefully selected, local managers. The Brazilian managers have been trained at home and abroad, and properly remunerated. The persons in top management at both incubators are women.
4. **Selecting good entrepreneurial tenants:** Those with innovative concepts, analytical and inter-personal skills, and strong growth potential, are not easy to find, as Biominas now knows. Good practice calls for a

transparent process for their selection and a flexible means for graduation. Under developing country conditions, they may also require pre- and post-incubation.

5. **Mobilizing investment and working capital for incubator and its tenants:** Led by SEBRAE, Brazil has a variety of financing sources for both incubator and tenants. This should however not be grounds for complacency and the incubator boards must move progressively towards recovery of operating expenses, say two-thirds on average (up to 100 percent and more at for-profit incubators).
6. **Adding value through quality services for tenant companies and affiliates:** The rationale of incubation is not just bricks-and-mortar but the counseling, training, information dissemination, synergy among tenants and mentoring provided, together with access to external networks of finance and support. The tenants at Biominas and ParqTec have rated these services highly.
7. **Creating linkages to the professional and business communities:** In Brazil as in other industrializing countries, a large proportion of the incubators are linked to technical universities as the main sources of technology for commercialization, faculty expertise, graduate students, documentation, computing and laboratory support. Biominas and ParqTec have strong interactions with both business and Government.
8. **Monitoring performance and assessing impact:** A SEBRAE representative sits on the governing board at both incubators to monitor the use of state funds. Sponsors and donors have themselves to blame if they do not participate, self-critically, in over-seeing the progress of their interventions or do not provide for—and insist upon—the collection of complete data for assessing performance.
9. **Promoting industry associations and international relationships:** ANPROTEC, combining the interests of both incubators and parks, has been playing an important role in compiling statistics, exchanging experiences, and linking up to the international community. To promote the internationalization of its operations, Biominas is now attracting high-tech foreign companies through its incubator.
10. **Planning strategically for the future:** The changing pattern of work, exponential technological change and globalization of trade now require that incubators -- and the businesses they serve -- plan purposefully for the future, if they are to survive and prosper.

## **Conclusion**

The ParqTec and Biominas incubators have demonstrated success in a number of areas. They have nurtured and launched new enterprises, developed linkages with universities and research centers, secured broad-based support from the private and public sectors, and met the expectations of stakeholders. Both contribute to the development initiatives of their respective city and state governments as well as to their tax revenues.

ParqTec and Biominas are typical of most Brazilian incubators in their reliance on high levels of public subsidy. This leaves them vulnerable should subsidies be reduced or eliminated as a result of economic crisis or changes in government policy. Faced with calls for government austerity, it is imperative that Brazil's business incubators actively develop new sources of service and rental revenues to supplement public subsidies.

The problems for further research are essentially in the areas of information gathering and defining the metrics, both the quantification and interpretation of costs and benefits, at the micro- and macro-economic levels. Few programs have adequately built into their management systems the routine accumulation and analyses of data on the success or failure of their graduates, and indeed of the service facility itself. Yet it is

precisely these longer-term outcomes that validate (or invalidate) the usefulness, impacts and sustainability of business incubation and other SME development programs.

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## **Annex-1: Incubator developments in selected countries**

**China:** Among industrializing countries, the largest program with 85 incubators is in China, involving over 2,000 enterprises. From a modest beginning in the late 80's with assistance from the United Nations Development Programme, the incubators have graduated over 200 enterprises, expanding their contribution to economic restructuring. Difficulties have been encountered, such as insufficient assistance to tenant companies, low levels of local technological development, and weak incubator management, and these are being addressed through intensive training programs.

Incubators in China are generally non-profit, state-owned corporations, reporting to some combinations of the provincial/municipal Science and Technology Committees and local economic development zone. While the Ministry of Science and Technology's TORCH program provides policy guidelines, the management responsibility is left to the local agencies. Two-thirds of the entrepreneurs come from adjacent universities and technical institutes. The local government often offers free land to help to reduce capital costs while flexibility in leasing part of the rentable space for commercial purposes raises operating revenues. Eight of the 85 are now being transformed to International Business Incubators, where small foreign high-tech companies will be facilitated to enter the complex Chinese market, while Chinese tenants will be helped on joint-venturing and exporting their products.

**Uzbekistan:** As the Government of Uzbekistan forces the pace of transforming its 70-year command system to a market economy, the business incubator program is helping to overcome the hindrances encountered by start-up, self-owned businesses, including problems of cumbersome registration, high taxes, inadequate banking, materials procurement, and access to credit and business support. With political support at the highest level and initial UN assistance, three pilot incubators were started at Tashkent and Samarkand in mid-1995. Their total investment and operating cost over three years is around one million dollars and over 200 jobs have been created.

In 1996 the Republic Business Incubator Network was initiated and has been expanded to 23 incubators serving 365 tenant businesses and creating 3,000 jobs, with a turnover of about US \$ 5 million. The program is also being used effectively to leverage small-enterprise friendly policies. Uzbekistan provides a good example of strong state support and effective donor intervention.

**South Africa** has had for many years a network of facilities called "hives of industry", established by the Small Business Development Corporation. A new development is the start of an incubator at Johannesburg by a large corporation – South African Breweries – to help provide alternative livelihoods to their laid off employees. The technology incubator at Technikon Natal, Durban will empower previously disadvantaged communities, by extending their technical education through hands-on experience to become employers, not just employees. State agencies – NTSIKA and KHULA -- are establishing three pilot Local Industrial Parks comprising business incubators and multi-tenant buildings.

**Malaysia:** The large state investment of US\$ 80 million in the new Technology Park Malaysia near Kuala Lumpur has now been "corporatized". The core facility at TPM is an innovation-incubation-enterprise complex, with dominance in information technologies. The integration of support facilities includes a prototyping center, quality control laboratory, recreational facilities and a small in-house venture capital fund. While the complex was under construction, TPM had started pre-incubating entrepreneurs in an interim incubator. Now, a dozen incubation variants are operating in Malaysia, mainly linked to universities.

**Indonesia:** Starting with UNDP assistance in 1994, three pilot incubators were established in Java: at PUSPIPTEK tech-park, Serpong; a regional incubator at Solo; and an industrial incubator at Surabaya. By osmosis of experiences, seven more began, many as “out-wall incubators” which also provided out-reach services to businesses in their own premises. Then, Government decided to establish a major national program with a dozen more incubators at universities in the out-lying islands. Today, with reduced state support, the program is in some jeopardy at a time when it is urgently needed.

**Egypt:** The Social Fund for Development of the Government of Egypt has initiated a network of business incubators as a component of its extensive SME development and employment generation programs. A business incubator at Tala in the Nile Delta started operations in March 1998 with 8 tenants and another 8 being inducted. The plan is to operationalize 10 incubators in 1999 and another 10 in 2000. (including biotechnology and information technology incubators at Mubarak Science City, “open incubators” for supporting selected small businesses in their own premises, and an incubator for women entrepreneurs) The implementation is being undertaken by the Egyptian Incubator Association, an NGO set up for this purpose, under coordination by the SFD Incubator Unit.