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SOFTWARE INCUBATORS IN LATIN AMERICA: EXPERIENCES AND PERSPECTIVES*
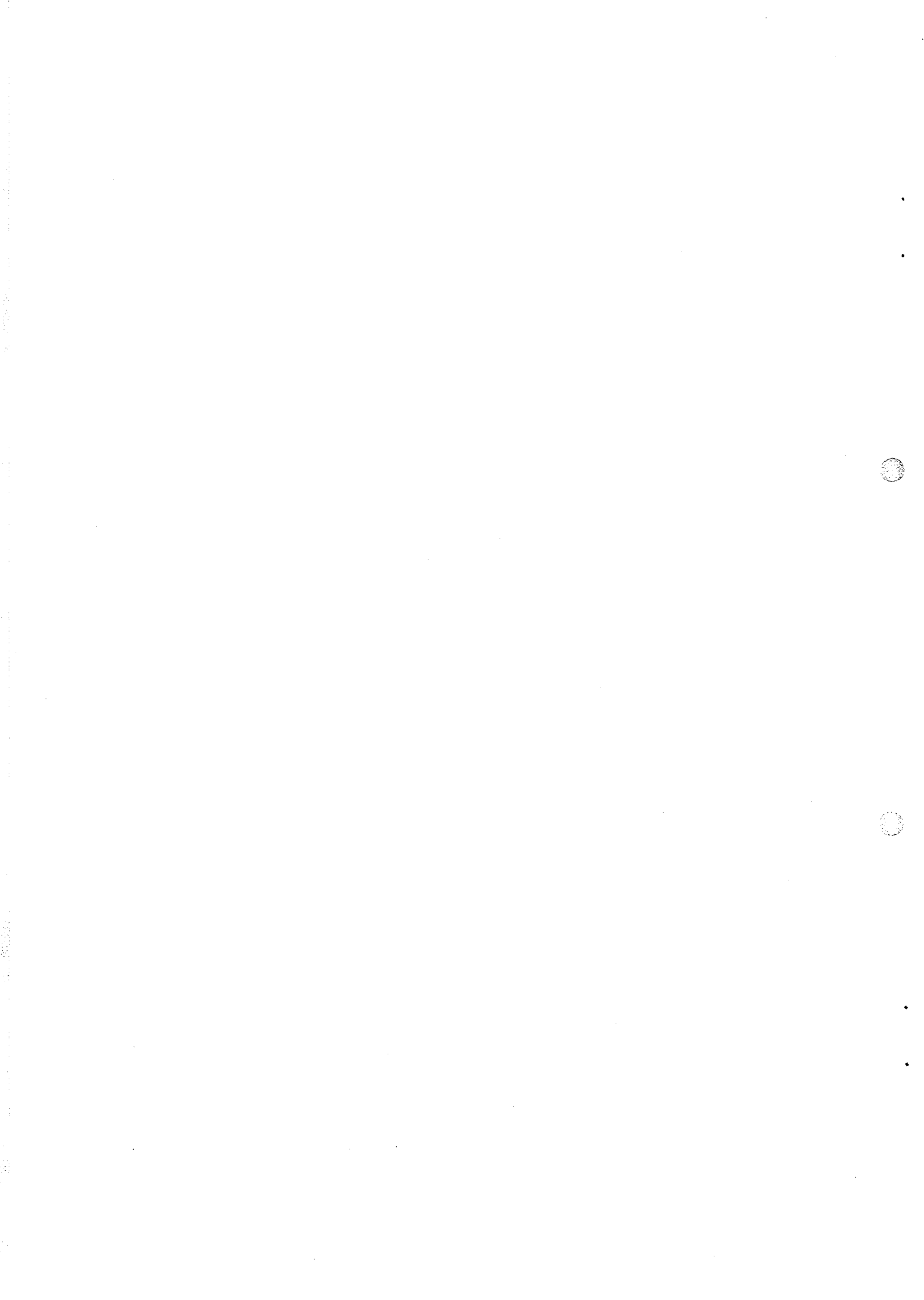
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Abstract: The world's software market has one of the fastest growth rates (i.e. 15% to 18% yearly). More than 90% of it is dominated by software companies of industrialized countries. The Latin American industry shares a practically insignificant part of this market. Even the domestic software market of Latin American countries is controlled by international companies. This article discusses the concepts of technology parks and incubators as a concrete alternative in order to increase the transfer of modern software technology to Latin American software companies. It tries to justify the argument that software parks and incubators can make a bridge between the Latin American software industry on the one side and renowned Latin American academic and research institutions on the other, to bring about a greater integration of all forces which can establish the necessary condition to enable Latin American companies to increase their participation on the world's software market.

1. INTRODUCTION

The Information Technology (IT) Industry is becoming the most powerful one of the planet. In 1992, the number of microcomputers sold in North America exceeded that of television sets [Iochpe93]. In that same year, INTEL was the company which spent more money on advertising. Besides the widespread use of mainframes by medium and large corporations, and the ever growing market of personal computers (PCs) and workstations, there are in these days only few areas of production, engineering, education, entertainment, or general services that do not include IT products as a component [Schware92].

More than 135 million PCs were sold worldwide by 1993 [Itamarati93]. Their prices have sunk by 35% compared to 1992 due to price reductions in microprocessor products. Innovation and lower prices in the microcomputer industry allowed for the development and production of user-friendly operating systems. The latter helped to popularize the use of computers among non-specialized users. This led to an increased demand for computer software to support many new and very different applications.

The world software market was expected to reach US$225 billion in 1993 [Schware93]. It is forecast to grow at a rate of 15% to 18% yearly, at least, until the end of 1994 [Correa93a]. According to International Data Corp (IDC), 57% of all software commercialized in the late 1980's originated from US companies. Japan managed to exploit 13% of the market while France conquered 8%, Germany 7%, and England 6%. Nowadays, these countries together control approximately 91% of the world's software market. The market share of software companies of developing countries is almost insignificant.

The Latin American software market is estimated to be something like 1% of the world's market. Unfortunately, even in their own countries the market share of Latin American software companies is very discreet. In Venezuela, for instance, in 1989 68% of the software was imported [Correa93b].

In recent years, two factors have led governments as well as international development agencies to both investigate and propose strategies and programs to help enhance the participation of the software industry of developing countries on the world's software market: on the one hand, the ever growing demand for more complex and expensive software systems forced the

software industry of developed countries to look for partnership; on the other hand, in most cases computer software production does not require as much investment as hardware production or communications services. Therefore, countries like Brazil are rethinking their IT strategies as to slow down the flow of government investments in the local microelectronics and hardware industry and are beginning to invest in both infrastructure and financing of an emerging software industry [CNPq92].

To illustrate the first factor introduced above, one can mention the demand of 75% of US companies for software re-engineering. Although 72% of these recognizes that, they do not have enough staff or time to carry out the task in-house [Correa93a]. Considering these two factors, software companies of developing countries are trying to conquer a greater share of the market following various strategies. India, for instance, has invested in body shopping as a way to profit from the very high qualified software professionals it forms. Chilean companies, on the other hand, have chosen the alternative of joint ventures with both the United States and European companies and also the export of packaged software.

Within the software market, both the software package and system integration are the fastest growing segments [Schware92]. Since the former is related to the microcomputer and workstation markets, it will probably continue to experience highest growth in the next years. System integration services represent a strong market segment that is related to the increasing complexity and interdependence of software subsystems. Integration services include project management, requirements analysis and design, contract programming, subsystems integration, education and training, and ongoing system support and maintenance. Both segments have grown approximately 20% in the last five years.

Even in the USA, a significant part of the software market and especially the PC segment is dominated by smaller companies, those with annual revenues of less than US$10 million [SoftLetter93]. In the USA, 59% of the companies that produce software for the PC market report annual revenues of US$5 million or less. In Canada's Technology Triangle (CTT), in Ontario, over 30 software companies account for less than 600 employees and report revenues in excess of US$50 million [Powell92]. Most of them are high-growth, export-driven firms (international sales can reach up to 95% of total sales) and all of them are research and development (R&D) intensive.

In Latin America, the local software industry concentrates mainly on the production of tailored software for specific applications and customers. As an example, in Venezuela 82% of the local software is tailored to support specific applications. The market for tailored software has been the only one where national industry can compete with advantage, since it usually demands a good deal of knowledge of specific customer's needs and local legislation and culture. It is clear that local companies face tremendous challenges when they manage to enter the market for package software and have to compete both at home and abroad with international companies that understand and dominate that market.

In Brazil, where the package software market is estimated to reach US$950 million in 1994 [Correa93b], most of the software sold is not produced locally. Due to both the hardware protection laws (1984-1992) which prevented Brazilian companies and customers from importing computers that incorporated higher technology, and the specialization of the local software industry in

tailored software (developed mainly to run on mainframes), the country now faces the challenge of creating the necessary infrastructure in order to provide its software sector with technology and marketing know-how enabling it to compete in both its own local and the international package and system integration markets. Through three integrated, government-driven programs (i.e. ProTem-CC, RNP, and Softex2000), Brazil plans to achieve the following goals by the end of the 1990's [CNPq92]:

- The development of a new generation of highly-qualified software developers who are familiar with emerging paradigms as object-orientation and client-server architectures as well as with new technologies such as multimedia-supporting hardware and software, and integrated software-engineering environments.

- The implementation of a national research network (similar to CTT's Computer Technology Network [Powell92]) on the basis of which research institutions as well as IT companies shall be able to develop joint projects in order to both enhance manpower qualification and transfer technology from research labs onto the market.

- The reorientation of the local software industry to help it acquire know-how in marketing and sales for the international software market.

Other Latin American countries either through their governments or private software sectors plan to develop or are already working on programs similar to the ones existing in Brazil. This is the case with Argentina's private software sector. In Chile, the Pro-Chile program of the Foreign Ministry is also an example.

1.1 THE ROLE OF SCIENCE PARKS AND INCUBATORS

Various organizations related to the Brazilian software development programs are creating software incubators as well as information technology parks in order to both speed up and simplify the processes of manpower qualification and technology transfer from academic and research institutions to production centers. These and other initiatives (e.g. the one at the Catholic University of Chile) rely on similar experiences in developed countries since the late 50's.

The role of science parks, incubators, and technopoles in the highly technological society nowadays can be best understood if one takes in mind that the companies (and countries) that control both highly qualified manpower and advanced technology are the ones which have competitive advantage on the world's market [Parry93].

Parks and incubators enable the interaction between research and academic institutions on the one hand and technology-intensive companies on the other [Medeiros92]. The government represents the third partner involved in this process of technology innovation.

In [Parry93], a science park is described as a business venture that aims at both enabling easy commercialization of science and technology, and

helping the growth of a high technology industrial sector. It can also be described as a property-based initiative that:

- is both formally and operationally related to a university or major research center;

- is designed to support the creation and growth of knowledge-based, technology-intensive businesses and related support organizations;

- includes a management sector which is engaged in the transfer of technology and business skills from the university to the companies on site.

A company incubator is a specialized science park where emphasis is given to the creation of new, technology-intensive businesses. Most science parks, however, provide infrastructure to encourage both the creation of new companies and the growth and/or reorientation of already existing ones.

Although it is not likely that leading software companies of developed countries might be willing to transfer their know-how to Latin American firms, there is a possibility to indirectly achieve this goal to some extent by means of the interaction between these firms and the computer science departments of some Latin American universities.

Most computer science professors in Brazil, Argentina, Chile, and other Latin American countries obtained their Ph.D. at leading universities and research centers in the USA, Europe, and Japan. Moreover, many of these highly qualified professionals came back to their original institutions and have built research groups involving graduate and undergraduate students of the highest skill level. Finally, many of these people still develop joint research projects with research groups at the university where they graduated. In this way, they can keep track of the development of information technology in the most advanced centers of the world. Science parks located near such Latin American universities and both formally and operationally related to them could encourage the association of highly qualified research groups with local software companies in order to enable the transfer of modern information technology available at these academic institutions.

In Latin America (and all over the world) the science and technology courses at the university have been used traditionally as a main source of qualified manpower. Most of the graduate and undergraduate students leaving university work as employees in either governmental or private, already existing business organizations. The idea behind a software incubator is to encourage young professionals, highly skilled employees of software firms, and even professors with entrepreneurial characteristics, to create their own technology-intensive businesses. These new companies have the possibility of already emerging with a high technology project and the know-how to develop it successfully.

1.2 SOFTWARE PARKS AND INCUBATORS IN LATIN AMERICA

However, one must be realistic when planning the development of either a complete science park or an incubator in Latin America. Almost all Latin American countries are facing hard economic situations. In these days, no one can expect that either government or private sector can invest massively in the creation and maintenance of such an enterprise.

On the other hand, this kind of initiative can succeed, only where there is both a demand for such a business venture and the willingness of many different and indispensable forces to join the project and to make it their own project (i.e. people from government, private sector, university). Most of the parks which succeeded have been administrated by people who made those initiatives their own life's project [Medeiros92].

Although, a significant number of successful technology incubators in Latin America (especially in Brazil) exist, very few of them are specialized in software technology. The author has participated in the planning phase and now works in the installation and management of the SoftSul [SoftSul94] Information Technology Incubator in Porto Alegre, Brazil. The remainder of this article is based on the experience with the planning and creation of that incubator as well as on other experiences in Latin America and in the rest of the world.

The remainder of this article is set out as follows: Section 2 describes modalities of science parks, incubators, and related initiatives. Moreover, this section comments on the right context for such an initiative to succeed and the market requirements it must cope with. Section 3 describes important aspects that must be considered for the creation, development, and management of a software incubator. International as well as Latin American experiences with such business ventures can be found in Section 4. Finally, some conclusions as well as comments on the fundamentals of software incubators are presented in Section 5.

2. SCIENCE PARKS AND INCUBATORS

The initiative called science park could actually be better identified by the name of scientific-technological park. This slightly different name can better express the main objective of the initiative, since the only debt to science is the one it has with the truth while technology is meaningful, only if it is useful to society.

Most of the existing science parks and incubators do not host software firms exclusively. There are examples of incubators which work mostly with information-technology based companies as is the case with the Austin Technology Incubator (ATI). Nevertheless, it also hosts bio-technology based business ventures. The majority of parks and incubators consulted for this study try to explore the main research areas of the universities around which they evolve. Generalizing, one can say that scientific-technological parks are concerned with the so-called new technologies like telecommunications, bio-technology, new materials, fine mechanics, computer software and hardware, and microelectronics.

The companies which should either join the park or be incubated are those that incorporate technology (know-how) as the most important resource they need to produce their products or services. Therefore, they are called technology intensive or technology based firms.

2.1 DIFFERENT INITIATIVES, ONE PURPOSE

In [Medeiros92] technological parks are defined as initiatives which model the systematic interaction between academic and research institutions on the one side and technology based companies on the other. The government usually plays a role in the creation and maintenance of these initiatives due

to the geopolitical and military interest that new technologies awake.

The main objective of parks is the development of an environment on the basis of academic and research institutions that can promote the growth of existing technology intensive companies as well as the creation of new ones, the so-called start-ups. Start-ups are usually created and taken care of in the context of an incubator.

The main elements of a park are:

- Academic and research institutions that are specialized in at least one of the so-called new technologies;

- A set of companies which use the technology being developed at the research institutions and, on the other hand, are interested in both exchanging information and developing joint projects where each company plays a complementary role;

- The demand or existence of a set of technological projects being jointly developed by the research centers and the companies. Such projects should be encouraged by the government due to their innovative and strategic characteristics;

- Appropriate organizational structure even if it works in an informal way.

An incubator is a condominium where emerging firms play the role of tenants. Each tenant receives part of the physical space for exclusive use (i.e. to build its office or plant) and uses, together with the other firms, common space provided for laboratories (labs), meeting and show rooms, toilets, warehouse, reception, guard posts, parking lot, and restaurants. Besides space, the incubator also provides the necessary equipment for the companies to develop their products or services, and administrative infrastructure like telephone, fax, and administrative personnel (e.g. clerks). Finally, the incubator can also offer (or contract) specialized services to its tenants like legal advice, technical training, marketing and sales planning, venture capital and managerial advice.

In [Parry93] the term incubator is used with another meaning. The director of the Science Park at the University of Surrey observes that entrepreneurs do not start new companies overnight. There is an interval during which they mature their plans before they "go it alone". Usually these people come from other companies where they work for some time, gain experience, dream about their own firm, and have a secure salary. These companies where entrepreneurs acquire experience in product innovation as well as work close to the market are called incubators by Parry. This is not the meaning this term has in this article however. Parry's incubator would be something like a **pre-incubator** to us; a former company where entrepreneurs worked as employees before they decided to start their own business.

Parks are classified into three categories in [Medeiros92]:

- **Parks with Informal Structure**: are composed of companies and research institutions dispersed in a relatively large area (e.g. a city with industrial district) and a formal control structure is not visible. Nevertheless, the partners of these kind of parks already develop joint

activities in a systematic way. Some of these activities can be related to an already existing incubator.

- **Parks with Formal Structure**: are similar to those described above as regards their organization in the sense of location, but these parks have already been formally established and have an organizational structure as well as management staff.

- **Technological Parks**: are those formally established parks that already have a specific physical location area inside a campus or close to it where companies can rent or buy land to establish themselves. Usually these parks reserve part of the land for building an incubator.

According to [Parry93], location, availability of land, and funding are only some of the constraints that influence and determine the way specific initiatives may evolve. Therefore there are no two parks which evolve in exactly the same way. Nevertheless, Parry points out three basic formats for parks and related initiatives:

- **Urban developments**: Most of them are restricted to the provision of an incubator center although some of these parks begin to build modern, efficient buildings as "grow on" space to replace old industrial buildings that surround their sites.

- **Campus developments**: These include innovation/incubator centers, research parks, and science-technological parks. They range from 6 to 200 acres (i.e. 2.5 to 83 hectares) and offer a much wider range of both accommodation and services compared with urban developments. At Surrey, for instance, the park has restaurant, conference facilities, a hotel, and limited banking facilities on site, and is located close to a regional sports complex.

- **Locale**: This includes technopoles and science cities. These are types of development that incorporate very large areas. Examples include technopoles such as Sophia Antipolis in France, Tsukba City in Japan, and the Research Triangle in North Caroline (USA). They offer an even wider range of facilities such as housing (for entrepreneurs and employees), retail centers, and leisure facilities (e.g. movies). They can be considered to be cities that have been both designed and built especially for the purpose of developing a high technology industry in a specific region.

One can also identify various classes of incubators. They can be classified according to the partners who own them, the infrastructure they offer to start-ups, and the way they select tenants. According to the partners who control them, existing incubators fall into three main categories:

- **Incubators owned by the government**: Especially in Latin America where the government is usually the biggest investor and the private sector is very individualist, incubators tend to be created and maintained by those government departments that are concerned with industry and commerce development. However, incubators created this way suffer from political pressure. Political interests can influence tenant selection and many aspects of infrastructure acquisition and maintenance. Moreover, the situation of the incubator can become unstable during election periods and, under certain circumstances, they can even be

closed by the incoming government. Such experiences with government-created incubators can be found in [Piccinini93].

- **Incubators owned by the university:** In these cases, the incubator is usually assigned for control by a group of professors from a technical sector. For instance, the SoftSul software incubator[1] was started as an initiative of the Informatics Institute of the university. The major risk faced by these incubators is the lack of managerial skills of the people who control them. An incubator should in the first place be a business venture itself [Medeiros92]. Although its profit cannot always be measured in terms of money or capital, it must be able to secure the means of its own maintenance. Furthermore, besides technical issues, start-ups need training and advice on marketing and managerial matters. Computer science professors usually do not have managerial knowledge nor have close relations to people who do. On the other hand, it is difficult to get other departments of the university to help manage the incubator [Piccinini93].

- **Incubators owned by private companies:** There are some successful examples of incubators being created and maintained by a consortium of private and governmental companies ([DelFosse92], [Kamijo92]). Actually this kind of incubator develops projects which are of interest to the companies participating in the consortium. It is not an incubator for independent start-ups. Due to the actual size and state of development of Latin American software companies, it seems difficult to gather companies together which aim at sponsoring the joint development of a large project to produce modern software technology for common use. These projects are usually concerned with the provision of both new development methodologies and large project management strategies.

- **Incubators owned by a consortium formed by university, private sector, and government:** This category seems to be the most appropriate for Latin American countries. The directory board (and possibly the management, too) represents the interests as well as the willingness of each partner. The university provides the technical assistance to the incubator. The private sector can identify the best projects from the point of view of the market and even join entrepreneurs in start-ups. Besides, partners of the private sector can supply start-ups with legal and administrative advice. The government can on the one hand provide part of the necessary investments to build the incubator and on the other hand help start-ups get financed and allow for tax reductions. Finally, since the government is the biggest buyer in many Latin American countries (as well as in the rest of the world), it could eventually become the first customer of some of the start-ups and thus secure them their first profit.

According to both the infrastructure and the services offered by an incubator, it can be classified as a:

- **Lab-support incubator:** Where start-ups can make use of the incubator's laboratories and common areas and services but must be located outside

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the incubator. This situation is typical of incubators that are created as a sector of a university's department. SoftSul's software incubator was created this way. Problems arose as start-ups tried to register with the Department of Commercial Affairs of the city of Porto Alegre and realized that they could not use the university's address as their own commercial address. Nowadays, that incubator has the status of a private company without the objective of profit.

- **Full support incubator**: Here entrepreneurs can rent private space inside the incubator to install their companies, besides being able to use laboratories and other incubator facilities and services. One of the risks associated with this kind of incubator is that start-ups may eventually exploit it simply as a place for rent. To prevent this situation, Medeiros [Medeiros92] proposes that the contract between incubator and start-up be either one for services to be offered or one for participation but never a rental contract.

Incubators usually select project proposals submitted by entrepreneurs on the basis of a set of requirements (which will be dealt with later in this article). Nevertheless, there are incubators where either the management or a special technical committee decides on which projects will be developed and gathers a team of both entrepreneurs and technicians to carry out the task [Kamijo92]. After the project, these people may or may not continue working as a firm. The latter case can be successful only if the incubator maintains the necessary management structure to control and, at least partly, finance the development of the selected projects.

2.2 THE RIGHT CONTEXT FOR AN INCUBATOR OR TECHNOLOGICAL PARK TO SUCCEED

Parry [Parry93] sustains that the right business environment in which a technological park or incubator has the best chances to succeed should include three main characteristics. They are related here in the context of most Latin American countries.

The first characteristic would be the existence of:

- rapidly growing high technology companies that due to internal conflicts (e.g. changing focus from quantitative goals to qualitative ones) can generate spin-off firms (i.e. break up into smaller business units and/or form alliances with smaller companies); and

- contract research organizations including universities, where short term contracts result in researchers having to develop a business in order to survive after their contract ends.

The concept of breaking large companies into small, horizontally organized very efficient firms has not yet been rightly understood and accepted in Latin America, at least in the software sector. This situation can be explained on the basis of two of the sector's characteristics. On the one hand, local companies share a very small piece of the market pie. On the other hand, most of these companies do not produce package software or work with system integration. Therefore, they usually do not generate spin-offs for those markets.

However, from other perspectives this situation may help create new software firms due to joint ventures between existing companies and

entrepreneurs. As an example, let's consider the Brazilian Government's Softex2000 Program [CNPq92]. Since 1992 the Brazilian National Research Council tries to encourage both governmental and private organizations to get together in order to promote the development of the local software industry. Softex2000's main objective is to increase software export in Brazil. There are now 13 so-called Software Nuclei spread over the whole country, from the North to the South. Most of them have been created as the result of a partnership among local government (i.e. state and/or municipal government), associations that represent the private sector (e.g. ASSESPRO - Data Processing Companies Association), local universities and major regional research centers, and the local office of SEBRAE (Brazilian Support Service for Micro and Small Firms). The nuclei are either transforming themselves into or building technological parks (with and without incubator).

Each nucleus should identify the demand of local firms for managerial as well as technological training, labs infrastructure, and marketing and sales contacts and advice. Relying on studies made by the nuclei about both technological and marketing requirements for the development of competitive package software, many existing national software firms (i.e. especially those related to the local market of tailored software) have realized that they would not be able to leave their actual market segment, in the short term, and prepare themselves in order to competitively explore the package software or system integration markets. Consequently these firms have shown interest in building joint ventures with start-up companies in order to enter those markets as soon as possible.

Many computer science researchers who work at Latin American universities as professors also work as consultants for both governmental and private companies. Among these professionals there are persons who would be interested in creating their own company. Nevertheless, the kind of contract many universities use to employ professors and researchers does not allow these professionals either to regularly work outside these contracts or to own private firms. In Brazil, this is the case in most federal universities. As is pointed out in [Medeiros92], universities and governments should rethink their contract practices to enable a greater number of highly skilled professionals to create their own businesses around those institutions.

A second important characteristic which must be present in the incubator's environment is that of a supply of companies that offer sponsorship to start-ups. This is still a problem in Latin America for, at least, two reasons:

-    Many Latin American economies are facing recession. Money flux is limited both in government and private sectors;

-    Financial institutions usually do not have special programs for incubated companies. The latter represent a class of firms which can neither be classified as a public utility in order to get free contributions, nor can they show the necessary guarantees in order to get money from the private financial sector.

The above considerations imply that the incubator's management should intercede with financial institutions in favor of start-ups. The incubator's name and assets should be accepted by those institutions as the necessary guarantee for start-ups to get loans. To do this, however, the incubator must be sure of the chances of success of its start-ups. Moreover, it must work

side-by-side with the start-ups and help them achieve success.

In Brazil, some governmental institutions (e.g. CNPq) can partly finance human resources necessary for start-ups. Furthermore, the CNPq and other development agencies run special programs for incubators. Through its incubator, the incubated company can get access to the necessary equipment but this will probably be shared among other start-ups, depending on the incubator's management strategy.

SEBRAE also has a support program for incubators. However, the money can only be spent on training and advisory services. No development agency in Brazil, for instance, can help financing marketing or sales without returns. Support for marketing and sales is very important to the success of start-ups but it is usually too expensive for an emerging firm to contract such services. Incubator owners must try to influence both government and the private financial sector in order to overcome this difficulty.

On this subject, Campbell [Camp87] and Allen and Bazan [Allen89] have already observed that the presence of an incubator in a certain region must be a consequence of a demand by the local community. Such demand should be materialized in form of investment on resources and financial support being organized by this community. Medeiros [Medeiros92] complements this idea stating that successful incubators follow a very simple recipe: they all represent a response to a concrete demand by the community and are strongly supported by the involved partners (private sector, academic and research institutions, and government).

In [Parry93] a third important characteristic of the environment is the existence of successful role models. From the experience in Surrey, Parry derived that exposing would-be entrepreneurs to the success of other start-up businesses helps to accelerate the rate of business creation.

It is worth mentioning that good managerial as well as legal advice can significantly cooperate for the development of high technology companies. Aspects like access to funding and copyright laws are fundamental in the environment of an incubator.

2.3 ESTABLISHING THE TARGET MARKET

Since there is no doubt that technological parks and incubators are commercial ventures and must be handled accordingly, one main criteria for their creation is that of identifying what they can do for the market and what the market expects from them. Relying on this knowledge, their owners should build the appropriate management structure to meet the requirements posed by the market.

Before the park at Surrey was established a number of studies about the market were carried out [Parry93]. First, a market survey was developed in order to identify what the customers wanted from the park. In the case of Latin American software incubators this question might be even harder to answer than it was at Surrey. There the survey covered the local market only. 200 high technology companies were surveyed to find out their expectations from the park. Among other things, analysts recognized from this study that the IT and software engineering market was dominated by a number of large organizations from which many spin-off companies could emerge. This is surely not the case in many Latin American countries.

Since in Latin America most local software companies develop tailored software for a very limited customer market, what they would expect from an incubator, in terms of products and services which start-ups could provide for them, might not be what the young entrepreneurs have in mind. The latter come from the university and have had contact with modern software engineering technology and products. The market they would like to explore is that of package software and system integration but this objective might receive very little incentive from the local market. On the other hand, when some company from the local market shows interest in a problem-solving software that could eventually be transformed into a package software (e.g. a program help developing environment), it might not have the capital to invest in the start-up which would carry out the task of developing the software.

The decision of what market to contemplate, the local or the international, is fundamental for Latin American software incubators. In Porto Alegre, we have identified two ways of reaching the international software market: by working with a few local software companies that have already succeeded in entering the international market and by building the necessary management structure for the incubator to enable it to directly contact the foreign market.

By attending international trade fairs and software marketing events (e.g. Softworld in Canada), it was possible for us to identify the demand for products and services of some foreign companies and to show them the potentialities of our start-ups. As a result of these meetings, a number of software companies of developed countries have already shown concrete interest in either purchasing or selling products and services to be developed in our incubator. On the other hand, the incubator's management is also responsible for the selection of start-ups that can meet the requirements of our new customers.

Another decision concerning the market is the kind of tenants the incubator will accept. Potential tenants of a software incubator include start-up (new) companies (with two or three people as entrepreneurs and employees), companies in early stage of growth (with around 10 people), R&D departments of larger companies that are located elsewhere, and companies that will develop both products and services related to the activity of software production and marketing that will complement the software companies' work.

Since in most Latin American countries the local software industry is small and works mainly for the tailored software market segment, there is in these countries a lack of businesses that are specialized in supporting software development and marketing activities. The incubator must therefore provide the means by which incubated firms can get legal and managerial advisory services as well as a set of other services such as manual translation and manual production, software publishing services, risk capital, marketing and sales planning and development, and training. In some cases, where there is no such support in the incubator's neighborhood, it might have to incubate new companies that should minimize this deficiency in the future.

Finally, the incubator owners (or its management) should rely on market studies to decide on aspects concerning both physical characteristics of the incubator and the services it should provide to tenants. It is clear that a

software incubator will host small to medium scale companies that need to accommodate people and machines. The questions which arise are:

- How much room each company will receive?

- Will it be possible for a company to either get more space or give up some space during its stay in the incubator? How flexible is space assignment?

- How much should space cost and how companies should pay for it?

3. CREATING, DEVELOPING AND MANAGING A SOFTWARE INCUBATOR

The development of an incubator should not be different from that of any other business venture, although depending on the objectives of any development the time horizon for financial success may vary [Parry93]. The first step in the creation of a software incubator must be the development of a business plan. In [Medeiros92] a number of aspects that should be considered when planning and developing a technology incubator are discussed in detail. In the following, we present these aspects and comment on them relying on both our own and other experiences in creating a software incubator.

3.1 GETTING THE PARTNERS TOGETHER

As already discussed in preceding sections, a specific context must exist within which an incubator can be successful by promoting the development of emerging business ventures. There is always someone who identifies the existence of such conditions first. When the SoftSul initiative was created, the Informatics Institute of UFRGS was the first partner to realize that the fastest way to promote the competitiveness of both existing and new local software firms in a market that is controlled by strong international software companies was to open its labs and offer consultancy to them. This idea has led to the creation of a software incubator inside the Institute. The second step was to persuade potential partners of both the importance and chances of success of such an initiative.

In [Medeiros92], the importance of creating a partnership involving the Government (in all its spheres), the private sector (e.g. through both companies and their representative associations), and the university is underlined as a way to guarantee support of the community for the development of an incubator. In this way, one can assure the political influence as well as the necessary investment in order to both build and legitimize the initiative. However, this can be difficult sometimes. In the case of the software market where most of the successful companies are of small and medium size, and especially in Latin America where many countries undergo hard recession and the market is not very large, at least the part of the private sector represented by software firms can become suspicious about collaborating for the development of a software incubator where new companies can prosper and might eventually compete with them in the future.

If a strong demand for the products or services that will be produced within an incubator exist, it might not be necessary to gather partnerships in order to assure the success of the initiative. The host institution can get its initial investment back quickly from the sales by the incubated firms. This is, for instance, the case with the Technology Incubator of the Catholic

University of Chile [LaVoz94][2]. Based on strong consulting activity in the areas of production planning and resource consumption optimization, a group of professors of the Department of Computer Science of that university decided to create a series of software products to help clients solve their problems. As the demand for those products increased, the university decided to create a business venture (SOLEX) in association with a private company (SONDA) to further improve the products as well as to commercialize them. This is the first company to be created inside the university. The university is now planning the creation of a second firm for both the production and commercialization of a chemical product for a US$2 million market which already exists.

3.2 PREPARING THE MASTER STRATEGIC BUSINESS PLAN

The partnership should invest in the development of a feasibility study which is expected to prove the existence of good market conditions as well as interested entrepreneurs and software companies, and centers of technological excellence.

The study should also be able to justify the development of an incubator in the region relying on market studies that indicate the possibility of return of the investment being made on it. Furthermore, the study should identify the main objectives to be pursued by the incubator's management and it's organizational structure [Pagnoncelli92].

In the case of Latin American countries, the partnership must decide whether the incubator should focus on the local or on the international software market. Besides physical space, all other services offered to tenants must be tailored to the requirements of the target market. Therefore, if the market being chosen is the local one, it is possible that start-ups will have to concentrate their work on both PC/DOS and proprietary operating system based software. On the other hand, if the objective is the international market, software will probably have to be developed in C^{++} (using the object-oriented programming paradigm) to run under UNIX. Thus, training programs, laboratory infrastructure, and marketing advice should cope with the specific requirements of the target market.

The feasibility study should also be able to identify the potential users of the incubator:

- Start-ups either using the incubator as tenants or located outside and exploring the incubator's services;

- Existing companies that are interested either in technological training or in the use of the incubator's labs;

- Joint ventures between existing firms and start-ups.

It is also important to decide where entrepreneurs should come from. The background of a computer science professor or graduate student can be very different from that of an employee of a local business who either represents

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it at the incubator or wants to create his/her own company. This is especially important when considering the development of a training program. In Porto Alegre, we tried to integrate the training of both incubator tenants and employees of local firms interested in acquiring modern software technology. This proved to be impossible, since tenants already have knowledge of various subjects that are completely unknown by most of the business people. On the other hand, computer science professors and students have little idea of many important issues related to both administration and technology management. However, no matter where they come from, most new entrepreneurs from the software sector have neither knowledge nor practice in aspects like long-term project management, software packaging and publishing, software distribution, and marketing.

In [Medeiros92], the task of evaluating a first set of projects submitted for incubation is considered to be part of the feasibility study. At UFRGS, due to a deadline for the submission of funding requests, we were forced to select a first group of tenants even before our incubator master plan was completed, in order to submit a proposal to FAPERGS (Research Supporting Foundation of the State of Rio Grande do Sul) on time. This decision brought us problems later when start-ups tried to legalize their situation with the municipality's board of trade and could not use the university's address as their own commercial addresses, since the incubator itself had not yet been juridically established at that time.

Parry [Parry93] states that the master plan at Surrey covered a whole range of issues from management through to property and finance. Furthermore, the document proved to be very important both in securing permission from three local government bodies for the project as well as in persuading various funding agencies. Another important consideration concerning Surrey's master plan is that it included a detailed marketing plan.

Although a software incubator does not necessarily have to sell space to companies as was the case with the science park at Surrey, it should develop a marketing plan in order to make the community aware of its existence and to gather the interest and understanding of companies that either could help support its development or would profit from using its services. The marketing plan is also very important in order to promote awareness of potential entrepreneurs at the university or in existing companies.

The following purpose should be addressed by the development of a marketing plan:

- To ensure the awareness of the community concerning the incubator;

- To ensure comprehension about the incubator's objectives and how these should be achieved;

- To convince the community that the conditions of the initiative will achieve the objectives;

- To induce participation in the initiative.

Strategies available to develop a marketing plan comprise, among others, direct advertising, editorial coverage, distribution of promotional literature, and running special events on site.

Last (but not least), the master plan should clearly establish the contribution of each individual partner in the initiative [Medeiros92]. The management of an incubator should not accept "symbolic" participation, that is, partners that contribute nothing to either development and maintenance of the incubator but have their names proudly associated with the success of the initiative.

3.3 ORGANIZATIONAL STRUCTURE AND MANAGEMENT

The organizational structure of an incubator is usually represented by a management entity that can be juridically established either as a private business venture, or a private trust, or a non-profit organization. In Section 2.1, we have already discussed the problems that may arise when the incubator is established either as a sector or department of the university or government. Furthermore, by making the incubator's management an independent entity, one prevents a situation where, from the start, some of the partners feel they are the real owners of the initiative.

The incubator's management structure should be kept as simple as possible. Only the really necessary staff should be contracted in order keep the incubator free from political pressure by any of the partners. On the other hand, a light organizational structure simplifies the communication with both partners and tenants and enables the management entity to always be aware of the necessities.

In [Medeiros92] an organizational structure for the incubator is proposed which consists of a superior council (i.e. board of partners), a management entity, and a consultants' committee. The superior council is composed of representatives of the partnership, that is, the sponsors of the initiative who contribute with resources to its development and maintenance. This council is responsible for the development of the incubator's master plan. Furthermore, it supervises the activities of the management entity and defines as well as modifies strategic policies for the initiative. The majority of the council members should represent entities of the private sector (e.g. software companies, banks, and representative associations) in order to reduce governmental influence and the use of political pressure in determining the actions to be taken.

One of the first tasks the council should undertake is to develop a set of internal rules that establish the duties of each sector within the organizational structure. The development of the statutes which regulate the behavior of tenants (i.e. their rights and responsibilities in the context of the incubator) and their relationship to the management entity is also a task that should be taken care of by the council.

Important issues that should be covered by the statutes are:

- **The kind of contract which shall be made between the incubator and the tenant**: To avoid the legal limitations existent for rental contracts in many Latin American countries, the relationship between incubator and tenant could be sealed by a contract for services and a commodatum for the free use of exclusive space. The services for which tenants would have to pay would be the use of common infrastructure, labs, management support, legal and marketing advice, training, and technical consultancy.

- **The time period during which the company can stay in the incubator:** Typically, the time interval for incubation is no longer than 24 months. During this time, a start-up company should go through three different developing phases: a starting, a growing, and a consolidation phase. Many incubators try to support start-ups until the time they start to sell their products or services. Successful tenants should not leave the incubator before they have achieved a sales volume which allows them to economically survive outside the initiative. On the other hand, if tenants fail to reach the consolidation phase in two years, they should be invited to leave the initiative to allow other entrepreneurs to have a chance to develop their companies with the incubator's support.

- **Subsidies regulation:** Subsidies given to tenants in order to reduce their share of the costs of space, infrastructure, and services should decrease according to the time they have already spent at the incubator. In [Medeiros92], a formula is proposed according to which tenants pay only 20% of the bill during the first eight months of incubation, 50% in the next third part of their stay, and 80% of the costs in the last eight months. In those special cases where tenants are allowed to remain in the incubator after two years, they should pay 100% of the costs of its stay.

- **Relationship between the incubator and existing companies which intend to use its services and infrastructure:** The use of incubator services and facilities by companies outside the incubator should always be formalized by a contract. Depending on the company's development stage as well as its economic situation, and on the technological contribution the incubator can make to its products and services, the incubator's management entity should decide how much to ask for its services and the use of its infrastructure.

- **Identification of both common and exclusive costs:** The statute should enumerate those services and infrastructure facilities that are of common use and therefore should have their costs shared among all incubated companies. Similarly, the set of exclusive services and facilities should be identified. The companies should pay for these services and for the use of these facilities on demand.

Relying on the rules established by the council, the incubator's management entity should take care of operational issues related to the selection and accommodation of tenants, the offering of services and training programs, the development and maintenance of the physical infrastructure of the initiative, the use and maintenance of the laboratories, the submission of funding proposals to governmental as well as private institutions, and the development of the marketing program.

The management entity should also develop both formal and informal channels which may increase the communication and encourage the relationship between professionals of incubated firms, on the one hand, and professors and researchers of the associated university on the other. Through these channels, the incubator should achieve one of its main goals: the transfer of technology from the academic centers to the private sector.

The incubator's management should assure access for tenants and associated companies to relevant technological as well as market-related

information such as the existence of research results which can help a start-up develop a product with less costs or the existence of an already established company that wants to subcontract a start-up for the development of a specific task. These and other opportunities can be found, for instance, in market analysis reports and electronically stored databases with either public or subscribed access. However, much interesting information for tenants and the incubator's management itself should be acquired by means of relationships to be established between the incubator's management, on the one hand, and the partnership (i.e. government, private sector, and university) on the other.

Finally, the management of the incubator should define criteria to follow and support the development of the incubated projects. Of special interest are the criteria for project selection and the strategy for helping successful tenants to move outside the incubator without any disruption.

The consultants' committee should help avoid political pressure on the partnership by the selection as well as evaluation of tenants. The incubator's management should create and maintain a database of technical consultants who can be contacted (and probably contracted) to evaluate project proposals and follow up their development within the incubator.

3.4 THE NECESSARY PHYSICAL AND ADMINISTRATIVE INFRASTRUCTURE

The incubator's physical infrastructure must provide exclusive space as well as equipment for each selected tenant. With regard to software start-ups, our experience shows that most of them require room for two to three people. Therefore, when designing the minimum space for tenants, the incubator's management should guarantee room for, at least, three medium sized desks (i.e. desks with sufficient surface to accommodate a microcomputer, writing space and eventually a telephone), a medium sized cupboard and/or a bookcase, and some chairs where visitors can sit. We believe that rooms of 24 m² can provide the necessary space to accommodate all these in a practical way.

The incubator should also provide facilities for common use such as:

- A show room which can be used by appointment;

- An entrance hall and a reception sector where a receptionist can both control the access of visitors to the incubator as well as help them find the tenants they are looking for;

- A number of meeting rooms of various sizes to enable both internal meetings of tenants and management, and meetings of tenants and visitors. Eventually space can be allocated to serve alternatively as a meeting or a show room;

- Toilets, cafeteria and/or restaurant, warehouse, and guard posts;

- Telephone lines and sets, facsimile, and possibly a post office;

- A computer network with a gateway to the Internet to enable tenants and administration to both communicate with and get information from other computing centers such as universities, research centers, and governmental agencies all over the world;

-    Security and cleaning services;

-    A clerk office that provides tenants with services such as accounting support, personnel recruitment advice, typewriting, and completion of technical documents (e.g. funding support requests).

There are a number of services that are of great importance for tenants to develop their work but usually cannot be provided by the incubator itself, since its administration and technical staff must be kept small. The incubator's management should, therefore, establish contracts with third parties (e.g. the university and private companies) who can then provide tenants with specialized services either at below standard market rates or even for free. A list of some of these services is given below:

-    Training programs to improve tenants' technological and managerial skills;

-    Marketing support for the tenants and their products and services;

-    Juridical advisory services in order to legalize the situation of start-ups by the government;

-    Advisory services in matters such as copyright and patents;

-    Advice on finance, accounting, engineering, and management.

The incubator can also help tenants get the above listed services by giving them access to university students in various areas through, for instance, a scholarship program relying on government funding programs.

Besides the infrastructure and services mentioned above, the incubator must provide tenants with either in-house or near-by access to laboratories and equipment for common use such as computers and software, network infrastructure, and peripherals like printers, modems, scanners, storage devices, etc. Furthermore, technology-intensive business ventures should get access to up-to-date bibliography. This concerns not only technical publications such as those one can find at the university library but also business publications, market analysis and prognostics, and product manuals.

Since most of the projects being developed in a software incubator are related to advanced software, hardware, and communications technology, tenants might need to contract high qualified manpower (e.g. network specialist) in order to complement the manpower allocated to projects. To help tenants get this aid at below market rates, the incubator should develop a scholarship program involving both the university and government. Such a program should enable tenants to select university students who get either scholarships or grants to work in incubated projects as part of their courses (i.e. practical training).

3.5   THE PROCESS OF TENANT SELECTION

In order to avoid political as well as economic pressures, project proposals should be submitted for a selection process on the basis of which the incubator's management can justify either their approval or refusal. Furthermore, all acts involving the selection process should be made public, from the call for participation to the notification of both selected and

refused proposals.

At the Technological Incubator of Curitiba (INTEC) [Intec93][3], for instance, the call for participation is periodically made through the press according to available space. In its call for participation, INTEC gives the maximum number of projects it can incubate, the deadline for submission of proposals and the date when the evaluation results will be made public.
At INTEC, proposals must fulfill the following requirements:

-   The project must be described according to specific rules and following a specific format;

-   The project team must be composed of highly qualified manpower, which should be confirmed by the résumé of each candidate;

-   An initial study explaining the market potentialities for the product or service being proposed must be presented. The incubator encourages the submission of proposals which can already prove the existence of customers who commit themselves to buying the results of the project;

-   Another study must be provided in order to prove the economic viability of the project;

-   Entrepreneurs should be able to prove their participation in entrepreneurial training courses;

-   A prototype showing the potential properties of the product being proposed must be presented.

At INTEC, project proposals are both evaluated and classified on the basis of the following criteria:

-   Market potentiality of the products and services being proposed;

-   Technical viability of the products and services being proposed;

-   The technological contribution of the new product for the market (i.e. the product's degree of technological innovation);

-   Entrepreneurial as well as team-building potential of the proponents; These qualities are evaluated by means of interviews;

-   Technical skills of the team being proposed;

-   Intensity of interaction with research institutions;

-   Initial capital investment necessary for the project to be launched;

-   Demand for qualified manpower;

-   The quality of the venture's business plan;

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- The space and infrastructure required by the project.

In [Medeiros92], a list of selection criteria is presented which contains some new requirements:

- The proponents must prove that they have technical skills as well as managerial capability, and the necessary capital in order for the start-up to survive after the incubation period;

- The project's requirements for space, infrastructure, and services must be compatible with the incubator's local existing conditions;

- Depending on the level of competition to be maintained within the incubator, the latter can refuse to accept projects which aim at developing products or services that are already being produced by either actual or former tenants.

At the Austin Technology Incubator, project proposals must show a potential to create jobs, already have a complete prototype of the product, and be likely to leave the incubator as independent businesses within three years.

After investigating project proposal forms of various technology incubators, Medeiros [Medeiros92] proposes his questionnaire be as follows:

- Conceptualization of the kind of business being proposed;

- The project's main objectives;

- Description of the products and services to be developed during the incubation period;

- Identification of the target market;

- Description of the project's macro environment (e.g. economic viability, legal rights and limitations);

- Description of the project's micro environment (e.g. suppliers, contractors, necessary resources, qualified manpower, and competitors);

- Technological conceptualization of the product (e.g. new methodology, new product, or new service, improvements on existing methodologies, products, or services);

- Origin of the necessary technology (e.g. to be developed by the start-up, to be bought either from a private company or research institution);

- Production process: definition of the methodology to be used, the demand for equipment and explanation of how it should be acquired, the necessary space and infrastructure, and the methodology of quality control to be applied;

- The actual state of the product or service: conception phase (i.e. initial research and development stage), basic project, detailed project, prototype, or commercialization phase;

- Marketing and sales plan: product's main advantages compared to competitors, evaluation of the demand for the product or service, equivalent products or services in both the international and local markets, sales strategy, distribution plan, price setting formula, and advertising plan;

- Financial aspects: cost composition (i.e. the role of technology, manpower, and other elements of the development cost of the product), sales prediction, evolution of the monthly income (for the first 24 months), the volume of capital at hand, total initial investment, capital return prediction, and funding sources;

- Organizational and management aspects: definition of the organizational structure of the start-up, demand for manpower and specification of the jobs, task distribution plan, and personnel recruitment plan;

- Specification of services: which services shall be needed eventually, or regularly, or even intensively.

With the submission of project proposals to the SoftSul Incubator, start-ups and entrepreneurs must provide information about the methodology as well as the technology, human resources, equipment, and software programs to be applied to the various phases of the software development and commercialization cycle: analysis, project, program, test, documentation, marketing, distribution, sales, and technical support and maintenance.

It is important to note that in Latin America the majority of the proposals for incubation at a software incubator will be submitted by either computer science students and professors or employees of existing companies. Therefore, it is realistic to expect that most of these people have neither the qualification nor the means for contracting qualified personnel in order to elaborate all those complex market as well as economic and technological studies that are required by the majority of existing incubators. At the SoftSul Incubator, we agree that the incubator's management should help proponents to prepare those studies. If the incubator does not have the qualified personnel to directly support proponents, it should get the necessary funding (possibly from the partnership) to subcontract. At our incubator, we have observed that most market as well as economic and technological studies which are carried out exclusively by proponents are not completely reliable.

3.6   AN EXAMPLE OF A TRAINING PROGRAMME

In July 1993, the SoftSul Incubator selected a first group of nine tenants for a maximum period of two years of incubation. Since most of the young entrepreneurs were either undergraduate or graduate students or even professors of the university's computer science courses, it was clear to us that they would need much more training in both general and complex project management subjects than in software technology themes. On the other hand, the already existing software firms which contacted SoftSul in order to improve their productivity and the quality of the software they produce have a great demand for modern software technology training.

At the end of 1993, SEBRAE and SoftSul signed a funding contract through which the former guarantees to directly subsidize the participation of incubator tenants in SoftSul's training program for two years. SoftSul's

management realized that this subsidy could indirectly help lower the price of a training program for existing companies as well. Therefore, SoftSul's management decided to develop a common training program for both incubator tenants and existing software firms.

The resulting training program integrates managerial subjects with technological ones. Neither tenants nor the staff of existing firms need to attend all the courses. They pay on a course-by-course basis. In what follows, we present the main subjects of SoftSul's Training Program for 1994. Managerial as well as financial subjects are taught either by SEBRAE's own staff or by consultants contracted by SEBRAE. Software technology themes are taught by university professors.

Managerial and Financial Subjects:

- The Building and Legalization of Companies;
- Entrepreneurial Activity: Initial Concepts;
- Marketing for Start-Up Companies;
- Market and Commercialization for Start-Up Companies;
- New Product Development;
- Sales Strategy for Start-Up Companies;
- Negotiation Techniques;
- Cost and the Formation of Price;
- The Management of Start-Up Companies;
- Human Relations and Business;
- Behavioral Development;
- Economic Viability Study;
- Viability Study's Follow Up;
- Business and Macro Environment;
- Market and Demand;
- Production Management;
- Commercial, Financial, and Investment Management;
- The Decision to Invest;
- Principles of the Business Organization;
- Industrial and Software Property;
- Basic Concepts of Both Quality and Quality Management;
- Export: Principles, Legislation, and Opportunities.

Modern Software Technology:

- Object-Oriented Modeling;
- Object-Oriented Programming with C++;
- The UNIX Operating System;
- Programming in the UNIX Environment;
- Interconnectivity and Network Management;
- Programming in the WINDOWS Environment;
- Relational Databases: Data Model, Data Modeling, and Data Manipulation;
- Relational Database Management Systems: Implementation and Performance Aspects;
- An Introduction to Expert Systems.

4.   **SOME RELEVANT EXPERIENCES**

Actual science-technological parks (including their incubators) are based on the North American experiences of the 1950's such as the Silicon Valley (in California) and the Highway 128 (near Boston). These areas evolved

in order to become huge industrial centers that are dedicated to modern technologies such as electronics and informatics. Relying on these experiences, new initiatives were developed in the USA which received the denomination of research parks [Pereira88]. These initiatives have prospered due to the existence of favorable conditions in the regions where they have been established. These conditions include the presence of technology-intensive companies, the offer of risk capital, and a close relationship between an active entrepreneurial community on the one side, and modern research and academic institutions on the other. In the USA, the government has contributed to the development of the parks by heavily investing in selected strategic research areas according to the region. Besides the above mentioned initiatives, the first generation of North American parks includes a technology park for robotics in Michigan, a park devoted to the microelectronics industry in North Carolina, and a park for advanced ceramics in New Jersey.

Following the USA experience, a number of technology parks and technopoles have been created in other developed countries such as Canada, Japan, France, and Great Britain. In England, most of the parks are owned by the private sector and located either close to or inside university campuses. They have proliferated in recent years by absorbing qualified manpower coming from the universities and other research centers due to government's economic policies. In the mid 80's there were already more than 30 science parks in England dispersed all over the country. In this article, we mentioned the experience at Surrey [Parry93].

In Brazil, the federal government has supported the creation and development of parks and incubators since 1984 when CNPq created a special funding program for this purpose. In these ten years of official support, technological parks as well as incubators have proliferated all over the country. Nowadays, such initiatives exist in at least 11 States of the Federation. Most impressive is the situation in the State of São Paulo where there are eight parks and incubators [Medeiros92]. The majority of parks and incubators actually operating in Brazil are not specialized in software technology. However, most of them nurture software firms.

After the CNPq established the Softex2000 Program in order to increase the presence of Brazilian software on the international market, many software nuclei related to that program have started to plan and implement parks and incubators that are specialized in software technology.

Nevertheless, software incubators and related initiatives seem not to be very popular in other Latin American countries. To our knowledge, Chile is now the only Latin American country besides Brazil which has a software incubator.

In the preceding sections, we have already introduced some existing technological parks and incubators (e.g. SoftSul of Porto Alegre, INTEC of Curitiba). In what follows, we comment further on some relevant initiatives that host software companies.

4.1 THE AUSTIN TECHNOLOGY INCUBATOR (ATI)

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Fax: (512) 794-9997

The ATI was created in February 1989 and opened to tenants in June of the same year. At that time, ATI comprised a space of 4000 square feet to be used as office space by tenants. Today, the incubator operates in 60,000 square feet of which 55,000 square feet represent office space and meeting rooms and the rest of the area is used as a small wet laboratory.

ATI is a technology business incubator, nurturing the growth of start-up companies which are developing new technologies. In five years of existence, the incubator has already graduated 15 companies and helped create 600 jobs. The types of technology that ATI has incubated include software, hardware, telecommunications, semiconductor manufacturing, and bio-technology.

ATI is part of the Center for Commercialization and Enterprise in The IC2 Institute at The University of Texas at Austin. The IC^2 Institute is an international research center focusing on the study of innovation, creativity and capital. The actual programs of the Center of Commercialization and Enterprise include the Austin Technology Incubator, The Capital Network, The Austin Software Council, The UT Austin Entrepreneurs' Council, and the NASA Technology Commercialization Centers. ATI works most closely with Capital Network and the Software Council. All these programs operate in the same building, most of them operate in the same office suite.

The Incubator's staff includes a director, an assistant director for external relations, a facilities' assistant, a financial assistant and a receptionist. The professional staff have backgrounds in various aspects of business development.

The incubator does not have equity in any of the incubated companies nor does it invest any funds. It operates as a non-profit organization providing service to the companies.

Companies interested in being incubated must submit a business plan for internal and external review. If the prospective tenant does not have a business plan, the incubator staff will work with third parties to create one. Proponents are evaluated on how well they meet the following requirements:

- Have a technology-based product and a proprietary market position;

- Have a prototype of the product;

- Can bring the product onto the market within one year of incubation;

- Demonstrate entrepreneurial capabilities of management;

- Show the potential to create jobs;

- Have growth potential;

- Have a well documented written business plan;

- Demonstrate team-building potential;

- Are likely to graduate as successful, independent businesses within three years.

The number of employees in each company may vary from as few as 1 to as many as 50. These numbers as well as the number of tenants are constantly changing. Actually, there are 27 incubated companies.

Tenants in the incubator have a three-year time limit on their stay, but most successful companies leave within two years. The three-year time period encourages tenants' growth and ability to create jobs. Their rental fees increase over the time interval of their stay. Besides inexpensive office space, the incubator offers the following services to tenants:

- Inexpensive access to meeting rooms, including an electronic meeting room, copy machines, fax machines, voice mail and the services of a full time receptionist;

- Access to an extensive network of professionals in accounting, law, marketing, finance, engineering, and management, all of them at below standard market rates or no cost at all;

- Access to university students in business, engineering, law, communications, public affairs, library science and other fields;

- In-house consulting services provided by ATI staff that have extensive experience on working with start-up companies.

Two examples of companies that either actually are tenants at or have already left ATI are given below:

CopiaTech Corp. develops and sells LegacyWare software which logically unifies heterogeneous computing environments. The software combines different data models into a single logical model enabling the user to manipulate the data as though it all resided on their individual system. Users can develop applications 10 times faster and applications can execute as much as 100 times faster.

Collaborative Technologies Corp. is the creator of VisionQuest, a LAN-based group decision support system. It is used for strategic planning, product development and total quality management by Fortune 500 companies and has reduced meeting time by as much as 70%.

4.2   THE IPA'S SOFTWARE TECHNOLOGY CENTER (STC)

STC was created by the Information Technology Promotion Agency of Japan's Ministry of International Trade and Industry (MITI) in October 1981 [Kamijo92]. STC is the first Japanese open laboratory type organization for software technology. It works as an R&D department of IPA and is supported by

universities, hardware industry, software vendors, and influent computer users. All results produced at STC are of public domain but carry private know-how of any of its partners.

STC's objectives involve R&D in interdisciplinary subjects covering software development, software applications, and the effects of software on society. It does not develop basic software or finished software products. STC aims at integrating potential academic talent with the development ability of software specialists, and the application know-how of computer users.

The organizational structure of STC consists of a management entity which is represented by IPA, a Project Selection Committee, and a number of Action Teams. At STC's request, subjects for R&D projects are proposed by institutions involved in information processing. Submitted themes are then evaluated by the Project Selection Committee. For each selected theme, STC's management tries to persuade other potentially interested organizations to join a project in order to develop it. Interested organizations participate in the project with personnel, advice, and indirect costs. STC assembles the action team, assigns the necessary capital to the project, and controls its development.

Action Teams are composed of technical staff coming from both university and the private sector. STC's staff are either on leave from their institutions to develop a specific project within a termed period, or assigned to STC as an additional job. The average size of a team is three to four technical staff. Projects last from two to three years. The average budget for an action team is equivalent to US$1 million including indirect costs (i.e. costs incurred by a company which a technical staff member leaves for a certain period in order to join an action team).

The institutions that join a project (e.g. contribute to a project with staff) form the so-called Members Committee of the project and advise its associated action team. Furthermore, when a prototype program is required, the action team can ask a software house to develop it.

The Selection Committee seeks themes within three major areas: software development technology, software application technology, and impact of software on the information society. These three R&D areas of STC are explained in more detail below:

- **Software Development:** Three major sub-areas have been selected: requirements specification, automatic programming, and software evaluation. Some project results in these areas are: SKETCH (Specification, Knowledge-base, Evolution and Technology), MOTHER SYSTEM (business application generator), PAPS (Practical Automation Programming System), SNAPSHOT (visual programming based on an object-oriented paradigm), and QFD (Quality Function Deployment, software evaluation by quality-function analysis).

- **Software Application:** Projects in this area comprise the following themes: computer-assisted instruction (CAI), computer-assisted design (CAD). The following projects have been developed: ACE (courseware executer and authoring system), Guidance System for Software Users (QA-type teaching material for UNIX), Understanding the Plant Layout Drawing, and Understanding the Drawings of Mechanical Parts.

- **Information-Society Related Software**: Projects in this area address themes like computer security and natural Japanese language processing.

In [Kamijo92], at least two main challenges of an open laboratory such as STC are pointed out:

- The difficulty of good project management. Since most of the STC staff are temporary and come from outside, it is hard to both get people trained and experienced in project management strategies, and identify leadership to be assigned to projects.

- The necessity to establish both an appropriate metric and a methodology to evaluate project results. Actually, for this purpose STC uses the marketability of the resultant technology as a measure of project success.

4.3   THE UNB'S TECHNOLOGY DEVELOPMENT SUPPORT CENTER (CDT)

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The University of Brasilia (UnB) founded the CDT in 1986. It has also been supported by Brasilia's Federation of Industry, the local government, SEBRAE, and CNPq. It was created to become a bridge between UnB and local technology-intensive businesses. The CDT is an autonomous center that gets part of its budget from the UnB. The other part is earned through services contracted by the industry.

CDT is mainly concerned with its technology incubator program which was created in 1990. The incubator hosts technology-intensive start-ups in the following areas: informatics, microelectronics, systems automation, precision mechanics, and bio-technology. The initiative actually supports the development of 15 companies.

CDT's organizational structure consists of a director, an administrative advisor, a clerk, two administrative aids, and four engineers. Its budget including personnel and all other expenses amounts to US$144,000 a year.

Tenants can rent space for US$3 per square meter a month. As with other incubators in Brazil, there is a subsidy for space rental that is reduced during the period of incubation. The subsidy given by the CDT to tenants for space rental and other services must be returned to the incubator after the companies have left it. It is paid in terms of a percentage (0.5%) of the company's gross income. Furthermore, CDT has a 1% participation in the company's income.

The following facilities and services are offered to start-up companies:

- Exclusive space of 30 square meters on the average;

- Communications infrastructure: phone, facsimile, telex, electronic mail (through BBS and BITNET);

- Administrative services: copy machines, cafeteria, and security;

- Training programs which include subjects like technology and project management, and training in administrative matters;

- The CDT owns two labs for common use: an informatics and a microelectronics laboratory. Besides these, tenants have access to all UnB's laboratories;

- The CDT maintains a team of technical consultants to support tenants' needs. Besides that, the CDT creates a bridge between tenants and UnB's professors and graduate students;

- Through the CDT, start-up companies may acquire scholarships from CNPq by means of which personnel can be hired for the development of incubated projects.

Tenants can stay at the CDT's incubator for as long as five years. Their initial contract is usually for three years. During their stay at the incubator, start-ups should organize themselves as a commercial entity in order to be able to survive in the market after leaving the CDT.

Among the results produced by software companies at CDT, we can mention software for office and laboratory automation and software for the control unit of facsimile machines.

4.4 THE TECHNOLOGICAL PARK OF PARAIBA (PaqTc-Pb)

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PaqTc-Pb is a private trust (foundation) which aims at the development of a high-tech industry by Campina Grande in the State of Paraíba. The technological park specialized in the areas of electro-electronics, informatics, and industrial design. It was created in December 1984 with support of the CNPq's Technological Parks Program.

The partnership that controls the enterprise is composed of the CNPq, the Government of the State of Paraíba, the Federal University of Paraíba (UFPB), and the Bank of the State of Paraíba (PARAIBAN). Other participants are the Municipality of Campina Grande and the Federation of Industries of the State of Paraíba (FIEP).

The PaqTc-Pb integrates a technological park with incubator, a commercialization sector, a department for the organization of events and training programs, a department for both technological cooperation and transfer of technology, and an information service that provides access to various databases. Its organizational structure comprises an administrative board, a management entity (composed of a general director, a technical director, and an administrative director), and a consulting committee. The initiative now has a staff of 20 members.

The incubation period consists of two distinct phases:

- **Implementation Phase:** A six-month period within which the start-up should form its staff, guarantee the necessary investment (e.g. risk capital), and acquire the necessary equipment;

- **Project Developing Phase:** A twelve-month period during which the company develops its product or service in order to be able to present concrete results according to the original project plan.

Actually, the PaqTc-Pb hosts seven tenants in its incubator and supports the development of 13 other already existent technology-intensive companies. Together, these businesses have an annual income of approx. US$4 million. Moreover, some of these companies already export their products to Canada, the USA, Portugal, and some Latin American countries.

4.5   THE BLUSOFT'S SOFTWARE INCUBATOR

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BLUSOFT is one of 13 software nuclei distributed over eight States of Brazil. As already mentioned, these initiatives aim at increasing both productivity and quality in software companies in order to increase Brazilian participation on the world's software market. Most of these initiatives are being developed as software-technology parks and incubators.

The BLUSOFT initiative is supported by Blumenau's Commercial and Industrial Association (ACIB), the Municipality of Blumenau, the ASSESPRO, the Regional University of Blumenau (FURB), the Telecommunications Company of the State of Santa Catarina (TELESC), and the State Government.

The organizational structure of Blumenau's Software Nucleus consists of an administrative council and an executive director who supervises a marketing as well as a technology and a financing sector. The software incubator falls under the control of the technology sector. It is composed of three elements: secretary, general services, and tenants.

Now the incubator can host 17 tenants, and it is expected to accommodate 50 start-ups in the near future. It occupies a whole floor at TELESC's building where the complete infrastructure of the incubator is being built.

The incubator's space is divided into five main sectors:

- Common use facilities such as reception, library, show room, meeting room, toilets, and labs;

- Exclusive space for tenants;

- TELESC's tele-informatics developing sector;

- SEBRAE's office which will offer managerial training and legal advice to tenants;

- Space for an advanced installation of the university inside the incubator.

It is important to note that the BLUSOFT initiative is not using labs and other facilities or services of some university, but is implementing its own labs and library and even opening space inside the incubator to create an advanced office of the university.

Among the services offered to start-ups by the incubator there is a post office service and the services of a library. Furthermore, the incubator will maintain special staff in order to offer in-house services, being juridical advice, technology and market information, joint equipment acquisition, and marketing and sales.

In the first six months in the incubator, tenants must pay a rent of US$2 per square meter. In the second semester, tenants pay US$4 per square meter rented. After the first year of incubation, tenants must ask for special permission in order to remain in the incubator.

The incubator's efficiency will be evaluated on the basis of the following criteria:

- The rate of start-ups which graduate from the incubator and succeeded on the market in relation to the number of tenants accepted by the incubator;

- The number of qualified manpower (with at least undergraduate course) working in incubated projects compared to the number of unqualified workers;

- The number of new jobs created by tenants and already graduated start-ups;

- The participation curve of Blumenau's software companies on both the national and international software markets.

5. CONCLUSIONS AND FINAL REMARKS

The world's software market reached more than US$200 billion in 1993. It is one of the fastest growing markets with a growth rate of 15% to 18% annually. While industrialized countries share more than 90% of the world's software market, Latin American countries have practically no participation in it. Even their own domestic software markets are dominated by international companies from developed countries.

In Latin America, the local software industry concentrates mainly on the production of tailored software for specific applications and customers. This has been the only market segment where domestic industry can compete with advantage, since tailored software usually demands a sound knowledge of specific customer's needs and knowledge of both local legislation and culture. However, the segment of tailored software accounts for a very small portion of the software market. Main segments are those of package software and systems integration.

To be competitive in those market segments, the Latin American software industry must acquire know-how in modern software technology as well as in other information technology areas (e.g. telecommunications and multimedia). A sound alternative to transfer modern technology to Latin American software companies is the development of technology parks and incubators that create the bridge between the software industry on the one side, and academic as well as research institutions on the other. The government should work in the background by giving economic support and buying the products developed at such technology transfer centers.

However, these initiatives can succeed only where there is both a domestic software market that demands modern software technology based products and services, and the support of the local community in terms of capital investment, political influence, and manpower to enable their creation and maintenance.

A number of factors must be taken into consideration during the planning and development phases of a software park or incubator in order increase its chances of success. In the context of Latin American countries the most important of them are:

- This kind of initiative cannot be created by law. It must be the result of a demand by the market and the local community. Otherwise, none of the partners involved in its creation will feel responsible for its success;

- The government should not be the owner of the incubator. Especially in Latin American countries, this fact could reduce the development chances of the initiative due to political pressure and unstable management conditions;

- The initiative should be located in some active software research center (e.g. a university's computer science department) and be able to provide access for tenants and other associated companies to the center's laboratories and qualified manpower (e.g. students and professors);

- The partnership controlling the incubator should guarantee the necessary investments for the initiative to be developed (e.g. capital for the construction or acquisition of a building and the hiring of the incubator's staff);

- Tenants should have easy access to risk capital. In order to guarantee these investments, the partnership should negotiate with financing institutions of both government and private sector. In the face of the deep recession which many Latin American countries are going through,

this seems to be one of the most difficult tasks that must be carried out by the partnership;

- The selection of tenants must depend on their manpower qualification and the real chances of their projects on the market. It should never be related to political convenience;

- Training programs for tenants should not only address software technology subjects but also develop tenants' managerial skills;

- Both start-up companies as well as the incubator itself should develop efficient marketing plans, because the success of software products is not related only to their technological properties but also to the ability companies have to put them on the market.

- Besides space and access to software laboratories, the incubator should provide tenants with a set of specialized services (e.g. legal advice) and a physical and administrative infrastructure. In order to maintain a reduced staff body, the incubator should subcontract some of the services to the local market.

REFERENCES

[Allen89]   Allen, D. N.; Bazan, E.: Evaluation of Multi-Tenant
                Buildings as a Component in Local Economic Recovery. Athens
                (OH), NBIA Publications, 1989.

[Baecker93]   Baecker, R. M.: Operating a Successful Software Business.
                Department of Computer Science, University of Toronto,
                Canada. Slides presented at the Seminar on Successful
                Software Business, Santiago, Chile, 1993.

[Camp87]   Campbell, C. et al.: Change Agents in the New Economy:
                Business Incubators and Economic Development. Athens (OH),
                NBIA Publications, 1987.

[CNPq92]   Directory of Special Programs - CNPq: Strategic Development
                of Informatics in Brazil: Articulation of Efforts and Re-
                positioning of the Sector. CNPq-PNUD Project, Brasilia,
                August 1992.

[Correa93a]   Correa, C.: Strategies for Both Software Development and
                Export in Latin American Countries. Invited talk at the
                EMPRETEC's Technical Workshop on Export Development of
                Computer Software and Services, Montevideo, Uruguay, April
                1933 (in Spanish).

[Correa93b]   Correa, C. (editor): Production and Commercialization of
                Software in Latin America. Zagier & Urruty Publications,
                April 1993.

[DelFosse92]   DelFosse, C.: Technology Transfer at the Software
                Productivity Consortium: A Partnership Approach. In:
                Gibson, D. V.; Smilor, R. W. (eds.): Technology Transfer in
                Consortia and Strategic Alliances. Lanham (Maryland),
                Rowman & Littlefield Publ., pp.213-221, 1992.

[Intec93]   IPARDES (ed.). The Technological Incubator of Curitiba:
                INTEC. Curitiba, Brazil, 1993 (in Portuguese).

[Iochpe93]   Iochpe, C.: Travel Report: SOFTWORLD'93, ITAA, World Bank,
                and Department of Commerce - Software Sector. SoftSul,
                Porto Alegre, Brazil, Sept. 1993 (in Portuguese).

[Itamarati93]   The Brazilian Consulate in San Francisco, Sector of
                Commercial Promotion. The Silicon Valley in the Context of
                both the World Market and the North American Industry of
                Information Technology: Trends and a Chance for the
                Brazilian Industry. Technical Report, San Francisco, August
                1993 (in Portuguese).

[Kamijo92]   Kamijo, F.: Comparison of Several Types of Consortia for
                Software Research and Development. In: Gibson, D. V.;
                Smilor, R. W. (eds.): Technology Transfer in Consortia and
                Strategic Alliances. Lanham (Maryland), Rowman &
                Littlefield Publ., pp.193-200, 1992.

[Medeiros92]   Medeiros, J. A. et al.: Poles, Parks, and Incubators: The
                Search for Modernity and Competitiveness. Edited by the
                CNPq, ISBN 85.7013.039.2, Brazil, 1992 (in Portuguese).

[Pagnon92]   Pagnoncelli, D.; Vasconcellos Filho, P. Planned Business
                Success. Rio de Janeiro, Qualitymark Publishers Ltd., 1992
                (in Portuguese).

[Parry93]   Parry, M.: Science Parks...the Driving Forces behind the
                Concept. Invited Talk. University of Surrey, England, 1993.

[Pereira88]   Pereira, M. G. et al.: The Implementation of Technological
                Parks in Latin America: The Brazilian Experience.
                UFRJ/Nucleus for Technological Innovation, Rio de Janeiro,
                March 1988 (in Portuguese).

[Piccinini93]   Piccinini, V. C.: The Collaboration Business-University:
                The Case of the Technological, Entrepreneurial Incubator of
                Porto Alegre. Series Documents for Study, PPGA - UFRGS,
                Porto Alegre, Brazil, Sept. 93 (in Portuguese).

[Powell92]   Powell, D.: Computer Technology Network: Company Directory.
                Information Technology Research Centre (ITRC), University
                of Waterloo, Ontario, Canada, 1992.

[Schware92]   Schware, R.: Software Industry Entry Strategies for
                Developing Countries: A "Walking on Two Legs" Proposition.
                In: World Development, Vol.20, No.2, pp.143-164, 1992.

[SoftLetter93] Benchmark Report: Technical Support Cost Ratios. In:
                Soft∘Letter: Trends & Strategies in Software Publishing,
                Vol.10, No.10, Watertown (Mass.), USA, Sept. 1993.

[SoftSul94]   Augusto, A.: A Project for the Rio Grande do Sul's Software
                Nucleus. Informatics Institute of the Federal University of
                Rio Grande do Sul, Porto Alegre, Brazil, Second Edition,
                January 1994 (in Portuguese).

[LaVoz94]   Engineering School of The Catholic University Will Open Two
                Companies This Year. Editorial of "La Voz de la Libre
                Empresa", Santiago, Chile, March 14, 1994 (in Spanish).