

CAPÍTULO 10. NEW TECHNOLOGY BASED FIRMS: THE PROCESS OF FOSTERING ENTREPRENEURSHIP

(preliminary draft text, to be revised and completed by July 2000)

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10.1 Technological Innovation, Entrepreneurship and Economic Development

Entrepreneurship seems to be the most recognisable and admired profession in the late nineties. The social functions it is assuming is enormous when debate about innovation, development and economic growth take place. Entrepreneurship has been responsible for the creation of new enterprises and revitalisation of existing ones, creation of new jobs and even the transformation of the economic environment as a whole. As the OECD (1998) states:

Nations prize entrepreneurship both because economies with substantial entrepreneurial activity constantly generate new and improved products and services, and because a significant level of entrepreneurship can have a number of social benefits. Such entrepreneurial economies are also likely to be highly adaptable and thus able to seize opportunities as they emerge. (OECD, 1998:1).

The American economy has been taken as an example of effort in stimulating entrepreneurship. As long as 1984, Drucker (1984) emphasises the importance of entrepreneurship within the American economy since it has generated more than 20 million new jobs between 1970 and 1980, a movement that has been accelerated during the current decade.

Entrepreneurial activity should not be confined only to businesses as an industrial activity. The so-called third sector (non-profit but non-governmental activity, such as health care institutions) and the fourth sector (public-private partnerships, such as bus transportation services) are also important components of the economic activity, being not more restricted to the American context but spread all over the world.

The enlargement of the meaning of entrepreneurial activity has a strong connection with the understanding of the entrepreneurs' responsibilities within society. In fact, these responsibilities have evolved over time, since the Middle Ages when an entrepreneur used to be an "actor and person in charge of large-scale production projects", through the 17th and 18th centuries in which an entrepreneur had his capabilities recognised through the right of profiting (Hisrich and Peters, 1998). During the 20th century, a handful of scholars – Schumpeter, Drucker, Shapero, among others – have dealt with entrepreneur/entrepreneurship issues. Schumpeter, for instance, defined an entrepreneur as an innovator who dealt with new technologies. More recently, Molian and Leleux (1997) point out that entrepreneurs are those individuals that are able of identifying an opportunity that might generate economic value and then seek adequate resources for its exploitation. The same line of thoughts is presented by Hisrich and Peters that consider "entrepreneurship [as] a process of creating something different with value by devoting the necessary time and effort, assuming the accompanying financial, psychological, and social risks, and receiving the resulting rewards of monetary and personal satisfaction" (Hisrich and Peters, 1998:6).

Currently, particular attention has been given to a specific kind of new venture: those referred as new technology based firms (NTBF) – usually small high technology firms operating in specific market niches, presenting a high capacity of raising financing and providing high rates of return.

What is clear, however, is that entrepreneurship, as an economic activity, requires not only entrepreneurs' personal skills but also adequate environmental conditions for being undertaken. Again, quoting the OECD Report (1998),

Fostering entrepreneurship involves ensuring that markets for capital, labour, goods and services are working well. It also requires that impediments to entrepreneurship be removed and that the conditions be established in which innovation and risk-taking can flourish. Policy-makers also seek to foster entrepreneurship through programmes which, for example, augment the supply of information, encourage networking, facilitate the provision of finance, and seek to create positive attitudes towards entrepreneurial activity. (OECD, 1998:1).

In terms of entrepreneurs' skills, Hisrich and Peters (1998) suggest some basic characteristics entrepreneurs should possess in order to be well succeeded in their profession, as presented in Table 10.1.

Table 10.1 – Entrepreneur's Skills following Hisrich and Peters (1998)

Technical Skills	Business Management Skills	Personal Entrepreneurial Skills
Writing	Planning and Goal setting	Inner control/disciplined
Oral Communication	Decision-making	Risk-taker
Monitoring Environment	Human relations	Innovative
Tech. Business Management	Marketing	Change-oriented
Technology	Finance	Persistent
Interpersonal	Accounting	Visionary leader
Listening	Management	Ability to manage change
Ability to organise	Control	
Network building	Negotiation	
Management style	Venture launch	
Coaching	Managing growth	
Being a team player		

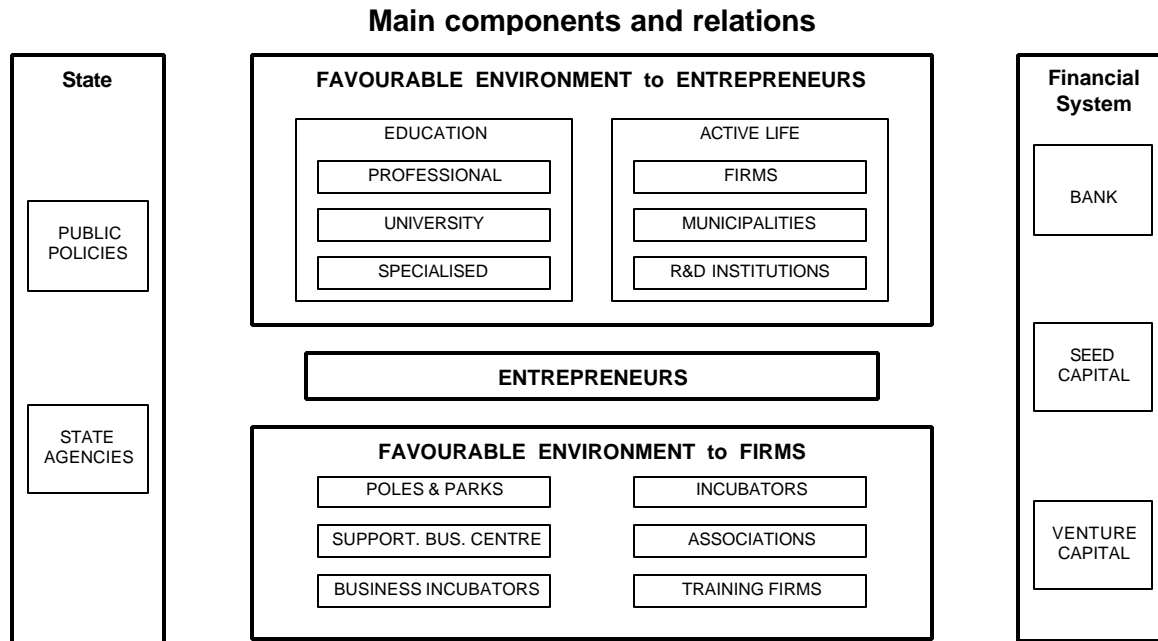
Source: Adapted from Hisrich and Peters (1998:20).

Besides personal skills, the very process of creating a new venture also requires the fulfilment of some conditions that are essential for the identification and development of a new enterprise. As Hisrich and Peters (1998) and Klofsten (1998) point out, the new entrepreneur should be able of:

- Identifying and evaluating the economic opportunity of an idea, taking into consideration its value, risks and returns, personal skills and goals, competitive situation;
- Developing a Business Plan that involves a series of plans such as financial plan, marketing plan, production plan, organisation plan, operational plan, besides executive summary, summary and appendices;
- Evaluating the required resources taking into consideration the existing ones as well as those that are missing and their sources, plus personal and environmental contexts;
- Evaluating the management team and its ability in coping with internal functions, taking into consideration the style and variables for success, as well as the identification of systems of control and potential problems.

In addition to the personal skills and some conditions that the entrepreneur and the new venture should respond and/or adjust to, the external environment in which the [new] venture will operate has a profound influence on its development. This external environment encompasses, for instance, public policies (education, science and technology, employment), financial systems, supporting agents and the market per se. Entrepreneurship is, in summary, an integrated system involving personal skills but also the environment that surrounds and moulds the way in which ventures are set up and evolve over time. It is this integration that makes entrepreneurship a process so difficult to be implemented and achieved. The diagram below, based on Andrez and Mateus (1999), summarises a dynamic entrepreneurship system with its essential components.

Figure 10.1 Dynamic Entrepreneurship System



Source: Andrez and Mateus (1999:29).

10.2 Structural Factors

10.2.1 Towards a new institutional framework and culture

North (1998:vii) has emphasised:

“History matters. It matters not just because we can learn from the past, but because the present and the future are connected to the past by the continuity of a society’s institutions. Today’s and tomorrow’s choices are shaped by the past. And the past can only be made intelligible as a story of institutional evolution. Integrating institutions into economic theory and economic history is an essential step in improving that theory and history” (North, 1998:vii)

Institutions and organisations are essential components of History. Institutions dictate the formal and informal rules to society, shaping the human interactions. Organisations, on the other hand, provide a structure to these interactions, and they include, according to North (1998) “political bodies (political parties, the Senate, a city council, a regulatory agency), economic bodies (firms, trade unions, family farms, cooperatives), social bodies (churches, clubs, athletic associations) and educational bodies (schools, universities, vocational training centres)”. Institutions and organisations have a symbiotic relationship, influencing and re-shaping each other, determining the opportunities in a society and how this society takes advantage of them.

State, as a political body, has a crucial function in supporting and stimulating organisations, among them those linked to the entrepreneurial activities. In this particular, State should not exceed or substitute the private initiative. Governments must act as a facilitator and an integrator of whole system.

In order to illustrate this point, it could be quoted the European Union policy effort to support European Small Businesses (among them the NTBF) as a resource for job creation and employment strategy. In other words, an effort to stimulating entrepreneurship. As Ianniello (1999) emphasises:

Small business (with less than 50 employees) are the vital driving force behind growth and employment in Europe:

- They represent 98,9% of EUR 19 [concerning the 15 members of the European Union, plus Iceland, Liechtenstein, Norway and Switzerland] enterprises;
- Over 90% of European enterprises have fewer than 10 employees;
- Small enterprises are less vulnerable to business cycle fluctuations;
- They are the most labour intensive;
- New jobs in Europe are created mainly in the smallest enterprises.

European small businesses face special difficulties in three main areas, namely: (1) internationalisation, mainly in relation to finding and evaluating partnership (subcontracting), establishing equal commitment with larger companies, lack of resources and communication issues; (2) external advice, mainly for supporting initial phases of a new venture; and (3) innovation and high technology, mainly for developing in-house R&D.

Specific Actions to Support European SMEs

Third European Conference of Crafts and Small Businesses (Identified priorities):

- To encourage the economic success of crafts and small businesses by creating an environment conducive to their development;
- To promote the emergence and development of a European small business culture;
- To ensure that the crafts and small business sector is taken into account from the very outset in the planning of national and Community measures and/or policies in the economic and social field, in particular in consultations and negotiations at all levels;
- To encourage crafts and small businesses and their representatives to become involved in the processes of exchange and co-operation, both intra-Community and with non-member countries;
- To increase competitiveness and innovation in crafts and small businesses.

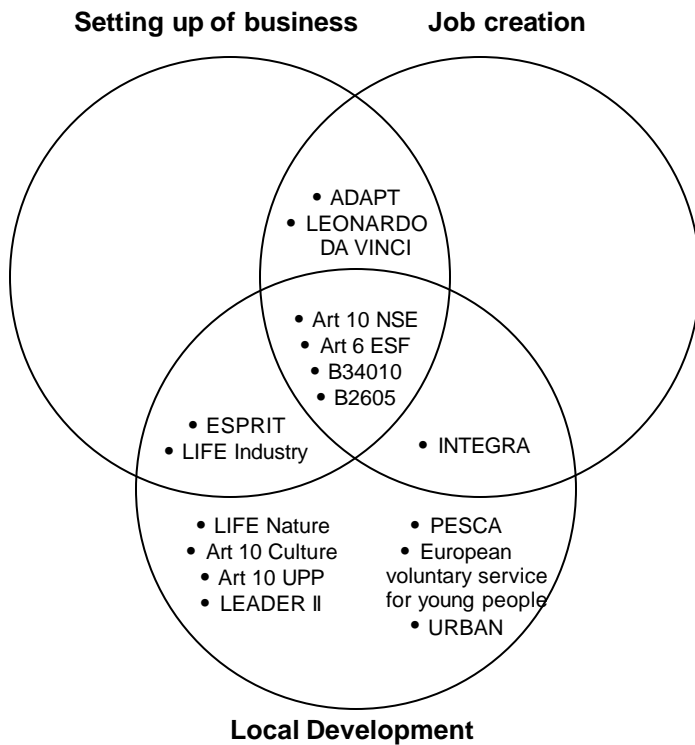
Launching of studies, seminars and pilot projects:

- Identification of the needs of crafts and small business, involving them in transborder activity;
- Improvement of standardisation of craft products;
- Financing of enterprises;
- Encouraging the spirit of entrepreneurship through training;
- Overcoming the specific difficulties faced by the target groups of entrepreneurs;
- Influencing Community policies to include the specific requirements of the sector and of women and young entrepreneurs in particular.

Source: Based on Ianniello, 1999:35.

The following chart presents the European Community programmes designed to help SMEs.

Figure 10.2 Community Programmes Helping Small Businesses



Other measures have also been encouraged within the European context. Particularly in relation to innovation and entrepreneurship issues, it has been acknowledged that Europe is lagging behind its major competitors (USA and Japan) in terms of translating scientific and technological achievements into industrial and commercial outputs. Aiming at supporting a very dynamic and heterogeneous community of small and medium European enterprises, the European Commission has designed specific programs in order to promote innovation and, as a consequence, to improve companies' internal and external competitiveness and nations' sustainable growth, social development and job creation. Examples of this strategy is the "Innovation" program and its ramifications such as the Promotion of Innovation and Encouragement of SMF, Technology Transfer & Technology Validation Projects, Support Networks, Innovation Relay Centres¹, support to technological infrastructures such as Science and Research Parks.

Portugal, as a European country, has also been set up its own initiatives in order to support Portuguese NTBF. Examples of these initiatives can be found in the establishment of, for example, the Agencia de Inovação, IAPMEI....

[to be discussed, revised and completed]

¹ "The goal of the IRC network is to promote innovation, to encourage exchange of research results between organisations across Europe, and to provide advice, consulting and training support which meets the specific needs of each company and their local industrial situation....Today, there are 53 Relay Centres in the European Union, Iceland, Norway and Israel, with further 10 Fellow Members in Central and Eastern Europe". The IRC project involves the participation of 172 across 18 countries.

10.2.2 Education and Training for a new culture

As discussed in chapter 3, learning is the fundamental ability of human beings lying at the heart of economic prosperity. We also proposed a new conceptualization of the mechanisms through which learning occurs and contributes to economic development, building on recent developments that try to deviate from the rigidities of the “standard model”. Our model emphasizes the importance of the learning processes, in contrast with the more traditional perspectives that focus primarily on the inputs and the outputs of these processes.

In this section, we present several instances in which the contribution of universities to economic development has gone much beyond the standard model, and has even surpassed what the three formalized ways of learning would lead us to expect. For lack of a better term, we group these instances as “learning-by-living”, reflecting the fact that the common feature to all of them is that they are developed by people living at universities. Universities provide an environment that allows people to learn just by the fact they are there, in an institutionally unique and special setting, a societal space for creativity, experimentation, risk-taking, intellectual venturing, and human interaction. We intend to stimulate an interest for future research, rather than presenting accomplished research results.

The organization of the section, in some sense, could almost define a taxonomy for the ways in which the hidden contribution of universities is reflected in society. We begin to discuss entrepreneurial universities, in which the institution itself took the initiative of explicitly promoting economic development. Then we discuss instances in which faculty and students proved to be entrepreneurial.

Entrepreneurial Universities

The term entrepreneurial universities was coined by Dylan Jones-Evans [60] and Burton Clark [61] to describe instances in which universities have proved to be key for regional economic development, going much beyond the provision of graduates and research. The case of Stanford is a classical example [62]. Inspired by the leadership of Dean Fred Terman in the 40s, Stanford developed a culture of actively engaging in the economic affairs of the community, namely by encouraging faculty to pursue private ventures outside the research lab.

A less known example is related with the role of the University of Texas at Austin in promoting the emergence of the city of Austin, Texas, as a technopolis. UT-Austin was key in attracting MCC to Austin, by using its resources and prestige to engage in a massive fundraising campaign. The funds raised largely due to the involvement of UT, in conjunction with local government and business leaders, was used to endow new chairs at the college of engineering, and even to construct the building that, eventually, housed the MCC consortium [63]. More recently, UT-Austin reinforced its activism in promoting economic development by launching and running one of the most successful business incubators in the United States, the Austin Technology Incubator [64].

Jones-Evans [60] and Clark [61] provide case studies of entrepreneurial universities in several European countries. The point is that, as with the American examples of Stanford and UT-Austin, sometimes universities as institutions go much beyond the classic role of providing graduates and R&D results, and actively engage in promoting economic development activities.

The ways by which universities can pursue this active role are extremely varied, as the few examples mentioned here suggest. Research is needed to systematize these forms of engagement, and to try to understand why and when they occur, and what are the conditions that make them have an impact.

Entrepreneurial Faculty and students

Somewhat related with the later subsection are the instances in which faculty members launch private ventures. However, this can occur even if the university does not provide a friendly environment to individual entrepreneurs. Gibson et al. [64] describe the case of Tracor, a Fortune 500 company founded by UT-Austin faculty members in the 50s. UT was not actively encouraging their faculty to be entrepreneurial, but the university context provided a context that launched the seeds of a successful business venture.

Also, the stories of Bill Gates, of Microsoft, Marc Andreessen, of Netscape, Michael Dell, of Dell Computer, and Joe Liemandt, of Trilogy, have something in common: they all begin with the protagonists starting their ventures while attending college. These colleges and universities were, respectively Harvard, University of Illinois at Urbana-Champaign, UT-Austin, and Stanford.

Many other examples of entrepreneurial faculty and students could be given in the US [65] and Europe [60, 61, 66]. These examples show how the environment provided by the university was valuable, not only as a source of technical expertise, but also as a mean to access capital for investment, and even customers. Literally, faculty members and students acquired a wealth of codified and tacit knowledge through learning by living at a university. Research is needed to try to understand which conditions lead faculty to be successful entrepreneurs, how the university may play a role, and what environmental conditions foster these activities. Universities must accept that some of their faculty will go way, taking their risks, impoverishing the intellectual capabilities of the university, but eventually creating local and global wealth, for the well-being of society at large. Wealth that may be valuable to the university prosperity in the long-run.

CASE STUDY: Junior Enterprises - The concept

A Junior Enterprise is a non-profitable association linked to a University, created and managed by students and aiming to be close to the market. Since its rational is to test the theory in practice, it can be linked to any area of knowledge. The main objective of a junior enterprise is to provide curriculum and professional experience and vision.

JUNITEC, the junior enterprise of Instituto Superior Técnico (IST), was funded in 1990 and since the very beginning was concerned with its self-financing. IST provided the space under a symbolic fee plus some facilities (computers, telephone and fax connections). The working groups of Junitec approach several areas of knowledge, providing the junior with competence for developing and delivering a large bunch of products and services. Consulting was the first step of this junior, being the MacIntosh representative in Portugal. After 1997, areas such as internet and multimedia assume a core function. Examples of products and services are the IST's CD-ROM and internet site; the Language Notebook CD-ROM, simulation of a Physics Laboratory for secondary schools and contracted by Porto Editora, monitoring aquatic system linked to Portuguese Regional Development Agencies, broadcasting technological diffusion to a private TV channel; the IST's economic vehicle for an inter-university competition; the NetINDEX that allows the access to more the 340.000 Portuguese web pages.

10.3 Funding and Investment for entrepreneurs

Financing new venture is a key feature to foster entrepreneurship, mainly when new technology based firms is on stage. This is because NTBFs require a set of specific financial instruments designed for supporting their several phases of development, with special attention to their initial steps. Four reasons have been mentioned for justifying this need: (1) high risk in commercial and technological terms; (2) lack of guaranties NTBFs present to face these risks; (3) uncertain profitability; and (4) lack of cash flow and equity capital.

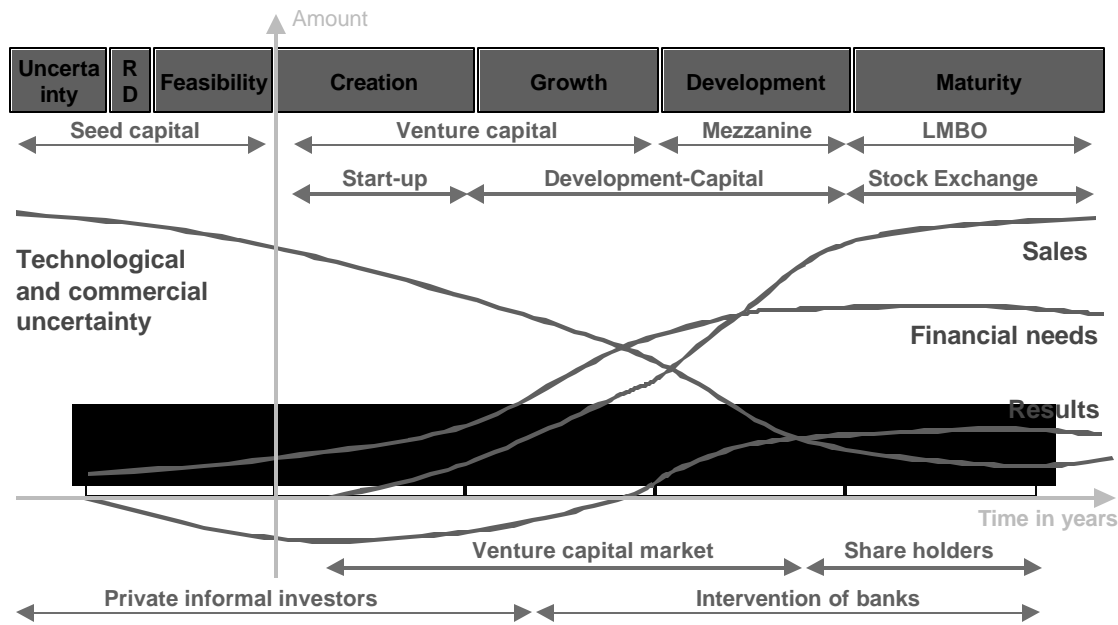
Table 10.3, based on the EIMS report (1995), synthesises the several modalities of financing that are relevant to the development of a new venture in its initial five years and according to its diverse phases of implementation.

Also the diagram below complements this information, identifying the different types of financing usually available from private investors to the different phases of NTBFs' development.

Table 10.3

Modality of Funds	Objectives
Seed Capital	Financing research, development and assessment of an initial business concept.
Start-up	Financing product development and initial marketing.
Other Early-Stage	Financing initial manufacturing and sales activities (product development stage completed)
Expansion	Financing increased production capacity, market or product development and(or provide additional working capital (growth and expansion of a company)
Bridge Financing	Short term funding for a company which is on the point of raising a new round of equity or about going public.
Replacement Capital	Financing the purchase of existing shares
Management buy-out (MBO)	Funds provided to enable current operating management and investors to acquire an existing business.
Management buy-in (MBI)	Funds provided to enable a manager or a group of managers from outside the company to buy into the company

Figure 10.3 The Different Types of Venture Capital



Source: European Commission, EIMS Report on “Research into the Financing of New Technology Based Firms” (1994:11).

These modalities of financing come usually through several public and private sources that constitute important agents in the process of financing NTBFs. In this context, it could be stated:

Private banks, that have been criticised by potential users due to their lack of flexibility and excess of rigidity in coping with the specific characteristics and needs of this kind of firms.

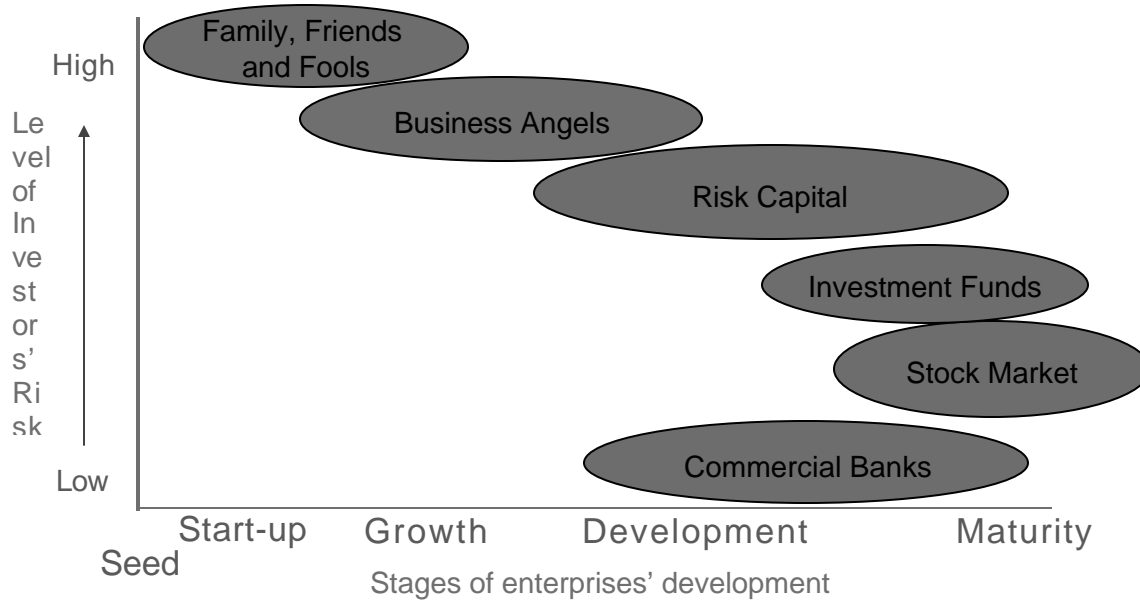
Venture capitalists represented by private and public banks and other specific agents such as pension funds that can assume a national and international approach. Usually, venture capitalists seek to be geographically closed to their clients in order to follow all the steps involved in the development of a new venture.

Business angels are those individual investors possessing both a high business expertise plus capital and are able of supporting local businesses in financial and technical terms aiming at increasing their performance.

Public aid represented by a variety of schemes under specific country’s rules. National and Regional organisms may provide support through the direct aid (subsidies), guarantee (annual fees varying from 0.5% to 1.5% of the total loan) and indirect aid (such as tax deductible R&D costs and tax credit for research).

In order to illustrate this information, the next diagram presents the action of these agents according to the phases of development of NTBFs.

Figure 10.4 Financing and the Stages of Enterprises' Development



Source: Based on Idéias & Negócios, June 1999, special issue.

Table 10.4

Venture Capital Associations by Country	
Country	Associations
Austria	40
Belgium	26
Denmark	15
Finland	29
France	111
Germany	115
Greece	4
Holland	49
Israel	70
Italy	56
Portugal	13
Spain	46
Sweden	41
United Kingdom	130
United States	1800
European Union (13)*	662

* European Union with the exception of Luxembourg

Source: Based on Idéias & Negócios, June 1999, special issue.

Within the European context, the search and use by NTBF of the above-mentioned sources of financial support varies from country to country. In general, banks, in spite of their lack of flexibility, seem to be the largest single source of capital used by entrepreneurs. Venture capital does not seem to be so profuse, mainly in the initial phases of projects, a period in which the uncertainties concerning new ventures is quite high.

Improving Access to Financing – Public/Private partnerships

The development of partnerships combining public and private financial resources and exerting a leverage effect on private capital are found to be the most effective way of improving financing of new firms. They should be encouraged, as should the exchange of experience between Member States in this respect. These partnerships can include:

- Specific mechanisms to finance expenses arising from protection of intellectual property rights.
- Public funding of expertise on which decisions on investment in technology firms are based, including during their growth stage.
- Mobilising private investors to invest in newly formed companies, in particular via proximity (local/regional) funds or funds linked to research establishments.
- Mutual funds, following the example of the Italian cooperatives which pay 3% of their profits to a mutual fund which helps to create new ventures.
- Appropriate guarantee mechanisms, including means to guarantee private investments (e.g. regional guarantee funds).

Source: Innovation and Technology Transfer, special edition, December 1998.

Portugal is not an exception within the European scenario and venture capital and business angels are not very diffused within the entrepreneurship community, even though there is evidence on changes in the near future. The main point to be emphasised here is that there is no lack of financial resources to be invested in Portugal – but the lack of knowledge about the functioning of these financial mechanisms by the entrepreneurial community allied to the high uncertainty and the lack of credibility of new ventures have made difficult their diffusion and usage. Table 10.5 presents the volume of venture capital funds, in 1997, according to the stage of development of new ventures for several countries. In addition, Table 10.6, shows that financing of early stages of development of NTBF are those in which the lack of investment is more sensitive.

Table 10.5 - Volume of Venture Capital Funds/Stage of Development (1997) (1,000 ECU)

Country	Seed/Start-up	%	Expansion	%	Buy-out	%	Total
Austria	2990	16.0	4874	26.0	10847	58.0	18711
Belgium	29793	16.6	144491	80.7	4680	2.6	178964
Denmark	2833	12.8	19265	87.0			22147
Finland	8716	7.7	81615	72.2	22653	20.0	112984
France	90163	7.2	549778	44.1	607620	48.7	1247561
Germany	200193	15.1	649723	49.0	475835	35.9	1325751
Greece	5073	31.2	10853	66.8	318	2.0	16249
Holland	151908	20.0	310597	40.9	297034	39.1	759538
Israel	98784	33.3	153468	51.8	44100	14.9	296351
Italy	73764	12.2	333831	55.4	195532	32.4	603126
Spain	21332	8.1	175389	66.9	65620	25.0	262341
Sweden	4497	1.3	81553	23.2	264881	75.5	350931
United Kingdom	99935	2.3	1464616	33.1	2863136	64.7	4427686
United States	303000		7343687				
EU 13*	692614	7.4	3860010	41.2	4809573	51.4	9362195

Source: Based on Ideias & Negócios, June 1999, special issue.

Table 10.6 – Portugal – Investment Distribution (1997)

Type of Investment	Value	%
Seed Capital	0,005	0.06
Start Up	11,31	13.57
Early Stage	1,78	2.14
Expansion	29,43	35.30
Bridge Financing	12,85	15.42
Recovering	18,81	22.56
Refinancing	3,57	4.28
MBO	2,32	2.78
MBI	0,64	0.77
Others	2,60	3.12

Source: Based on Ideias& Negócios, June 1999, special issue, quoting APCRI.

Table 10.7 - Portuguese Venture Capital Societies and Funds

Societies/Funds	Year	Stage of Financing	Number Enterprises	Investment
BPI – Capital de Desenvolvimento Inter Risco–Sociedade de Capital de Risco SA BPI Private Equity BPI Participações FRIE Inter Risco FRIE Banco BPI Inter Risco	1988 1993 1990	Early stage, development, MBO/MBI		
SOSET – Sociedade de Desenvolvimento Regional da Península de Setúbal SA	1991	Seed, start-up, MBO, re-structuring and modernisation	6	
CAMPTRIS – Companhia Portuguesa de Capital de Risco SA	1998	Start-up, later stage, MBI	14	
Caixa Investimentos	1986	Re-structuring and internationalisation	60	
Fundo de Turismo – Capital de Risco SA Fundo de Capital de Risco FCR-F. Turismo	1991 1995	Start-up, financial re-structuring and expansion	7 10	
PME Investimentos - Sociedade de Investimentos SA FRIE/PME Investimentos FRIE/PME Investimentos-RETEX FRIE/PME Investments – TEC	1989 1993 1994 1998	Star-up, expansion, re-structuring and internationalisation	31 11 15	
IPE Capital–Sociedade de Capital de Risco SA FRIE/IPE Capital I FRIE/IPE – RETEX-PAIEP	1988 1993 1994	Start-up, MBO, early stage Internationalisation Re-structuring and internationalisation	19 5 2	
ES Capital – Sociedade de Capital de Risco SA FUNGEPI/BES FRIE/PEDIP II/BES	1997	Development	22	
PME Capital – Sociedade Portuguesa de Capital de Risco SA FRIE PME Capital FRIE PME Capital Retex FRIE PME Capital Global	1989 1993 1994	Start-up, expansion and development and re-structuring	125	

Source:- Based on

CASE STUDY: BIOTECNOL

The company BIOTECNOL LDA, was founded by Dr. Pedro de Noronha Pissarra, who studied biotechnology as his undergraduate degree. During his Ph.D. Dr. Pissarra carried out research work at several research institutions, where he worked on bio-thermodynamics and on Metabolic Control Analysis (MCA) and kinetic analysis of metabolic pathways. His expertise is therefore in biochemical/metabolic engineering.

It was in 1996 while doing Postdoctoral work at the Centre for Biological & Chemical Engineering - Instituto Superior Técnico (CEBQ), on metabolic flux analysis of recombinant proteins production, Dr. Pissarra developed the idea behind BIOTECNOL LDA, and its philosophy. The official start-up was in November 1996.

Dr. Andrew Kelly joined BIOTECNOL SA in December 1996. Dr. Kelly has a strong molecular biology background that complemented Dr. Pissarra's skills.

During the year of 1997 both Pedro de Noronha Pissarra and Andrew Kelly, earned the first seed capital for the company by providing consultancy to a Portuguese pharma group. They were responsible for the emergence of rDNA biotechnology at a classic antibiotic company. During that consultancy contract, Pedro de Noronha Pissarra and Andrew Kelly selected and analysed several key patents and evaluated key molecules for production as generic recombinant proteins.

Upon identification of one target molecule, they established contacts with a German company, who already had the mature technology for production of that particular protein. They then established a second consultancy contract with the referred German company for technology transfer into the Portuguese pharma group. Such contract allowed them to raise enough money to set-up the company at a well-established modern science park in Oeiras. Throughout such project they acquired significant know-how and experience in the field. That showed to be very precious for the field of activity of BIOTECNOL LDA.

Together Pedro de Noronha Pissarra and Andrew Kelly had written in late 1996 a USD \$950 000 grant application to Agência de Inovação under the aegis of PRAXIS XXI program - research consortium between Universities and SMEs. For that purpose, BIOTECNOL SA (as project leader) established a consortium contract with the Centre for Biological & Chemical Engineering - Instituto Superior Técnico (CEBQ) and the Biological Engineering Department of the Universidade do Minho. The project was later partially funded and the consortium received USD \$355 000 for research & development in late 1997. BIOTECNOL SA was making the most out of its idea by using laboratory space at the university and also by using existing equipment academic structure and human resources.

The initial organisation was made of a small team, consisting of enthusiastic but inexperienced young scientists. The team did a tremendous job in setting up the company basis and core strategy, acquisition of funds for R&D, strategic partners, development of ideas and maturing its market and orientation. BIOTECNOL SA is now in the process of identifying the right people for the right places to build a scientific development based team, with multidisciplinary backgrounds and those complement each other. There are currently_xxxxx__full time employees working with the company.

The company also recognises the need to establish a management team parallel to the R&D efforts. Without sound managerial skills a company, despite its technology, will not have the capacity for taking its technology to the market in the first place.

CASE STUDY: NEURÓNIO

Funded in June 1992, Neurónio is leader in the Portuguese Multimedia and Integrated Business Solutions market, supported on Internet technology. Growing at a 50% rate in 1998, the firm initially began with technical training and consultancy in Multimedia and Information Systems as well as the development of customised software solutions. In 1995, it added the Internet, applying the acquired experience. Nowadays, Neurónio, with a 30-people multi-disciplinary team, delivers consultancy, and offers services relating to the development and integration of Internet solutions.

A bit of history...

Maria José Francisco and José Coutinho were, in 1990, final year undergraduate students majoring in Electrical Engineering at Instituto Superior Técnico - IST-, and were challenged to conceive and develop an automatic guided vehicle (AGV) for EFACEC's warehouse (EFACEC is the largest industrial Portuguese group specialised in electrical and electronic equipment production and industrial logistics). Both, at the time belonging to the research group ahead of a Mobile Robotic project at IST, accepted the challenge. After two years (1990 and 1991), the warehouse had already four AGVs. These two young entrepreneurs were distinguished with the Industrial Design Award by the Portuguese Design Centre.

The will to fund a firm industry-oriented arose during the development stage of the AGVs' project, more precisely in late 1991. The future business' main idea focused on the supply of automation solutions, namely those related to material automatic transport - AGVs. These solutions also implied the development of multimedia, information systems, incorporating friendly user interfaces.

The know-how and experience, the entrepreneurship and the motivation which sprung from the success of such an innovative project applied to the Portuguese industry (a window of opportunity), were reasons enough to lead the two young research entrepreneurs to believe that, in general, the possession of a good idea and its well succeeded application assured entrepreneurial success.

Once decided the core business and having consolidated their technical knowledge, the two initial promoters had to find out another partner with commercial and entrepreneurial experience, essential to complement the existent expertise. Victor Capella was invited to take part in the firm, not only for his academic training in management and outstanding leadership revealed by his career, but also because he shared the same ideas, empathy and easy going relationship. All these factors were essential to explore synergies and to undertake a common project. This partnership conferred the complementarity and flexibility paramount to the firms' starting-up stage.

Taking into account that one of the main reasons for NTBFs' failure is the lack of the young entrepreneurs' specific training in areas like management and elaboration of business plans, the team sought for expert support. In late 1991, the liaison to CPIN- Centro Promotor de Inovação e Negócios – a technology incubator developed through IST in order to support the creation and the development of NTBFs - showed itself as crucial. The support consisted of the facilities (which included all the necessary communications network), support services to the development of the starting-up activity (secretariat, documentation centres, meeting rooms, and advise in the preparation of business plans), as well as facilitating the participation of the young entrepreneurs in training actions oriented towards the needs of a small firm.

The incubator was also important in carrying out the business' evaluation, in particular market studies, a difficult and very expensive task, even though crucial in this phase of the project.

Considering previous experiences, Neurónio concentrated its activities in the electrical equipment sector, which besides being one of the most important in Portugal, was considered the aim of the project. The market study, supported by CPIN, allowed to gain a sensible approach to the market (how, when and how much to sell). The results were astonishing: the market was eager for the solutions in the AGVs' area. However, potential clients were too long on taking a decision to buy the product, making it unfeasible to estimate revenues, thus compromising the project. Nevertheless, the study also revealed the market desire for multimedia information systems.

In light of these evidences, it was clear that it was necessary to adapt the initial business plan to the market needs and opportunities, reorienting and redefining the core business, again with CPIN's support. During the following two years (1992-1993) - the incubation phase - the idea-project became a firm, sited at CPIN. Eight people, seven of them possessing electronic engineering background and an eighteenth person as administration staff, composed the team.

Neurónio starts its activity as a firm in January 1992. In June of the same year, the firm is legally registered as a three-partnership limited company, endowed with a 25.000 USD share capital (at 1999 prices). During 1992 and 1993, many of the proposals advanced to clients and the market came from the good relationship with IST - academics and engineers linked to many Portuguese companies. However, relying only on the endowed stock capital, without seed capital and banking financing, the firm had to resort to other activities not contemplated in its core business. At this stage, consultancy and technical training revealed themselves invaluable to face the operating expenses of the firm, as well the opportunity to build up an entrepreneurial structure suitable to the market characteristics. These activities made Neurónio profitable during the first years and allowed the building up of wealth for future investments. Neurónio left the incubator after two years. This coincided with the first stable phase in terms of clients and projects.

[to be discussed and completed by July 2000]