Spinning Off New Ventures from Research Institutions Outside High Tech Entrepreneurial Areas

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ABSTRACT

In this thesis, I examine how spinning off new ventures from academic institutions works in an environment outside developed high tech clusters and how it affects models of ventures. I examine these questions by studying the case of Belgium. There seems to be two archetypes of spin-off processes depending on the academic institutions capabilities. The first, practiced by specialized research institutes, involves a proactive technology opportunity search phase and an extensive concept-testing phase before ventures are founded. It can be characterized as a high selectivity and high support policy. The second and most common type, practiced by universities, leaves the initiation of projects to individual researchers and provides limited support for concept testing before ventures are founded. Most concept testing needs to be conducted after founding. This type of spin-off process can be regarded as a low selectivity and low support policy. The few ventures, spun off by specialized research institutes could adopt a high-growth orientation right away, becoming "pure" venture capital-backed firms from the outset. Ventures spun off by universities at a very early stage could only adopt a basic business model of contract-based work, often technical consulting. About half of these ventures never intended to go beyond this business model and settled in a small business model of venture with no growth orientation. The founders of the other half tried to build a firm that was going to be more than a substitute for a job. For these founders, the initial,

basic contract-based work represented a source of revenue, as well as their main source of knowledge building. Indeed, given their lack of business experience, without incubation capabilities from their university or an entrepreneurial community to support them, these founders could not borrow much relevant business and entrepreneurial knowledge from their local environment. They had to learn basic business and management skills largely by experimenting. As a result, these ventures went through a transitory, or gestation period, before they could develop a viable business model with high potential and growth objectives. I label this model of venture "prospector." I argue that this may be the dominant type of growth-oriented venture emerging in environment outside advanced high tech clusters where the entrepreneurship infrastructure is not well developed.

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TABLE OF CONTENT

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INTRODUCTION

In the 1990s, the fall of the Berlin Wall and technology innovation prompted globalization of the world economies (Berger et al., 999). With the blossoming of information technology and biotechnology industries, it was clear that the world was moving towards an information society and knowledge economy (Economist, 1997; OECD, 2000). Concerns also emerged that, compared to the USA, Europe was lagging in most technology sectors (Bannock, 1998). As a result, the importance of technology innovation increased in the eyes of European policy makers. [1] The success stories of Boston and Silicon Valley suggested new ways of achieving technology innovation and economic growth (Saxenian, 1994; Lee et al., 2000).

Entrepreneurship was at the core of this innovation process (Roberts, 1991). The unprecedented growth of the financial markets in the 1990s validated this model. All over the world, attempts have been made to emulate Boston and Silicon Valley (Castells and Hall, 1994), but their complex "ecology" which had grown organi-

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1 "Innovation has become the industrial religion of the late 20th century. Business sees it as the key to increasing profits and market share. Governments automatically reach for it when trying to fix the economy. Around the world, the rhetoric of innovation has replaced the post-war language of welfare economics. It is the new theology that unites the left and the right of politics" (The Economist, Survey Innovation in Industry, 17 March 1999).

cally (Saxenian, 1994) turned out to be difficult to replicate (Brown and Duguid, 2000b). Scholars highlighted that part of this ecology consisted of close links between university and industry (Gibbons, 2000), such as the new ventures spun-off from research institutions (BankBoston, 1997; Roberts, 1991). Academic research thus appeared more clearly as a source of technology innovation. This was an important issue outside the USA where academic institutions have traditionally played less of a role of conducting research that contributes to technological development and industrial performance (Owens-Smith et al., 2001). Also, entrepreneurship appeared as a valid mode of technology transfer from academic institutions.

Outside the two developed high tech clusters mentioned above, however, spinning off new ventures from research institutions has been a marginal phenomenon in spite of growing policy initiatives to support it (Callon, 2001; Mustar, 2001; Roberts and Malone, 1996). No more than a couple dozen academic spin-off ventures are created each year (Callon, 2001). Their size, growth rates, revenues, and product generation are modest (Callon, 2001; Downes and Eadie, 1997; Mustar, 1997; Stankiewics, 1994).

The purpose of this thesis is to understand key aspects of the spin-off process in a context outside traditional, developed high tech clusters. At the environmental level, I explain what factors most influence spin-off processes. At the level of research institutions, I clarify the key dimensions of spin-off processes. At the firm level, I describe how starting a new business outside a developed high tech area influences the venture's characteristics and abilities. I studied the case of Belgium in the late 1990s because it is representative of such a context and is compact enough to be investigated in detail.

I found that, in the absence of strong entrepreneurial community, spinning off ventures from academic institutions was primarily a policy-driven phenomenon. These policies, however, varied across the two regions in Belgium and appeared to be strongly influenced by local conditions. One of the most useful policy instruments appeared to be hybrid government organizations bridging public, academic, and private sectors. Elements of environments supportive to entrepreneurship were replicated but capabilities to put them to work were largely built through local experimentation.

The implementation of policies largely relied on academic institutions and was, thus, mediated by their organizational capabilities. Specialist research institutions, created by the new public policies, were better able to develop comprehensive spin-off processes involving a long incubation. Traditional universities showed more difficulties in adjusting to the new competencies required for technology transfer and venture formation and, in most cases, lacked scale.

The majority of ventures were spun off at an early stage and, as a result, could only initially adopt basic business models, often based on contract-based work. Founders who pursued greater ambitions than a traditional small business (SME) needed to go through a transitory period of building basic business skills and refining a viable business model, largely by experimentation, before they could develop a growth strategy. I propose that this form of growth-oriented venture, which I label "prospector," is representative of academic spin-off ventures founded in environments with weak entrepreneurial communities and poor incubating capabilities. In the early phase of such start-ups, it seems that the main challenge is to succeed in their transitory phase, consisting in learning relevant skills and building a viable business model, than to grow fast early on. This is thus in contrast to advanced high tech regions, where high growth early on is seen to be key and is possible due to a developed entrepreneurial infrastructure.

My findings are presented in seven chapters. In chapter 1, I review the relevant literatures. In chapter 2, I explain the design and method that I adopted in this research. Chapter 3 offers an introduction to the research site: Belgium. Chapter 4 focuses on characteristics of the environment that are important to the academic spin-off process. In chapter 5, I analyze the process of spinning off ventures from academic institutions and the different forms this process takes in various research organizations. Chapter 6 analyses the forms that academic spin-off ventures take in this environment. Chapter 7 summarizes my findings and discusses their implications.

CHAPTER 1

RESEARCH QUESTION AND LITERATURE REVIEW

1. RESEARCH QUESTION

Spinning off new ventures from research institutions has played a key role in the development of high-technology clusters such as Boston and Silicon Valley (e.g., Roberts, 1991; Saxenian, 1994). In Europe, in contrast, it has been a marginal phenomenon thus far (Callon, 2001; Mustar, 2001). Interest, however, grew among European policy makers, academic institutions, and investors in the late 1990s (e.g. OECD's Science Technology Industry Review No 26; Nauwelaers, 2001). There has indeed been a realization among these actors that the phenomenal success of the technology sector in the United States in the last twenty years is largely due to new entrepreneurial technology firms, including academic spin-off firms (BankBoston, 1997; Bannock, 1998; European Commission, 1998). It has been established that new entrepreneurial firms play a key role in keeping the economy at the edge of technology development by introducing radical innovations (Dosi, 1992; Feldman, 2001). In Europe, however, most research institutions have only recently started to consider technology transfer for commercialization a part of their mission. Europe also has weak entrepreneurial communities.

As a result, in this thesis I explore how spinning off new ventures from academic institutions in an environment outside developed high tech clusters works and how it affects models of ventures.

2. EMPIRICAL LITERATURE REVIEW

Several bodies of empirical literature are relevant to this research question. First, I identify literature that is useful to understand the context in which spinning off academic institutions occurs. Second, I review literatures that inform us about university-industry relationships and the process of spinning ventures from academic institutions. Finally, I examine the nascent empirical studies on academic spin-off ventures outside the developed entrepreneurial clusters of Boston and Silicon Valley, with a particular focus on Europe.

2.1. Literature on high tech entrepreneurial clusters

Recent Belgian policy initiatives in favor of technology innovation and spinning off ventures from research institutions have been inspired by efforts to emulate elements of successful American high tech clusters. The literature on these clusters is thus relevant (e.g. Kenney, 2000; Lee et al., 2000; Roberts, 1991; Saxenian, 1994).

Obviously, the properties of these regions are complex and evolving. The following characteristics should, however, be highlighted. [2] First, there is strong, historical, path-dependent development of these regions related originally to a massive influx of government funding to defense projects and the emergence of a few industries in particular: semi-conductors, biotechnology, and electronic component systems, including computers (e.g. Roberts, 1991; Rogers and Larsden, 1984; Rosegrant and Lampe, 1992; Saxenian, 1994).

Second, they operate within the distinctive US system of innovation and entrepreneurship, composed of laws, regulations, and conventions for securities, taxes, accounting, corporate governance, bankruptcy, immigration, research and development that

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[2] The following paragraphs are primarily inspired by Lee et al. (2000).

are more favorable to new business ventures than the systems of most other countries. For instance, the regulations that make the cost of changing jobs low explain the high job mobility credited for the rapid circulation of knowledge in these regions. [3] Bankruptcy laws that give limited liability to entrepreneurs and venture capitalists are credited with enhancing a risk-taking mentality, tolerance for failure and the dynamic of "creative destruction." It is not clear if one factor in particular is the most critical, but together they form an "ecology" that is supportive of entrepreneurship.

Third, these regions exhibit populations of organizations that are complementary and supportive of innovation and entrepreneurship. They have strong research institutions, such as MIT and Stanford University, along with numerous technical and vocational educational institutions. What distinguish these institutions are their strong interactions with industry.

There is a specialized business infrastructure composed of established firms, a high density of new ventures, and an array of

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3 "Silicon Valley's labor force is unusually mobile, resulting in a market that matches the needs of individuals and firms in a rapid, continual recycling of people. Such a highly mobile workforce contributes to collective learning, as tacit knowledge is conveyed and shared when professionals move from one company to another. The whole region gains as knowledge is spread throughout the community, and professional employees find positions that maximize their contributions." (Lee et al., 2000: 8)

support services for new high-tech businesses: individual ("angel") investors, venture capitalists and bankers, lawyers, headhunters, accountants, consultants, suppliers, sub-contractors, research and design firms, and a host of other specialists.

Government, non profit organizations, trade associations, and labor councils address the non-business needs of the region that are necessary for its economic performance: improving education, building information infrastructure, reducing traffic congestion, and improving government operations.

There is also a strong sociological dimension. Saxenian (1994) argues that Silicon Valley's regional network-based system:

> promotes collective learning and flexible adjustment among specialists producers of a complex of related technologies. The regions' dense social networks and open labor markets encourage experimentation and entrepreneurship. Companies compete intensely while at the same time learning from one another about changing markets and technologies through informal communications and collaborative practices; loosely linked structures encourage horizontal communication

> among firm divisions and with outside suppliers and customers. The functional boundaries between firms themselves and between firms and local institutions such as trade associations and universities are porous in a network system. (3)

In part because of the success of high tech clusters of Boston and Silicon Valley, there has been a resurgence of interest in the geography of economic activities in the last decade from scholars in various fields who are building on a perspective in economics initiated by Marshal (1920). Breshi and Malerba (2001: 817) suggest that the new awareness of space and territory as important economic factors results from the increasing realization that variations in economic growth and performance across regions depend on a number of relatively immobile resources: knowledge, skills, institutional, and organizational structures. Many regions have tried to emulate the success of Boston and Silicon Valley in the USA, or Baden-Wurttemberg in Germany, by setting up science parks, technopoles, sources of risk capital, and financial schemes to support innovation.

Breschi and Malerba (2001) describe key features of high tech clusters as follows:

> Learning through networking and by interacting is seen as the crucial force pulling firms into clusters and the essential ingredient for the ongoing success of an innovative cluster. The way firms learn in an innovative cluster embrace user-producer relationships, formal and informal collaborations, interfirm mobility of skilled workers, and the spin-off of new firms from existing firms, universities and public research centers. More generally, a key feature of successful high-technology clusters is related to the high level of embeddedness of local firms in a very thick network of knowledge sharing, which is supported by close social interactions and institutions building trust and encouraging informal relations among actors. This is the second crucial issue that is, almost invariable, associated with well-developed and effectively functioning technology-based clusters. The possibility for individual firms to tap into the body of localized knowledge

and capabilities depends, in a fundamental way, on the ability to establish and maintain effective social links and lines of communication. At the collective level, the effectiveness with which knowledge can be shared is conditioned by the existence of common norms, conventions, and codes for exchanging and interpreting knowledge. In this perspective, geographical proximity often overlaps and combines with institutional, organizational and technical proximity in fostering processes of collective learning. Besides offering an industrial atmosphere favorable to innovation and entrepreneurship and social capital supporting trust and co-operative relationships, a further key feature of technology-intensive clusters is related to the availability to a common sets of resources, some 'exogenously' given, like universities and pubic research centers, and some others endogenous to the clusters' development, like a pool of specialized and skilled labor, whose main effect is that of reducing the cost of the

> uncertainties associated with firms' innovative activities. (819-820)

While we are starting to understand the features and dynamics of successful high tech clusters, we know little about how clusters emerge (Bresnahan, 2002; Romanelli and Bird Schoonhoven, 2001). Starting a cluster is very different than sustaining one in terms of processes and economics (Bresnahan, 2002). A recent special issue of *Industrial and Corporate Change* (Vol. 10.4) addressed this issue and high-lighted the following points.

First, a highly skilled labor force with university-trained human capital has been identified among the key conditions for the emergence of a high tech cluster. Also important is the mobility of skilled workers among firms and across firms, universities, and pubic research centers. The mobility of the workforce is seen as a major source of new firm formation, as well as the mechanism through which information and knowledge flows locally. The relevant skills of this workforce need to be technical, as well as managerial.

Second, the ability to take advantage of technological and product spaces that are not yet exploited and are complementary to those in leading clusters is another important condition. Establishing cooperative connections with established high tech regions appears key to achieve this objective. Conversely, competition with existing leaders on similar products and markets is a difficult strategy, especially if the new cluster is located in a different country than the leading ones.

Third, most research looks at regional systems as isolated, self-contained entities but external linkages play a central role. For emerging clusters, they provide access to knowledge, skills, contacts, capital, and information about new technological opportunities and markets. This highlights that high tech clusters have both a local dimension and an international one, which interact at various levels and determine the dynamics of shaping the rise of a cluster.

Fourth, the accumulation of capabilities through the growth of the first successful firms plays a central role in the development of a cluster. These firms influence the subsequent creation of new firms through spin-offs, human capital formation, and the creation of new skills.

Fifth, clusters are embedded in a specific national system of innovation and production, which differ in terms of development, actors, structure, government policy, and legal and social institutions. Sixth, non-firm organizations may emerge and become key elements in the dynamic and growth of a cluster.

Seventh, there is a consensus among researchers about the ineffectiveness of public policies attempting to direct the formation of a new cluster through top-down interventions, such as technopoles, science parks, and firm incubators. Instead, government can contribute better to the formation of a new cluster by facilitating the formation of new firm, by investing in education and producing support infrastructures.

2.2. Literature on local innovation systems

Understanding characteristics of developed high tech clusters in the USA is important for seeing that one way to improve our knowledge of the context in which ventures are spun-off from research institutions in Belgium, is to base it on a good understanding of the local innovation system. Freeman (1987) defines a local innovation system as "the network of actors in the public and private sectors whose activities and interactions initiate, modify and diffuse innovations and implement them in new products, new production processes, and new organizational forms" (quoted by Meeusen, 2000: 3). These actors are firms, institutions of higher education, research laboratories, and national and supranational government agencies. Meeusen (2000: 3) recommends viewing them as a network of interacting agents distributing and operationalizing knowledge. The recent book edited by Capron and Meeusen (2000) offers a detailed analysis of Belgium's innovation system. Nauwelaers' (2001) report on the Belgian science technology and innovation policy provides a useful complement this book.

2.3. Literature on university – industry relationships

In particular, since the passage of the Bayh-Dole Act in 1980, university–industry relationships have dramatically increased in the USA. [4] New ventures set up to commercialize tech-

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[4] "U.S. patents granted to universities increased from 589 in 1985 to 3,151 in 1998 (National Science Board, 2000). During this same period (and especially during the 1980s), industry funding of university research increased from $630 million to $1,896 billion (NSB, 2000). Moreover, ties between industry and uni-

nologies developed by university faculty, researchers, and students have played a central role in developing both formal and informal entrepreneurial activities involving university inventions (Mowery and Shane, 2002: v). These authors stress, however, that the ways in which university research affects private sector innovation still remains unclear.

Originally, innovation was viewed as a "linear model," but a representation of innovation as a more interactive process has emerged in the last twenty years (Cohen, 2002: 1). In the linear model (Bush, 1945), industrial innovation proceeded from basic to applied research, to development, then to commercialization. In other words, university research proceeds upstream and independently of technology developments. A richer representation of the innovation process has, however, emerged over the last twenty years (Gibbons and Johnston, 1975; Kline and Rosenberg, 1986; Nelson, 1990; von Hippel, 1988). This new representation describes industrial innovation as a more interactive process wherein public research sometimes leads the development of new technolo-

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versities have generally deepened, as reflected in the 60% growth in university-industry R&D centers in the 1980s (Cohen et al., 1998) and the more than eightfold increase in university technology transfer offices between 1980 and 1995 (Association of University Technology Managers, 1999)" (Cohen, Nelson, and Walsh, 2002: 3).

gies, but it also focuses on problems raised by prior developments and buyer feedback.

The U.S. and European university systems are very different notably from the point of view of university–industry relationships and of the link between the two spheres in terms of the innovation process. Owen-Smith et al. (2002: 25) characterize the differences as follows.

The U.S. university system, with its mix of both public and private institutions, has long played a significant role in conducting research that contributes to technological development and industrial performance. In Europe, universities contribute more to knowledge for its own sake and to the preservation of distinctive national cultures (Ben-David, 1977). In the 1990s, the emergence of key science and technology-based industries, primarily information/ communication technologies and biotechnology, where the United States has a clear leadership, has greatly contributed to economic growth. There is a consensus that U.S. universities and research institutes played a key role in this process (Mowery and Nelson, 1999; Mowery et al., 2001) with their diverse interfaces with industry, their growing tendency to patent, and the increasing licensing revenues they generated from the sale of intellectual property. Science-based start-up firms have been a key component of this trend, with university researchers acting as founders, consultants, and members of scientific advisory boards. [5]

In contrast, European universities have lagged a long way behind the experience and practices of US academic institutions in terms of industry collaboration and research commercialization. Howells and McKinlay (1999) attribute this to institutional and legal barriers. European universities have often prohibited academic staff from working directly with industry. They claim that social and cultural attitudes, notably perceptions about what universities' role in society should be, have also been obstacles against involvement with industry. They characterize the situation in Europe prior to the 1990s as:

> In Europe, research exploitation and commercialization by universities has been more associated with the role of universities in *facilitating* industry in the exploitation of their research and IP output. This difference in emphasis and perspective by European universities was undoubtedly a reflection of all the insti-

[5] See review by Agrawal (2001).

> tutional and cultural barriers that prevented universities from taking a more proactive and entrepreneurial approach towards its own research output. Commercialization of its own research was simply not seen as a university's mission. It was industry's duty to pick up the 'crumbs' of universities research and for industry to develop it, not the universities. Where European universities did feel they had a role to play in commercialization it was as a facilitator; helping industry to research, develop and refine what scientific and technical projects it wanted. Even here, though, it was in a largely passive sense; industry came to universities, universities did not proactively seek out industry. [83]

Since the late 1980s, however, European attention has shifted to technology policy and academic technology transfer (Howells and McKinlay, 1999). Following concerns within the European Union of its competitiveness in science-based industries, programs have been developed to encourage matches between universities and industry. Howells and McKinlay (1999) report, for instance, that in order to overcome these limitations, intermediary institutions and agencies have been set up, such as IMEC in Belgium, which provide an interface between universities and industry, but the authors argue that, in a way, this has delayed universities becoming involved with industry.

In spite of being behind in this evolution, European universities are experiencing significant changes. Debackere (2000) highlights the pressures research institutions have experienced in recent years that pushed them towards more technology transfer and contacts with industry in general. Research institutions, which are generally publicly funded, have been under budgetary pressure from their governments (Capron and Meeusen, 2001). This has led them to search for alternative sources of financing and to engage in commercial activities. They have also increasingly been under pressure from governments to show economic local spill over of their training and in particular of their research activities (Science Technology Policy Review, 2001: 8). Finally, in a growing knowledge economy, research institutions have increasingly become part of the cycle of innovation, which has recently become more global. Powell at al. (1996) argue that when a knowledge base is both complex and expanding and the sources of expertise are widely dispersed, as in the case of the biotech industry or software, the locus of innovation will be found in networks of inter-organizational relationships, rather than in individual organizations. This is because, in such a context, no single firm controls enough knowledge internally. Instead, innovation is found in the 'interstice' between firms, universities, research laboratories, suppliers, and customers.

Similarly to their counterparts in Europe, this has led research institutions and universities in Belgium to adjust to new roles beyond their traditional ones of teaching and training, particularly in the late 1990s, by increasing their focus on technology transfer, notably through spinning off ventures. Debackere (2000) emphasizes that such adaptation does not go without difficulties.

2.4. The process of spinning off ventures from research institutions

Our knowledge on how the process of proactively spinning off new ventures from research institutions works in contexts outside advanced high tech clusters is still limited (Callon, 2001). The only publication that I have come across that contributes to the understanding of this issue is Roberts and Malone (1996). Their data indicates that selectivity and support are the two main dimensions of an academic spin-off policy. I summarize this in Figure 1.1 below.

Figure 1.1. **Dimensions of academic spin-off policies**

Support \ Selectivity	LOW	HIGH
HIGH	• Passive role in project discovery • High spin-off effort • Internal selection decision • Mixed source of venture funds • Moderate management involvement • Moderate spin-off rate • High cost per spin-off • Low return on input	• Active role in project discovery • High spin-off effort • Internal selection decision • Internal source of venture funds • High management involvement • High spin-off rate • High cost per spin-off • High success rate
LOW	• Passive role in project discovery • Low effort per spin-off • External selection decision • External source of venture funds • Low management involvement • Low spin-off rate • Low cost per spin-off • High return on input	• Active role in project discovery • Low effort per spin-off • External selection decision • External source of venture funds • Low management involvement • Low spin-off rate • Moderate cost per spin-off • Low return on input

Source: Roberts, E. and D. Malone (1996). "Policies and structures for spinning off new companies from research and development organizations." *R&D Management* 26 (1). [6]

The authors stress that only two of the quadrants are viable courses of action: the low support/low selectivity and high support/high selectivity. The low support /low selectivity policy consisting of spinning off many ventures; little support reduces the cost of spinning off, but seeks safety in numbers. "Choice is left to external agencies (such as venture capital funds) who are generally felt to have greater experience and expertise in 'picking winners' and there is less potential for conflicting objectives than the R&D organization" (Roberts, 1996: 41). The high support/high selectivity consists of spinning off a few well-supported ventures. It relies on picking potential winners and supporting them to increase their chances as much as possible.

On the other hand, the policy consisting providing low support and of exercising high selectivity runs the risk of underinvestment in a narrow portfolio. The policy of high support/low selectivity is seen by the authors as the most risky because most of

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[6] The authors write, "The matrix contents are hypothesized implications and results of the support and selectivity policies in terms of the technology licensing office's role in the spin-off process."

the investments risks being made are with low potential, very risky ventures.

These authors stress that the process of spinning-off ventures from research institutions is very different in developed contexts, from an entrepreneurial point of view, compared to contexts that are underdeveloped. In developed contexts, such as Boston or Silicon Valley, there is a strong entrepreneurial community that has the capability to select the best entrepreneurial projects and allocate resources to them.

The spin-off process follows a "business pull" process in which research institutions can adopt a fairly passive strategy. In contrast, in underdeveloped entrepreneurial contexts, where there is no strong entrepreneurial community, research institutions need to be more proactive and provide incubation capabilities to their spin-off projects. There is a "technology push" process in which research institutions exercise selection and provide support. The authors classify the environment for university spin-offs along two dimensions: the support those projects receive from universities and the selectivity the latter exercise in choosing projects.

Figure 1.2. **Academic spin-off policies and types of entrepreneurial environments**

HIGH

Support

	Policy adapted to entrepreneurially <u>under developed</u> environments
Policy adapted to entrepreneurially <u>developed</u> environments (Boston, Silicon Valley)	

LOW HIGH

Selectivity

Source: Adapted from Roberts, E. and D. Malone (1996).

According to Roberts and Malone (1996), an environment of low support and low selectivity, is more fitted to a strong entrepreneurial environment; i.e. an existing community of actors involved in the entrepreneurial process, such as entrepreneurs and financiers. With low support and low selectivity on the part of the R&D organization, the market selects the projects. Their data support this view, since MIT, Stanford, and Harvard, are rated in this quadrant. They argue that in an environment where spin-offs are not usual and venture capital is scarce, a policy of high support and high selectivity is more likely to work. In such a context, they recommend providing incubating capabilities.

2.5. Literature on academic spin-off ventures outside the USA

Companies created to commercialize technologies developed in a research institutions are not new. Many current large firms were started by scientists in the 19th century or the early part of the 20th century. For instance, early in the 20th century, a professor at the École des Mines de Paris, Conrad Schlumberger, started up a very small geophysical surveying firm that is now the Schlumberger Group (Mustar, 2001). Similarly, Werner von Siemens and Gerard Philips set up spin-offs, which would later develop into the multinationals that we know (Mustar, 1995). Up until the 1980s, however, most academic spin-off initiatives stayed small "boutiques" (Mustar, 1997).

In recent years, however, changes occurred that induced policies to systematize the process against the backdrop of transforming the roles of academic institutions. Budgetary pressures from governments have put pressure on research institutions to look for alternative sources of funding and to develop "commercial activities" (Debackere, 2000; Technology Industry Review No 26: 8). At the same time, governments started to put pressure on their public research institutions to show economic spillover of their traditional research and training activities (Debackere, 2000; Etzkowitz and Webster, 1998). The success of Boston and Silicon Valley in translating scientific research into commercial success, and even whole new industries, triggered the interest of policy makers in these models of innovation, entrepreneurship and initiatives increased (European Commission 199; Science Technology Industry Review No 26).

As a result, policy makers in industrial countries have devised policies to stimulate technology transfer of public research, notably by spinning off ventures from research institutions (e.g. Callon 2001; European Commission, 1998). Belgium belongs to this trend (Clarysse et al., 2001; Surlemont et al., 1999). Among these policies, a recent OECD survey (Callon, 2001) reports that many countries have assigned ownership of intellectual property to the performing research institution; loosened employment laws to allow public researchers more contact with the private sector; provided seed capital for initial stages of funding; or fostered the development of service centers to help public, would-be entrepreneurs realize their commercial goals (Science Technology Industry Review No 26: 8). Universities and research institutions have become far more entrepreneurial than they used to be. They patent more, license their technologies more strategically, invest in incubators and science parks, and increasingly provide training and services to help their budding entrepreneurs (Science Technology Industry Review No 26: 8).

Although spinning off ventures from academic institutions has emerged in the late 1990s as a new way to transfer academic research to industry, the literature on this topic is limited and what exists is rather descriptive (e.g., Chiesa and Piccaluga, 2000; Mustar, 1997; Rickne and Jacobsson, 1999). The OECD survey reveals the following characteristics about academic spin-off firms outside the USA, especially the high tech clusters of Boston and Silicon Valley. The characteristics are consistent with earlier findings from academic research and policy reports.

- Most other OECD countries witness the creation of no more than a couple dozen such firms each year.
- Their size, growth rates, revenues, and product generation are modest, at least in the first decade of their existence. While a small percentage of spin-offs do blossom into high-technology giants, a large proportion survive without growing considerably. These data support prior findings (Downes and Eadie, 1997; Mustar, 1997; Stankiewics, 1994). They are also consistent with observations of new technology-based firms in general (Storey and Tether, 1998: 938).
- Their failure rate is significantly below national averages. This confirms the observations of Roberts (1991) in Boston.
- Academic spin-off ventures are mainly in the biomedical and information technology fields. It is not clear whether this is due to low costs of entry, small scale economies, the closeness of industry to research, or the fact that it is possible for firms to act as research consultants while developing new products and services. In any case, not all academic disciplines equally generate new firms.

- Spin-off firms tend to come from a small number of top research institutions. There are exceptions, but the support structures on which public spin-offs rely are expensive and not worth developing if an institution does not generate enough intellectual property to justify a professional technology commercialization staff.
- Academic spin-off firms cover a large variety of types of firms and there is not a clear consensus on the definition of an academic spin-off firm (Callon, 20001; Pirnay, 2001). Mustar (2001) interprets, correctly in my view, the variety of experiences across countries and the lack of a fixed definition as a sign of a phenomenon in full experimentation and growth.

The OECD survey concludes that the impediments to spin-off formation are not yet well understood as data on financing, growth and life cycles are hard to come by. It confirms an earlier statement by Roberts and Malone (1996) who stress:

> the regions are rare where such entrepreneurship and spin-off activities are common. In most regions, even with R&D producing good and useful technology, the new spin-off company phenomenon is virtually absent.

> The reasons for such regional differences are not obvious. (18)

There seems, thus, to be a need for a better understanding in three domains. First, we need a better understanding of what characterizes these areas that do not have a tradition of technology transfer from research institutions and do not have an entrepreneurial tradition, but where, on the other hand, policy initiatives seem to multiply in order to compensate for this lack of entrepreneurial infrastructure. Second, we need to improve our understanding of the process of spinning off new ventures in such contexts because we do not seem to have a clear idea of what the process involves. Third, the concept of academic spin-off firms seems to cover various realities, so we need to better distinguish among the various types of academic spin-off firms that may exist.

3. THEORETICAL LITERATURE

Scott (1998: 131) suggests that organizational environments are assessed either in technical or institutional terms. The technical elements are the more materialistic, resource-based features, while the institutional elements encompass the more symbolic cultural factors affecting organizations. The contingency, resource dependence, transaction cost, and population ecology theories all focus on the technical environment and their effects. Cultural forces – norms, roles, scripts, and rituals – are the focus of institutional theory in sociology (Scott, 1995). In organization theory, the environment can thus be conceptualized in two complementary ways: in terms of resources and in terms of culture (Scott, 1998: 131).

In the resource view (Hannan and Freeman, 1989), the context is determined by the availability of resources, such as an influx of money or technological innovation (Astley, 1985; Brittain and Freeman, 1980; Carroll et al., 1990). The dynamic within the context is then determined by the competition for these resources, with the fittest organizations surviving and the others disappearing. In this view, the environment exercises mainly competitive pressures. For instance, Silicon Valley emerged because of a historic breakthrough in technology with the invention of the microprocessor and, later, with the advent of the biotech revolution (e.g., Saxenian, 1994). Additionally, it benefited from a supply of funding of historical proportion during and after World War II. Nowadays, it relies heavily on efficient capital markets, primarily venture capital, to allocate financial resources to the best projects (Lerner and Gompers, 1997; Sahlman, 1990).

However, the environment should also be regarded as a social system and its impact analyzed in cultural and symbolic terms (Scott, 1987, 1995). In this perspective, cultural forces promote conformity and imitation among organizations, often independently of the dominant form's functional utility. Young organizations may adopt practices not because they are the most efficient but because they are dominant, accepted standards, which mitigate their lack of legitimacy (Singh et al., 1986) and their resulting "liability of newness" (Stinchcombe, 1965). They also adopt existing forms and practices because they provide an efficient, ready-made solution that limits search cost (Aldrich and Kenworthy, 1999; Romanelli 1999). In this institutional view, the pressure from the environment is not of a competitive nature, but an imitative nature.

Standardized solutions and best practices circulate, for instance, through personnel turnover (DiMaggio and Powell, 1983; Freeman, 1982: 16), business forums (Kanai, 1989; Nohria, 1992), or "corporate kin groups" [7] (Saxenian, 1994). It also diffuses through business practices such as consulting, cross-licensing, second-sourcing arrangements, technology agreements, joint ventures. (Lee et al., 2000; Saxenian, 1994). The circulation of standards can also be stimulated by intermediaries who manage to bridge several, otherwise unconnected, groups such as, in the case of Silicon Valley, lawyers or venture capitalists linking investors and entrepreneurs (Suchman, 1994, 2000).

Organizational ecology focuses almost exclusively on flows of operational resources (the raw materials that support organizational survival), while institutional theory concentrates primarily on flows of constitutive information (the basic rules that determines organizational structure). However, these two perspectives are increasingly perceived as complementary rather than antagonistic (DiMaggio, 1988: 8; Westney, 1993: 57), notably because institutional factors shape many aspects of the technical (Scott, 1998: 131). Also, in the growth and structuration of actual organizational communities, the environment exercises its influence through intersecting flows of resources and of information. In other

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[7] "Generations" of firms descending from the same "ancestor" such as Fairchild, HP in Silicon Valley, or DEC in Boston.

words, these flows are not independent of each other; information channels resources and resources filter information (Suchman, 1994, 2000). This idea finds an illustration in Suchman's (1994) ideas about the role played by law firms in Silicon Valley:

> By providing basic summary packets of standardized solutions (standard-forms contracts, norms about corporate structure, guidelines for arranging capital infusions, etc.), law firms helped to reduce the level of uncertainty in the community, and, indirectly, to free additional resources for industrial expansion. By reducing the level of uncertainty over time, the venture capital financing process (as well as other aspects of the startup life cycle) grew increasingly institutionalized, with venture capitalists, lawyers and entrepreneurs developing increasingly stable and well-understood roles. Institutionalization, in turn, drew forth additional resources from established capital markets, additional entrepreneurs from established industries, and additional legal expertise from established law centers. (62)

If we look at developed high-tech clusters using this perspective, they are characterized by an efficient infrastructure for the exchange of operational resources and a stable structure for the dissemination of relevant knowledge in the form of summary templates of standardized solutions (Suchman, 1994).

In the same perspective, pre-emerging or even in emerging high tech clusters, appear different. Resources and information are limited (Feldman, 2001) and they do not circulate efficiently because organizations operate in relative isolation. There are few standards to guide organizations, so they must experiment a great deal with management practices, governance systems, and business models (Lawrence, 1981; van de Ven and Garud, 1989). Scholars analyzed the early years of Silicon Valley in these terms (Rogers and Larsden, 1984; Suchman, 1994).

I believe that this view of an emerging entrepreneurial region applies to the environment in which academic spin-offs were created recently in Belgium. It was a new activity for all parties, from policy makers to administrators of research organizations, to entrepreneurs. It involved the creation of whole new types of organizations, such as investment funds and growth-oriented new ventures, as well as the adaptation of existing organizations to new roles, as in the case of research institutions. Due to the novelty of spinning off new ventures, organizations needed to experiment before standards developed.

As a result, I find Suchman's (1994) analysis of the emergence of Silicon Valley interesting and useful and his conceptualization of how a fragmented group of firms grew from isolated entities to become an organizational community with a high level of internal interaction and interdependence, a distinctive normative and behavioral style, and a collective identity (Suchman, 2000: 73). Obviously, Belgium has little in common with Silicon Valley, but, beyond the example of the California high tech cluster, it is the mechanisms of the process of emergence of an entrepreneurial community that is relevant for this thesis.

Until the 1970s, local high tech firms operated largely in isolation (Rogers and Larsen, 1970). The microprocessor revolution of the 1970s created the technological basis for the emergence of several new industries, but the destiny of these industries remained largely dependent on the development of a social infrastructure capable of integrating their activities in a mutually complementary way.

Suchman describes the growth of this social structure by focusing on the role of law firms and venture capitalists. Initially, the main obstacle to the commercialization of these new technologies was the difficulty of obtaining funding from traditional institutional investors. This failure of the capital markets and subsequent modifications in capital gains taxes, created an opportunity for well-connected and wealthy investors to provide initial "venture capital."

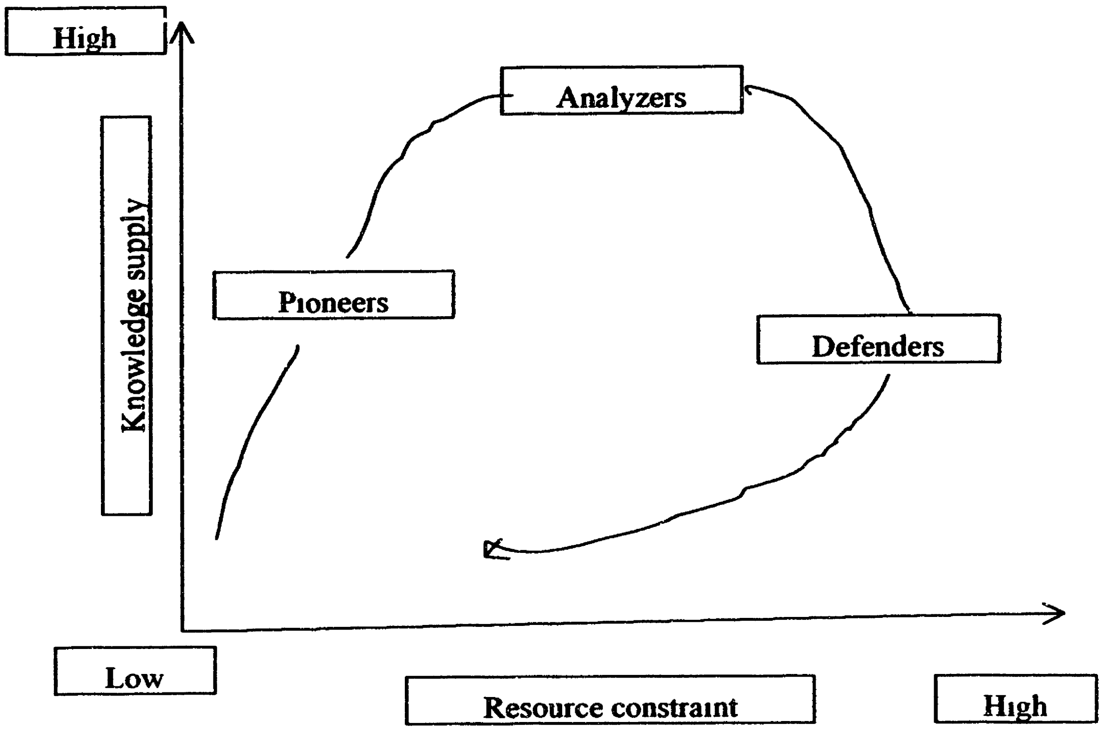
During this initial stage of development of Silicon Valley, local law firms were among the few organizations enjoying regular contacts with new high-technology ventures and venture capital funds. These contacts slowly fostered commonalities between these isolated parties. By diffusing among their clients standard contracts, norms about corporate structure, guidelines for arranging capital infusions, etc., law firms helped to reduce the level of uncertainty in the community and, indirectly, to free additional resources for industrial expansion. This winnowing process was a two way street: as law firms increasingly offered business advice based on their clients' experiences with various models, clients increasingly selected law firms based on lawyers' reputations and track records within the community. Silicon Valley legal practice became a creation as well as a creator of the emerging community structure.

Over time, the venture capital financing process grew more institutionalized, as well as other aspects of the startup life cycle, with venture capitalists, lawyers and entrepreneurs developing increasingly stable and well-understood roles. Institutionalization, in turn, attracted additional resources from established capital markets, entrepreneurs from established industries, and legal expertise from established law centers. Each new infusion altered the existing community structure somewhat, but later waves tended to build on the existing order. Progressively, this dynamic produced a coherent organizational environment characterized by stable resource flows and also stable social expectations. Ultimately, participants in this process shared not only geographic proximity, but also cultural proximity.

The contributions of Silicon Valley's law firms and venture capital funds did not come from their traditional legal and financial activities, but from their role as "pollinators; i.e., their influence on flows of constitutive information and operational resources, in particular by transmitting "know how" between firms that otherwise had little contact with one another. Suchman qualifies this process as structuration, i.e. the development of coherent and consistent social relations, shared meanings, stable interaction patterns, and consensually defined roles within a group of previously isolated firms.

Extrapolating from his observations, as well as industry life (Lawrence, 1981; van de Ven and Garud, 1989) and population ecology theories (Hannan and Freeman, 1989), Suchman analyses the emergence of an entrepreneurial community as a life cycle following a circular path in a two dimensional space defined by an information domain and a resource domain. He argues that, as an organizational community matures, it moves through three stages and that in each of these stages different types of organizations prosper. For the purpose of the case of Belgium, the first stage is the relevant one.

Figure 1.3. **Entrepreneurial domain life cycle**



Source: adapted from Suchman (1994: 64).

In the initial stage, the accumulation of resources, or the emergence of a new technology attracts "pioneers," [8] agile entrepreneurial organizations that are fit to exploit change and newly uncovered resources (Hannan & Freeman, 1977; Lawrence, 1981). This "proto-community" of isolated, pioneering organizations pro-

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[8] Borrowing from Lawrence (1981), Suchman labels these firms "prospectors," but I substituted this label with "pioneers" in order to avoid confusion with the distinct concept of "prospector" that I develop later in the thesis.

liferates rapidly in a large variety of organizational forms. A great deal of trial and error occurs with competing organizational models and practices. Consequently, the store of knowledge and models on how to operate in this new space (what Suchman calls "constitutive information") increases rapidly, while untapped resources decrease. In Silicon Valley, this phase corresponds to the invention of the microprocessor in the early 1970s.

This technological breakthrough motivated engineers, academics, and even hobbyists to start numerous new ventures in spite of a lack of relevant business experience and guidelines on how to operate in this new area. I will argue later in this thesis that this is the stage that participants involved in spinning off new ventures from academic institutions in Belgium were in during the late 1990s and early 2000. Based on his observations of law firms and venture capitalists, Suchman adds that, during this early phase of entrepreneurial experimentation, some ventures interact with potential information intermediaries who, as a result, observed a great number of organizational forms.

The second stage of development occurs as the increasingly overcrowded community undergoes a "shake-out." At that stage, successes and failures contribute to promoting or eliminating some organizational models. After some time, their observations lead intermediaries to begin to identify recurrent problems and common solutions among their clients. Different intermediaries, however, draw different lessons from their observations, because they interact with different firms and develop competing prescriptions. As a result, the development phase of the entrepreneurial community enters a second "sponsorship" phase. Suchman suggests that Silicon Valley experienced such sponsorship phases during its two slowdowns in the early 1980s and mid 1980s. Organizational archetypes remain fiercely contested, but the association with particular intermediaries becomes an important predictor of organizational form. Several organizational archetypes begin to emerge. Pioneers are replaced by "analyzers" who attempt to systematize the chaotic nascent sector, often by trying to impose industry standards and "sound business practices" (Van de Ven & Garud, 1989). In Silicon Valley, the onset of this stage corresponds roughly to IBM's entry into the microcomputer market.

At some point, as the community approaches maturity, selection pressures begin to increase on both the population of clients and intermediaries. Some models disappear with their sponsors. Highly visible successes and failures inspire rapid real and superstitious, vicarious learning. Clients increasingly favor intermediaries with good track records, while intermediaries more and more adopt popular and successful organizational models. Ultimately, "a limited number of archetypes gain ascendance, forming a community-wide repertory of taken-for-granted solutions to highly typified problems" (Suchman, 1994: 309). The new order favors firms that are structurally well-suited to the sector and that are also well-adapted to coexist with each other. The mutual adaptation of these organizational forms promotes stability of the sector. "Defenders" come to dominate the population and make the entry of new firms difficult.

At the environmental level, another aspect is relevant to my study. The interest in technology transfer and spinning off new ventures from academic institutions in the late 1990s in Belgium was inspired by the success of the technology sector in the USA and was an attempt at emulating elements of developed high tech clusters in the USA. Replication of foreign organizational models of entrepreneurship and academic technology transfer thus represented a major aspect of the changes that occurred in Belgium in the late 1990s. From this point of view, Westney's (1987) theorization of the replication of foreign organizational models is relevant.

According to Westney (1987: 28), adoption of a foreign organizational model is always selective. First, selection occurs because information about alternative models is always imperfect. Second, foreign ideas can also conflict with valued local patterns and they can be rejected. Third, organizations operate in "organization-set" or in an "organization field," composed of "other organizations that regularly interact with it, for instance, to provide resources or services, buy its products, or exercise formal control over one aspect or another of its operation." If the "importing" organization does not benefit of a similar organization-set, it will be restricted in implementing new structures and in adopting new practices from its original model. Saxenian (1994: 7, 39) provides a good illustration of such organizational field in her description of the various actors technology start-ups in Silicon Valley rely on: universities, business associations, local government, venture capitalists, law firms, and professional service providers.

The factors proposed by Westney that make replication of a foreign organizational model selective can be found in Belgium. First, information about alternative models is imperfect. Indeed, in the late 1990s, although the growth-oriented model of venture had been advertised a great deal following the success of the technology sector in the USA, few people had operational knowledge of how to build a growth-oriented technology venture. Second, foreign ideas can also conflict with local values and, thus, can be rejected. For instance, the tolerance to failure is much lower in Europe and job mobility goes against the expectation people have stable employment (OECD, 1999; Trumbull, 2002).

Third, organizations need to operate in sets or fields of other organizations. Without these "collateral organizations" (Romanelli and Bird Schoonhoven, 2001), it is difficult to replicate the original model. For instance, descriptions of Silicon Valley and Boston indicate that new ventures rely on a web of service providers that form a key support infrastructure to entrepreneurial initiatives (Saxenian, 1994: 39). Such a supportive community was largely absent in Belgium in the late 1990s and early 2000.

The above discussion proposes a view of the environment in terms of resources and knowledge. It argues that, in order to emerge, new types of organizations need both flows of resources and knowledge; depending on the state of supply of knowledge and resource constraints, different types of organizations will emerge. It thus leads to viewing organizational structures as the result of intersecting flows of resources and knowledge.

Most nascent entrepreneurs start as reproducer rather than innovator organizations (Aldrich, 1999: 80; Burton, 2001; Romanelli and Bird Schoonhoven, 2001: 386). They assemble building blocks of established organizational models and practices according to inherited rules which they acquire by imitation (DiMaggio and Powell, 1983) and the circulation of personnel (Brittain and Freeman, 1980). According to Aldrich (1999: 92), the three most likely forms of knowledge that nascent entrepreneurs need are previous experience, advice from experts, and imitation/copying. To the extent that nascent entrepreneurs are breaking away from established forms, they face the challenge of creating new knowledge themselves. This is even true in case of replication of a foreign model because, as Westney (1987) stresses, information about the original model is always incomplete. The emergence of innovative organizational forms is, however, difficult because competitive, normative and cognitive pressures favor reproduction of existing forms (Hannan and Freeman, 1989; DiMaggio and Powell, 1983). I propose that such a view is helpful to understand the changes in Belgium in the late 1990s and early 2000 with the transfer of technology from academic institutions by spinning off new ventures.

New organizational forms are important because they contribute to organizational diversity and the ability of societies to respond to social problems may depend on the diversity of organizational forms (Hannan and Freeman, 1989). An important aspect of change at the macro level, indeed, is the replacement of existing organizational forms by new ones (Aldrich, 1998; Schumpeter, 1950). Furthermore, because new organizational forms are incarnations of beliefs, values, and norms, they emerge together with new institutions and contribute to cultural change (Rao and Singh,1999: 64; Scott, 1995; Stinchcombe, 1965).

CHAPTER 2: RESEARCH DESIGN

1. INTRODUCTION

This chapter explains the research design that I employed. First, I define the research question and explain how I formulated it by following the iterative process of data collection and analysis. Second, I define the relevant terms, including "academic spin-off venture." Third, I justify the choice of an inductive research design. In Section 4, I clarify this study's target population and how I selected a sample of firms and regions. In Section 5, I describe my various data sources. In Section 6, I elucidate the data collection process, which went through four iterations, and give a short summary of the data analysis process at each stage.

2. RESEARCH QUESTION

In 1999, when I resumed my academic research in Europe, I wanted to continue research that I had initiated in Boston on management teams in new technology start-up companies. This choice was justified by the fact that anecdotal evidence and various articles stress the importance of management teams in the success of new technology ventures (e.g., Bird Schoonhoven and Eisenhardt, 1990; Roberts, 1991; Roure and Maidique, 1986). However, even though their role in the success of new ventures is important, founding teams have seldom been studied.

When I started interviewing in firms in Belgium, I discovered that the management teams of most academic spin-off firms were extremely limited. For the most part, founders were young scientists or engineers with no business experience; they did not think about partnering with experienced managers to build their firm. Although this was consistent with the literature (e.g. Chiesa and Piccaluga, 2000; Mustar, 1995, 1997; Rickne and Jacobsson, 1999), I was surprised by the similarity of these characteristics. There was, thus, little to say about "management teams" as such.

It appeared that spinning off ventures from research institutions was fairly new in Belgium and represented a significant departure for research institutions. Not much knowledge existed on the topic as the concept of academic spin-off ventures was not well known. Given the recognition in the USA that spinning off new ventures from research institutions is a major way to exploit academic research commercially (Mowery and Shane, 2002) and the acknowledgement of the role played by science-based start-up firms in technology innovation and economic growth (BankBoston, 1997; Owen-Smith, 2002), I decided to widen the focus of my study to the phenomenon of spinning off ventures from research institutions in Belgium. What made the case of Belgium interesting is that spinning off ventures proactively from research institutions was new. It was conducted by research institutions which, for the most part, had no experience in technology transfer. Finally, it was emerging in a context where there was no entrepreneurial community. Thus, in many ways, it contrasted from most of the literature that focused on the most developed high tech clusters of Boston and Silicon Valley (e.g. Roberts, 1991; Saxenian,1994) and, to a lesser extent, Cambridge, UK (Segal Quince Wicksteed).

I initially focused my attention on firms and tried to understand what factors might explain why some firms opt for a small business format while others choose to adopt a growth-oriented model of venture. In the course of the field study, this question seemed so much embedded in what happened in research institutions and the policy level that I again broadened the focus of my study.

My research question now centers on how the process of spinning off ventures works in an environment outside high tech clusters and how it affects models of ventures

3. DEFINITIONS

The phenomenon of academic spin-off venture is not well defined, which probably reflects its emerging nature as well as local realities across countries. Callon (2001) reports that no common definition of what counts as a spin-off venture has yet emerged from the technology policy literature:

> The term is used rather loosely and refers generally to any new, small, high technology or knowledge intensive company whose intellectual capital somehow has origins in a university or public research institution. But different spin-off studies include a rather wide

> range of affiliations between the firm and the parent public institution in their definitions. (18)

She adds that half the countries surveyed by the OECD in 1999 reported that they had no official definitions an academic spin-off venture. In his exhaustive literature review on academic spin-off firms, Pirnay (2001) identifies eleven definitions of academic spin-off firms.

Spinning-off ventures from research institutions is a form of technology transfer, which involves the creation of a new firm (Louis et al., 1989; Jones-Evans and Klofsten, 1998; Roberts and Malone, 1996). It is thus different from other modes of technology transfer, such as contract research, consultancy, patenting and licensing, and test services. The technology transfer can be formal or informal.

The most formal case would be that in which a research institution licenses a technology to a new spin-off firm. However, there are many cases in which scholars leave a research institution and establish a firm that exploits the know-how they accumulated during their tenure at the research institution. I include this type of case in my definition of an academic spin-off firm. It seems to me that the important qualifying features in being defined as an academic spin-off firm are the technology transfer from a research institution and the fact that the firm is new, established for the purpose of exploiting this technology. This definition would not include firms set up by professors at research institutions for the purpose of undertaking their consulting work. I also exclude firms founded by students.

Thus, the definition that I propose is: an academic spin-off venture is a new firm whose activity is based on the commercialization of a technology developed initially within a research institution.

The academic spin-off process can involve various parties. Roberts and Malone (1996), for instance, distinguish among four roles: the R&D organization, the technology originator, the entrepreneur, and the venture investor. I adopt a terminology that is more applicable to Europe.

I first distinguish the research institution from other parties involved in the spin-off process. This is the organization where the technology was initially developed. The technology transfer unit is the division of the research institution that oversees the spin-off process. Up until the late 1990s, Belgian academic institutions did not have a technology transfer capability, but they all created a structure devoted to technology transfers between 1996-2000, under pressure from the government. The technology originator is the scientist or group of scientists from whom the technology originated. The founder or the founding team is the person who or group which creates the academic spin-off firm. In Europe, this is generally the scientist(s) who work(s) or used to work in an academic institution, so that the roles of technology origination and founder often overlap.

The venture investor is an outside investor. When this exists in Europe, it is often an investment fund of a research institution or of a public sector agency. Indeed, in Europe, venture capital is much less developed and venture-capital investments tend not to invest in early stage ventures (e.g. Bannock, 1998; Sapienza and Manigart, 1999). Finally, incubating organizations, or incubators, are organizations that "nurture" start-up firms in their early stages by providing them with operational resources and entrepreneurial competencies.

As Roberts and Malone (1996) point out, in practice, sometimes the five roles are clearly separate, but in other cases, there is overlap among them. This is often the situation in Europe. For instance, the technology originator is often a founder of the spin-off firm and, in the early stages of the firm's life, functions as the manager as well. Similarly, the research institution can be the promoter of the fund and manager of the incubating organization.

As I will describe in more detail in Chapter 6, the literature suggests that there are two archetypes of new ventures: SMEs and growth-oriented ventures. SMEs essentially appear as a vehicle for self-employment (Timmons et al., 1992: 9). They are characterized by low capitalization, closed ownership, weak management, no or low growth orientation and they target continuity (e.g. Donckels et al., 1993; Storey & Tether, 1996; Storey, 1994; Wtterwulghe, 1998). Growth-oriented ventures, in contrast, are geared towards creating value for their founders and their shareholders through the realization of capital gain. They typically pursue business opportunities with high potential.

4. INDUCTIVE RESEARCH DESIGN

Since the phenomenon had not yet been explored much, as emphasized in chapter 1, I found it more appropriate to adopt an inductive design, seeking to gather insights from the field with the aim of building hypotheses and creating a theory, rather than testing hypotheses drawn from theory.

The choice of such an inductive research design is consistent, for instance, with Brown and Eisenhardt's (1997) argument:

> The underlying logic of the research presented here is grounded theory building, which involves inducting insights from field-based, case data. We chose grounded, theory building, because of our interest in looking at a rarely explored phenomenon for which extant theory did not appear to be useful. In such situations, a grounded theory building approach is more likely to generate novel and accurate insights into the phenomenon under study than reliance on either past research or office-bound thought experiments. (2)

Methodologies and research designs to conduct such research have been developed by a number of authors (Eisenhardt, 1989; Glaser and Strauss, 1976; Strauss, 1987; Miles and Huberman, 1984; Yin, 1984). Some empirical studies following an inductive design have made excellent contributions (e.g., Ancona and Caldwell, 1992; Brown and Eisenhardt, 1997; Burgelman, 1983b; Gersick, 1988, 1994; Leonard-Barton, 1988; Perlow, 1998, 1999). I adhered most closely to Eisenhardt's (1989) prescriptions for inductive research.

5. DATA SOURCES

Eisenhardt (1989: 537) suggests that inductive research typically combines multiple data collection methods; this provides stronger findings. I followed this approach by combining data collection through interviews, archival data from research institutions, government agencies, and firms.

First, I gathered data on the policies of the governments of the two main regions in Belgium: Flanders and Wallonia. [9] I collected primary data sources by interviewing one administrator from

[9] I briefly explain in chapter 3 the particularities of the Belgian political system.

the agencies of each region involved with science, technology, and innovation (STI) policies. (See Appendix 2.1 for details.) I also obtained archival data on these policies. (See Appendix 2.2.) However, I chiefly relied on secondary data, primarily on Capron and Van Meeusen (2000) and Nauwelaers (2001). (See Appendix 2.3 for secondary data.)

Second, I collected information on the seven academic institutions in Belgium that were either the largest or the most significant from the point of view of spinning-off ventures.

Specialized Research Institutes:

- Institute for Microelectronics (IMEC), [10]
- Flanders Institute for Biotechnology (VIB)

Universities:

- Katholieke Universiteit Leuven (KUL),
- Rijks Universiteit Gent (RUG),
- Université Catholique de Louvain (UCL),
- Université de Liège (ULG),
- Université Libre de Bruxelles (ULB).

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[10] I provide an English name when the institutions use an English translation of their name, otherwise, I report the name in the original language: Dutch or French I later refer to these organizations by their initials.

In Figure 3.1 and in Table 3.1 in chapter 3, I provide data on these academic institutions.

I interviewed twenty representatives of these research institutions and universities. (See their references and the date of interview in Appendix 2.1. The interview guide appears in Appendix 2.4.) My interviews with founders of spin-off ventures were also a major source of data on research institutions and universities (See below.)

Information provided about spin-off ventures by representatives of universities and research institutions in interviews turned out to be unreliable. They tended to exaggerate their accomplishments. For instance, they often overstated the number of firms spun off from their research institutions. This became apparent to me when I wanted to interview in firms that had been presented as academic spin-offs and found that some of them did not exist or existed only on paper; or, if they did actually exist, they were not academic spin-off firms. (See Appendix 2.5 for the list of firms forming the population of academic spin-off firms.)

Third, I identified the population of academic spin-off ventures founded before the end of 2000 by triangulating several data sources. Since research institutions and universities were unreliable, I needed to complement these sources with others. Government agencies were one source. Other researchers interested in academic spin-off firms were another (Surlemont et al., 1999). Direct contact by telephone was a major source of information to discriminate firms that were academic spin-off ventures from others. Sometimes web searches achieved the same objective. Interviewing entrepreneurs was a major data source because of the links among them.

Identifying the population of academic spin-off ventures was an on-going process during the whole research. I finally estimated that 106 existing firms could be considered academic spin-offs of research institutions and universities. Only three ventures were spun off from academic institutions that I did not study. I present a list of this population in Appendix 2.5 with data about sources of information, the time when I identified firms, and the list of firms that I excluded from the list, as well as reasons why I did so.

Of this population of 106 firms, I interviewed forty-one and gathered data on six via a questionnaire, when interviews were not granted. [11] (See Appendix 2.1 for a list of these firms. The list of firms in the population from which I did not gather data appears in Appendix 2.6. See Appendix 2.7 for a copy of the interview guides.) It includes three versions of the interview guide, because I started with a fairly open interview guide and, as the study progressed, I was able to detail questions better. (See Appendix 2.8 for a copy of the questionnaire filled in by those firms which turned down requests to be interviewed, but agreed to provide written information.)

This group of forty-six firms thus represents almost half the population and is a representative sample. Firms were included based on my identification of the population and their agreeing to be interviewed. I tried to achieve a balance between firms from different academic institutions and between older and younger firms.

Is the sample biased or is it representative of the population of Belgian academic spin-off ventures? I believe that the sample is representative, because until the last quarter of 2000, I pursued data gathering until the information that I collected became repeti-

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[11] Originally, my plan was to build a questionnaire based on what I had learned from the interviews In collaboration with Prof. Clarysse of RUG and his team, we sent a questionnaire to 133 firms in Belgium In spite of numerous follow up calls, the results were poor Few questionnaire were eventually returned and those that were, were incompletely filled in, except for the six that I included in my sample

tive. There may be a bias regarding firms founded before 1996, in particular in the 1980s. Among these firms, those which were most difficult to interview were firms with the strongest SME characteristics. Their founders have a strong sense of independence which translates sometimes into suspicion towards any outside parties trying to obtain information. Since one of my findings is that the dominant model of venture during this period was the SME, the bias is probably that the reality is even stronger than what my conclusion suggests.

With regard to ventures founded between 1996 and 2000, Professor Clarysse and his team at the Rijks Universiteit Gent, the University of Ghent, pursued interviews in 2001 and 2002 with ventures in this population that had been founded in the late 1990s. They confirmed the three archetypes I have identified which are presented in chapter 6.

Interviewing founders of academic spin-off ventures first raised the issue that I mentioned above about identifying academic spin-off ventures. Once firms were identified, obtaining permission to interview also was usually difficult. Entrepreneurs were not eager to participate in the interview process. I see several reasons for their reluctance. They work with insufficient resources and are, thus, very busy. Independence and self-reliance appeared to be dominant feature of their culture, which is common among small business owners (Donckels et al., 1993; Wtterwulghe, 1998). This translates into suspicion about sharing information. By referring to a university administrator or professor who directed me to the firms, I often gained greater cooperation from prospective interviewees. I usually interviewed one person at each firm. For the reasons just cited, it was difficult in most cases to interview more than one member of a firm.

I gathered a lot of archival data on the firms, research institutions and government agencies supporting spin-off firms, as well as the context in general. The archival data that I collected appears in Appendix 2.2. With the exception of firms that had had public offerings of their stock, archival data on the firms were generally limited. This is due to the nature of the firms: small firms and their entrepreneurs in Belgium do not keep archival data and, more importantly, generally were not willing to share such information with me. I checked websites of each firm that had one, but seldom did these sites provide data that I had not obtained through the interviews.

I used the "Belfirst" financial databank of the Belgian National Bank to gather financial and demographic data. However, a large portion of firms did not report any or much data to the National Bank.

Finally, I used secondary data on science, technology and innovation in Belgium; university–industry relationships; academic spin-off ventures and new, technology-based firms. I list these sources in Appendix 2.3. They also appear in the bibliography at the end of this thesis.

6. DATA COLLECTION

6.1 Introduction

While conducting my field research, I was able to use the Vlerick School of Management in Gent as a base and, more specifically, the Department of Management of Technology headed by Professor Clarysse. The funding provided by the European Commission permitted me to hire two research assistants who helped schedule appointments for interviews. They accompanied me on interviews and, after observing my work, eventually started conducting interviews themselves. With a few exceptions, two of us were always present during interviews.

I took notes during the interview and immediately wrote a report after each interview session. Each document includes both factual data reported by the interviewee and my comments linking the specifics of the interview with references to other interviews, in an attempt to identify trends. These comments also created links with organization theory and entrepreneurship literature to identify frameworks to analyze the data, as well as to gain insights for theory building.

I created a file with interview notes, the interview report, and all relevant archival data on each firm. A similar file exists with data on each research institution. Soon after I wrote the report, I submitted it to my co-interviewer for his assessment of the reliability of the data, and for comments about the interview. As Eisenhardt (1989: 538) stresses, this process provides more confidence in the data and is a source of creative insights. Every other week, we all sat down to discuss the emerging picture or, more often, the puzzles that emerged from interviews. I followed the same process during the two years of data gathering.

Research based on an inductive design is by nature recursive in that it includes iterations of data collection and data analysis. For instance, Perlow (1999) writes:

> I followed the guidelines suggested by Glaser and Strauss (1967) and Miles and Huberman (1984) to develop empirically grounded set of insights. I used an iterative process in which I developed hunches, compared those ideas to new data from the site and then used the new data to help decide to retain, revise, or discard those inferences. Periodic analysis during the data analysis throughout the data collection process helped sharpen questions, focus interviews and observations, and ground evolving theory. (64)

Similarly, Eisenhardt (1989: 542) suggests that series of cases must be treated as series of experiments, with each case serving to confirm or deny insights and relationships among constructs. In this logic, she proposes that each case is comparable to an experiment; multiple cases are analogous to multiple experiments.

In the course of my research, the process of data collection went through four major iterations, which were punctuated by data analysis:

- The first iteration extended from February 1999 to August 1999,
- The second iteration extended from September to November/December 1999,
- The third iteration extended from December 1999 to May 2000,
- The fourth iteration extended from June through December 2000.

6.2. First iteration of data collection: February to August 1999

Table 2.1. - **Organizations and firms from which I collected data during the first iteration**

Organizations	Date of interview
VIB (Flemish Institute for Biotechnology)	19-Feb-99
UCL (University of Louvain)	01-Mar-99
Instituut voor Wetenschap en Technologie	01-Mar-99
RUG (Rijks Universiteit Gent)	9-Mar-99

RUG (Rijks Universiteit Gent)	9-Mar-99
Centre Spatial de Liège	12-Mar-99
Willems Institute	12-Mar-99
EEBIC (Erasmus European Business and Innovation Center)	18-Mar-99
Direction Generale de la Recherche Scientifique (DGTRE)	24-Mar-99
LUC (University of Limburg, Hasselt)	16-Apr-99
UA (University of Antwerp)	26-May-99
VUB (Vrije Universiteit Brussel)	8-Jun-99
Leuven R&D	23-Jun-99
ULG (Univesité de Liège)	22-Mar-99
Firms	**Date of interview**
LMS	30-Jan-99
Cropdesign	9-Feb-99
Elsyca	26-Feb-99
Polyflow	1-Mar-99
Easics	11-Mar-99
Eurogentec	12-Mar-99
Lasea	12-Mar-99
Neurotec	17-Mar-99
Iris	22-Mar-99
Oligosense	22-Mar-99
Telemis	29-Mar-99
ISMC	6-Apr-99
Stag	15-Apr-99
Destin	16-Apr-99
Eurogenetics	19-Apr-99
Androme	19-Apr-99
ANSEM	1-Jun-99
Metris (B)	1-Jun-99
Eyetronics	3-Jun-99
Materialise	3-Jun-99
Metis	8-Jun-99
Meac	23-Jun-99
Data Analysis Products	23-Jun-99
Elias	1-Jul-99
Optidrive	1-Jul-99
Hypervision	8-Jul-99

ICOS	28-Jul-99
Netvision	3-Aug-99
IMO	10-Aug-99
Krypton	30-Aug-99

In early 1999 I started the present study by searching the literature and identifying academic spin-off firms in Belgium. I knew of a number of academic spin-off firms and knew that more existed, but no exhaustive list of academic spin-off firms had been established. I started by asking the research institutions about firms that they had spun off as a way to begin identifying the population and building my sample. Among the nineteen Belgian universities, I initially targeted the five larger ones which cover the full range of academic fields: the Katholieke Universiteit Leuven (KUL), the Université Catholique de Louvain (UCL), the Université de Liège (ULG), the Rijks Universiteit Gent (RUG), the Université Libre de Bruxelles (ULB). By triangulating the information that I was gathering, I learned that other smaller, more specialized research institutions had also spun off firms. Finally, I interviewed representatives of the two main regional, Belgian governments, Flanders and Wallonia, about their policies towards academic spin-off firms and sought their help in identifying firm

Meanwhile, in parallel, I started to interview firms as soon as February, 1999. I began with a fairly open interview guide and refined it over time as the interviews provided insights and I gained a more comprehensive picture of the context of academic spin-off firms.

How did I construct this initial interview guide? I was mostly interested in understanding what differentiated firms which adopted an SME boutique format from those which adopted a growth orientation, especially with regard to their founding conditions and their early stages of development. As mentioned earlier, SMEs are essentially vehicles for self-employment that are characterized by low capitalization, closed ownership, weak management, no or low growth orientation and they target continuity. Growth-oriented ventures, in contrast, are geared towards creating value for their founders and their shareholders through the realization of capital gain. They typically pursue business opportunities with high potential and included an exit, i.e. sale or a public offering of shares, at some point. By growth-orientation, I mean the objectives of founders consisting of going beyond a substitute for a job or other lifestyle objectives.

Based on this difference, the following constructs were important to explore: governance, founding conditions, and institutional environment.

This first iteration of interviews in firms extended from January 1999 to April 1999 and included fifteen firms. This initial group of fifteen firms was selected based on convenience, i.e., the opportunity to identify an academic spin-off firm and management agreeing to an interview. As much as possible, I tried to interview a few firms from each research institution. As suggested by inductive studies, I then developed empirically grounded sets of categories.

In short, the analysis of data collected during this iteration led me to the following conclusions. First, at the environmental level, I realized that there had been an institutional change in the mid- to late 1990s. Prior to this period, the environment was unfavorable to academic spin-off firms. There was little risk capital available, research institutions were generally indifferent to transfer of technology, some were even hostile to it, and policy makers did not make it part of their agenda. At the firm level, the majority appeared to have little growth orientation and functioned as small businesses. This was not surprising in the case of firms founded prior to the mid-1990s, given the unsupportive context at that time. I was more surprised to find that, well into the late 1990s, most firms still resembled SMEs and relatively few firms seemed to have adopted a growth orientation.

6.3. Second iteration: from September to December 1999

Table 2.2. - **Organizations and firms from which I collected data during the second iteration**

Institution	Date of interview
Imec (InterUniversitary Research Center in Microelectronics)	14-Dec-99

Firms	Date of interview
Sinvaco	1-Sep-99
Epas	10-Sep-99
Belsim	27-Sep-99
Biocode	28-Sep-99
Gamma	28-Sep-99
Horpi Systems	30-Sep-99
Unisensor	30-Sep-99
Innogenetics	7-Oct-99
Metalogic	9-Oct-99
Inverto	19-Oct-99
Microbelcaps	5-Nov-99

Consistent with inductive research design, which treats cases as individual experiments that are replicated until new data confirm earlier information, interviews were extended during the fall of 1999. Based on the insights provided by the first interviews, I developed a second, more refined, interview guide to interview ten additional firms. To summarize, in this iteration I focused the data analysis of the environment of academic spin-off firms on research institutions which appeared to play a central role in shaping academic spin-off firms. It became clear that two types of research institutions needed to be distinguished: specialized research institutions and universities. In my analysis of the firms, I tried to move beyond the very basic categories of firms that emerged through the first iteration of data collection. I explored a number of avenues to categorize firms, although none of these areas seemed satisfactory at that point.

6.4. Third iteration: December 1999–May 2000

Table 2.3. - **Organizations and firms from which I collected data during the third iteration**

Institutions	Date of Interview
Vrije Universiteit Brussel (VUB)	25-Feb-00
Université Libre de Bruxelles (ULB)	28-Feb-00
IMEC	02-Feb-00
University of Liege (ULG)	22-May-00
Firms	**Date of interview**
Septentrio	30-Jan-00
Fillfactory (*)	25-Feb-00
Biotechtools	28-Feb-00
Coware	2-May-00
ATC	Feb-25-00
Lambda X (*)	Feb-25-00
Micromega (*)	Feb-25-00
Optimal Design (*)	Feb-25-00
Mithra Pharmaceutical (*)	Feb-25-00
Organic Waste System (*)	Feb-25-00

In this third iteration of data collection I interviewed two other representatives of universities and three other firms. Analysis of the data collected during this iteration and in previous ones led me to realize the differences in spin-off processes between research institutions and the impact the differences had on firm formation. At the firm level, I was able to perceive the types of firms with greater definition. Beyond SMEs and venture capital-backed types of firms, a hybrid type began to surface. The key differences between this hybrid and SMEs was, however, still difficult to untangle

6.5. Fourth iteration: June to December 2000

Table 2.4. - **Organizations and firms from which I collected data during the third iteration**

Firm	**Date of interview**
Octalis	1-Sep-00

This was essentially an iteration of analysis of the data collected so far and of broadening of the data collection at the policy level. I felt that the latest interviews were not providing additional information, so I decided to stop collecting primary data. I started to code the data I had on firms, in order to be able to identify more clearly dimensions that may be relevant. This involved several iterations as well. I wrote cases of the firms that appeared to represent the richer examples and for which I had the best data. I also continued to categorize data on the research institutions and their spin-off process.

CHAPTER 3

INTRODUCTION TO THE RESEARCH SITE

The first section of this chapter presents a brief description of Belgium, including its geography, population, and political system, as well as aspects of the science, technology, and innovation policies relevant to an academic spin-off venture. The second section presents data on the current population of academic spin-off firms. The final section gives a historical perspective on the emergence of academic spin-off firms and academic entrepreneurship since the 1980s.

1. GEOGRAPHY, POPULATION, AND POLITICAL SYSTEM

Located in the western part of Europe, Belgium is bordered to the north by the Netherlands, to the east by Germany and the Grand Duchy of Luxembourg, and to the south and west by France. Its surface area is 32,545 square kilometers and its population is approximately 10.2 million. Thus, Belgium has a very high population density on a territory that represents 1% of the European territorial area. The nation gained its independence from the Netherlands in 1830, and today its government is structured as a federal parliamentary democracy with a constitutional monarchy. Belgium is nowadays composed of three regions, Flanders, Wallonia, and the Region of Brussels.

During the last several decades, the country rapidly evolved into a newly defined federal structure. Capron et al. (1999) summarize this structure in the following way:

> Belgium is a federal State composed of several authorities... The three categories of institutional actors are the federal authority, the Communities and the Regions. The three Belgian communities, which are based on language differences, are: the Flemish Community, the French Community, and the German-speaking Community. These correspond to population groups. The founding of the three regions, the Flemish region, the Brussels Capital Region, and the Walloon Region, is historically inspired by economic concerns, in that the regions wanted to be autonomous with regard to their development policy. To some extent, Bel-

gian regions are now similar to the American States or the German "Lander." (3).

2. BELGIUM'S ECONOMY [12]

The present prosperity of Belgium in rooted in its long-standing tradition of openness to innovations and new ideas. The Belgian industrial revolution was based mainly on an imitation diffusion process of British innovations. In the first half of the 19th century, Wallonia was the first place in continental Europe to undergo the Industrial Revolution. At the end of the 19th century, Belgium had the highest GDP per capital in continental Europe. The turn of the century saw the economic take-off of Flanders, while the slowing down of the Walloon economic expansion started. In the post World War II period the economic decline of Wallonia and the economic rise of Flanders grew. As a result, one primary characteristic of the Belgian economy is its unequal spatial development. The Walloon region suffers today of problems similar to those of old British industrial areas (Capron 2000: 22).

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12 Main source for this section is Capron and Van Meeusen (2001a, 2001b).

This historical development explains why the technological orientation of the economy has until recently been concentrated in traditional industrial activities, such as metallurgy, chemicals, and textiles. Belgium turned to R & D activities in the new high tech fields after other countries, which had started their industrial revolution later. Belgium's efforts to restructure its economy in the 1970s was not very effective because it took mainly the form of subsidizing failing firms that had little prospects. The following spiraling effect of public debt service made it impossible for the government to provide funds for reorientation the technological bias. That the industrial crisis hit the South of the country more than the North aggravated the situation. The problems stemming from the tensions between the two communities deflected the attention of politicians for too long, at the expense, for instance, of an adequate science, technology, and innovation policy (STI).

In 1989 and in 1993 the country was reshaped into a federation with large areas of policy given to the regions and the communities, including STI policy. Regionalization had two kinds of effects. First, since the regions were freed from servicing the debt, which continued to be carried by the federal government, it triggered an activation of the conversion of their economies towards higher tech sectors. The Flemish government placed a higher priority on STI policies and defined them in a more focused way. By the end of the 1990s, the Walloon regional government was, however, moving in the same direction.

Second, the regionalization seems to run contrary to a general European trend towards scale enhancement. As such, regionalization aggravates the disadvantages of being a small country on the international scene. Small countries acting on their own cannot reach minimum scale to fund major research projects in high tech disciplines in financial terms, human capital terms, or in terms of the size of the market.

As a result, "the Belgian base in high tech industries is very limited" (Capron 2000: 32). The manufacturing structure of the Belgian economy is mainly oriented to medium low and low-tech industries. High tech and medium high tech industries account for only 8% of the total value added created by the business sector as a whole, including services (Capron and Cincerra, 2000a: 100). Capron and Meeusen (2000b: 214) found that three-quarters of the R & D budget in firms is spent on development of new products and processes and only one quarter on research. Furthermore, high tech industries spent the smallest percentage of their R & D budget on research relative to development. Although Flanders has a higher technological base than the two other regions, it is under the European average except in a few sectors. The manufacturing base of the Walloon economy is even weaker than the two other regions and European averages.

Another characteristic of the Belgian economy is its large level of openness which makes its export / GDP ratio among the highest of the European Union. It also has a high structural unemployment rate, probably due to its high labor costs. The Belgian economy is also characterized by a large underground economy, which has resulted from the onerous fiscal and parafiscal pressure, the large structural employment deficit, and the generous social security system. "A main challenge for the Belgian economy is to preserve its international competitiveness by moderating labor costs, improving the investment rate, and encouraging SMEs" (Capron, 2000: 25).

3. BELGIAN SCIENTIFIC INSTITUTIONS

Table 3.1. - **Belgian Universities**

	Number of students (1)	Number of personnel (2)
Katholieke Universiteit Leuven (K U Leuven)	28058	5358
Université Libre de Bruxelles (ULB)	17502	3035
Vrije Universiteit Brussel (VUB)	8894	1757
Universiteit Gent (UG)	22052	3772
Université Catholique de Louvain (UCL)	20966	3613
Université de Liège (Ulg)	13385	3279
Katholieke Universiteit Brussel (K.U Brussel)	753	73
Limburgs Universitair Centrum (LUC)	2182	407
Universiteit Antwerpen (UA)	9203	1787
Rijksuniversitair Centrum Antwerpen (RUCA)		
Universitaire Faculteiten Sint-Ignatius Antwerpen (UFSIA)		
Universitaire Instelling Antwerpen (UIA)		
Université de Mons Hainaut (UMH)	2466	493
Faculté Universitaire des Sciences Agronomiques de Gembloux (FSAGx)	1135	438
Faculté Polytechnique de Mons (FPMs)	910	344
Facultés Universitaires Catholiques de Mons (FUCaM)	1387	148
Facultés Universitaires Notre-Dame de la Paix à Namur (FUNDP)	4125	827
Facultés Universitaires Saint-Louis à Bruxelles (FUSL)	1384	121
Grand total for the Belgian Universities	**134402**	**25452**

(1) Source Universitaire Stichting, Fondation Universitaire (website)
(2) Source Universitaire Stichting, Fondation Universitaire (website)

Source: extract from Nauwelaers (2001)

Belgium has seventeen universities and nineteen research institutions. Of the latter, three are relevant for this thesis: the Inter-university Institute of Microelectronics (IMEC), the Flemish Institute for Technological Research (VITO), and the Flanders Institute for Biotechnology (VIB).

Capron et al. (1999: 14) write that Belgium has five research centers of international reputation.

- IMEC, the Institute of Microelectronics,
- The Center for Human Heredity at the Université Catholique de Louvain, which has developed an international reputation for its research on gene technology,
- The Université de Liège's Space Research Center, one of the world's most renowned institutions in space research. It works closely with the European Space Agency.
- The Institute for Molecular Pathology of the Université de Louvain, which conducts cutting-edge research linking fundamental biological research and medical research.
- The Department of Molecular Biology of the Université Libre de Bruxelles, which specializes in the field of genetic manipulation.

Small countries, like Belgium, are faced with entry costs in a number of domains, so they cannot master the whole spectrum of R&D. As a result, the efficiency of their science and technology policy is conditioned by their ability to use their resources selectively in a few niches where they can acquire a competitive specialization and in which barriers to entry are not too high and scale is limited (Capron 2000: 23). The efficiency of their science and technology policy is also related to their ability to participate and to leverage their participation in international R&D programs. Small countries like Belgium also face the increasing challenge of Newly Industrialized Countries (NICS), especially in mature technologies.

Overall, Capron (2000: 25) estimates that the university system is able to keep up with the advances of science, although it cannot necessarily do pioneering exploration, except in some specific scientific niches like health research. A new challenge of Belgian universities is to become real partners in regional development and to leave their ivory towers to translate their research output into products and new enterprises as well as to forge closer and more fruitful ties with industry (Capron, 2000: 33). Moreover the role of joint research centers, which are partly financed by each industry and whose task is to facilitate technology transfers and assist firms into identify new technological opportunities, is very important (Capron, 2000: 35).

There are three main weaknesses in the Belgian science system: the low level of employment, the instability of this employment, and the aging of the research staff (Foundation Roi Baudoin, 1985; Capron, 2000: 33). These difficulties are related to the fact that, in order to reduce the public spending deficit, the public R & D support was substantially reduced so the growth of public support for R & D grew at less than 3% over the period 1969-1990. The government budget appropriation for R & D now represents 0.64% of the GDP against 0.70% in the mid-1970s. However, there was a slight improvement in public R&D spending in the last few years (Capron, 2000: 25).

Patent and scientific publications data are the output indicators most commonly used to measure technological and scientific activities. The Belgian propensity to patent is less than the European average (Capron and Cincerra, 2001b: 176). Belgian firms as a group thus seem less innovative than the European average on the basis of this criterion. Belgium is more a technology user than a technology producer. The authors add that the Belgian R&D system is to a large extent oriented towards product innovation. Only 5% of patent applications come from academic institutions, research institutions, and government agencies (Capron and Cincerra, 2000b: 181). [13] As Table 3.1 shows most universities filed very little patents.

Table 3.1. - **EPO patents applications (1980 – 1996) of Belgian public research institutions, universities, and government agencies**

	Public institutions (I), universities (U), governments (G)	
I	Centre de Recherche Métalurgique	126
I	Interuniversitair Mikroelektronika Centrum	35
G	La Région Wallonne	27
U	Leuven Research and Development	23
I	Stichting Rega	22
I	S.C.K. / C.E.N.	19
U	Université Catholique de Louvain	16
I	International Institute of Cellular and Molecular Pathology (ICP)	16
I	Vlaamse Instelling voor technologish Onderzoek (VITO)	14
G	Etat Belge, Service de Programmation de la Politique Scientifique	13
U	Rijks Universiteit Gent	10
U	Université Libre de Bruxelles	9
U	Université de Liège	4
I	Sociéte de Recherche et de Developpement Industriel (SOREDI)	2
I	Institut d'Enseignement Special, atelier Protégé les Erables	2
I	Institution pour le Développment de la Gazéification Souterraine	2
	Public institutions (I), universities (U), governments (G)	
I	Wetenschappelijk en Techn. Centrum va de Belg. Textielnijverheid (Centexbel)	2
I	Misc.	15

Source: Capron and Cincerra (2000b:181)

[13] However, the number of university patent applications multiplied by 2.5 from the 1981-1988 period to the 1989- 1996 period, while the total number of patent application multiplied by only by 1.6.

If patents can be viewed as a main indicator of innovative output in industry, publications are often considered to be a good indicator of the innovative effectiveness of the higher education system (Patel and Pavitt, 1995). Around 72% of publications originate from the five largest universities (KUL, UCL, ULB, RUG, ULG). Belgium is in a favorable position in three scientific fields: clinical medicine, biomedical research, and physics (European Commission, 1997). These scientific specializations roughly correspond to the main technological specializations found in the analysis of patents. However, a slow but real decline in the number of scientific publications is observed in comparison with the European evolution; the Belgian share of international publications at the world level is decreasing, while the European share is increasing (Capron and Cincerra, 2000b).

4. ENTREPRENEUSHIP IN BELGIUM

Although the Belgian economy relies a great deal on SMEs, it scores low in terms of entrepreneurship. The Global Entrepreneurship Monitor (GEM) research program is an annual assessment of the national level of entrepreneurial activity. [14] Initiated in 1999 with 10 countries, it expanded to 21 in 2000, and to 29 in 2001. The research program, based on a harmonized assessment of the level of national entrepreneurial activity for all participating countries, involves exploration of the role of entrepreneurship in national economic growth. Although GEM does not ambition to be a scientific study, it is a rare source of comparative data on indicators of entrepreneurship.

What is striking is that on most indicators of entrepreneurship activity or propensity, Belgium ranked last. For instance, the total entrepreneurship activity was among the lowest. This ratio means that in 2000 only 2.4% of Belgian adults were estimated to be involved in an entrepreneurial activity by either running his or her business and trying to set one up. Support for entrepreneurs was also low. Belgium ranked second to bottom in the proportion of interviewees who had invested in a start-up. Only 7% of graduating students were "thinking" of starting a business within the next three years, compared to 19% in the USA. When asked, if they would think of starting their own business in the long run, only 12% of Belgian students give a positive answer, compared to 33%

[14] http://www gemconsortium.org/

in the USA. The study also reveals that the Belgian adult population scored below average in its confidence that there will be good business opportunities in the next six months.

Venture capital has been a strong force behind technology entrepreneurship in the USA (e.g. Sahlman, 1990; Lerner and Gompers, 1999). In Europe, however, it is still only a fraction of what it is in the USA (e.g. Unice, 2000). It only started to take off in Europe in the late 1990s (e.g. European Commission, 1998; Manigart et al. 2002). The fact that statistics on Belgian venture capital only start in 1987 reflects how recent this activity is.

A peculiarity of venture capital in Belgium is that it was largely initiated and it is still dominated by the public sector (Manigart & Van Hijfte, 1999). More than half the venture capital invested in the 1980s were invested by pubic institutions (Manigart & Hijfte, 1999: 12), which is significantly more than in other European countries. The first Belgian venture capital organization was GIMV, the government of Flanders' public investment company, founded in 1980. GIMV is still the largest venture capital organization in Belgium.

Another characteristic of Belgian venture capital is the contrast between Flanders and Wallonia. According to the estimates of Debackere et al. (1998) and Manigart & Hijfte (1999: 25), currently 87% of venture capital in Belgium is invested in Flanders.

Until 1996, seed and start-up venture capital investments did not exceed 0.01% of GNP in Europe and in Belgium, one-fourth of the USA percentage. However, Manigart & Hijfte (1999: 25) stress that, since 87% of venture capital is estimated be invested in Flanders, this would put the share of seed and start-up venture capital investments to 0.02% of GNP, twice the European average, but still half the size of these investments in the USA.

Investments in technology sectors increased in Europe and in Belgium in the 1990s, especially after 1995. Investments in these sectors reach 0.033% of GNP in 1996 and 0.062% of GNP in 1997, three times the European average (Manigart & Hijfte, 1999: 29). Given the imbalance of venture capital investments between Flanders and Wallonia, the figure for Flanders is very favorable compared to the European average.

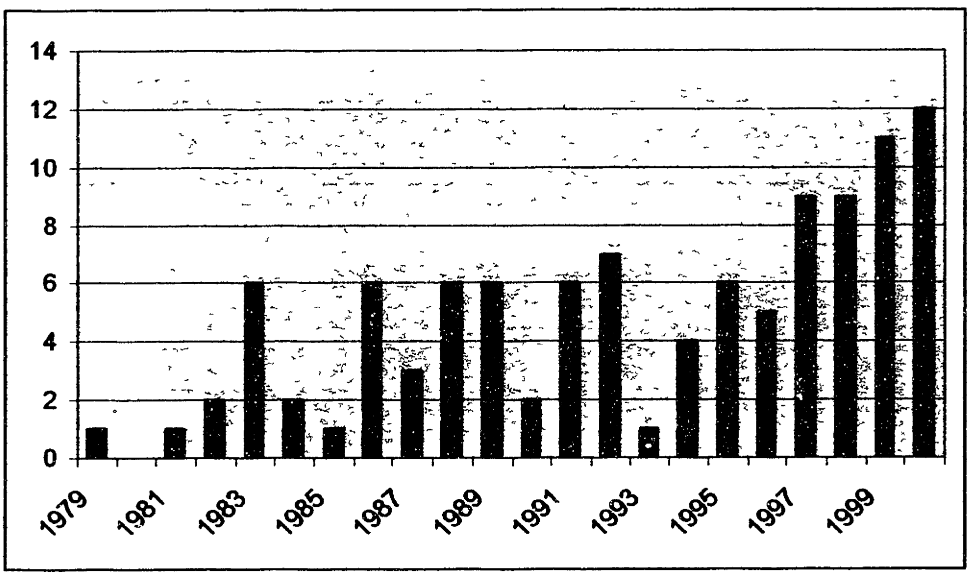
One of the preferred exit routes of venture capitalists is the stock market (Sahlman, 1990). In the mid 1980s a "second-tier" stock market for SMEs was created in Belgium, as in other European countries. However, these markets never really took off, in part, because they were perceived as inferior cousins of the main stock markets and so companies moved up to the main market as soon as possible (Bannock, 1994: v). It took 30 or 40 years for European firms to go public (European Commission, 1998). Finally, in 1996 and 1997, EASDAQ and EURO NM, two pan-European stock markets for young growth firms modeled after NASDAQ, were created.

5. ACADEMIC SPIN-OFF FIRMS IN BELGIUM

Several sources converge in estimating the number of academic spin-off ventures in Belgium to approximate one hundred by the year 2000 (Capron and Meeusen, 2000; Clarysse et al., 2001b; Surlemont et al., 1999). My own attempts at identifying the population of academic spin-off ventures confirms this figure. The number of one hundred should be mitigated by the fact that this population includes firms founded in the early 1980s. In total it is, thus, a small population. It is consistent with the relatively low tech and lack of entrepreneurial features of the Belgian context. What are the characteristics of this population?

First, the phenomenon has only recently taken off in the late 1990s and the rate of founding had increased significantly starting in the late 1990s.

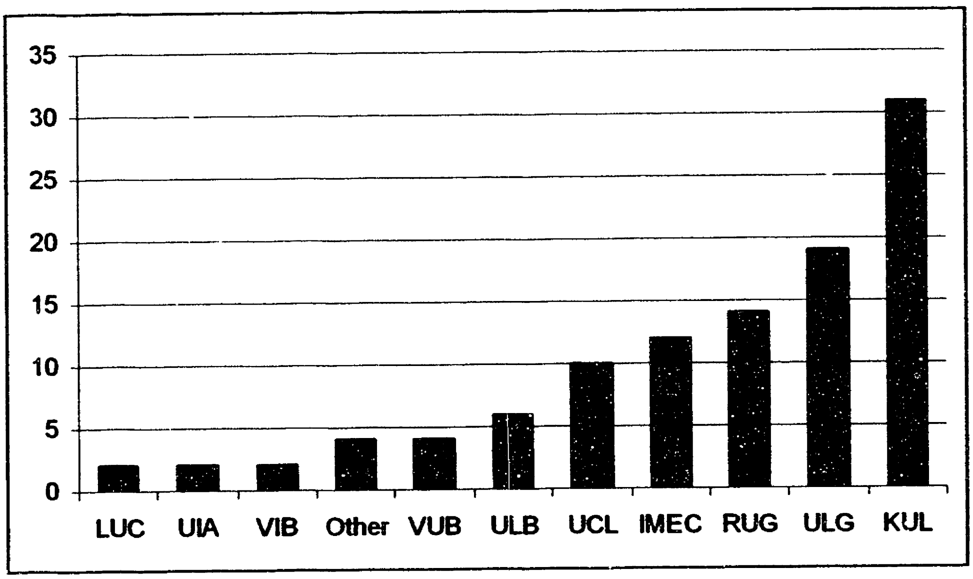
Figure 3.1. Distribution of creation of academic spin-off firms over time



N = 106
Source: compilation of data from the Belfirst data bank of the National Bank

Second, academic spin-off ventures concentrate in a few universities and research institutions.

Figure 3.2. Distribution of academic spin-off firms across academic institutions

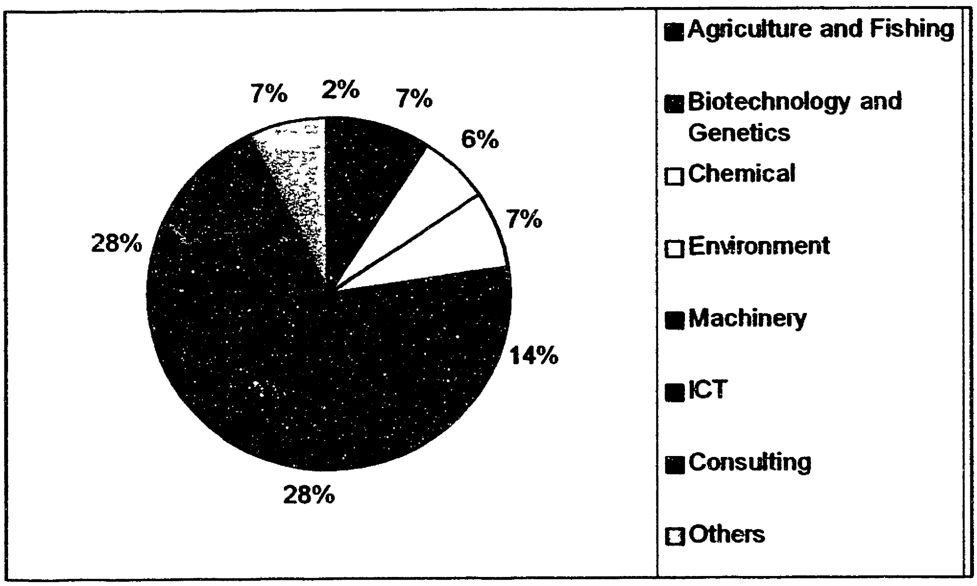


N= 106

Source: compilation of data from the Belfirst data bank of the National Bank
Legend. "Other" includes academic institutions that have only one spin-off venture. They are: FPM, FUNDP, FUSGX, and DNH

Third, academic spin-off ventures concentrate in a few economic sectors.

Figure 3.3. Distribution of Belgian academic spin-off firms by industry

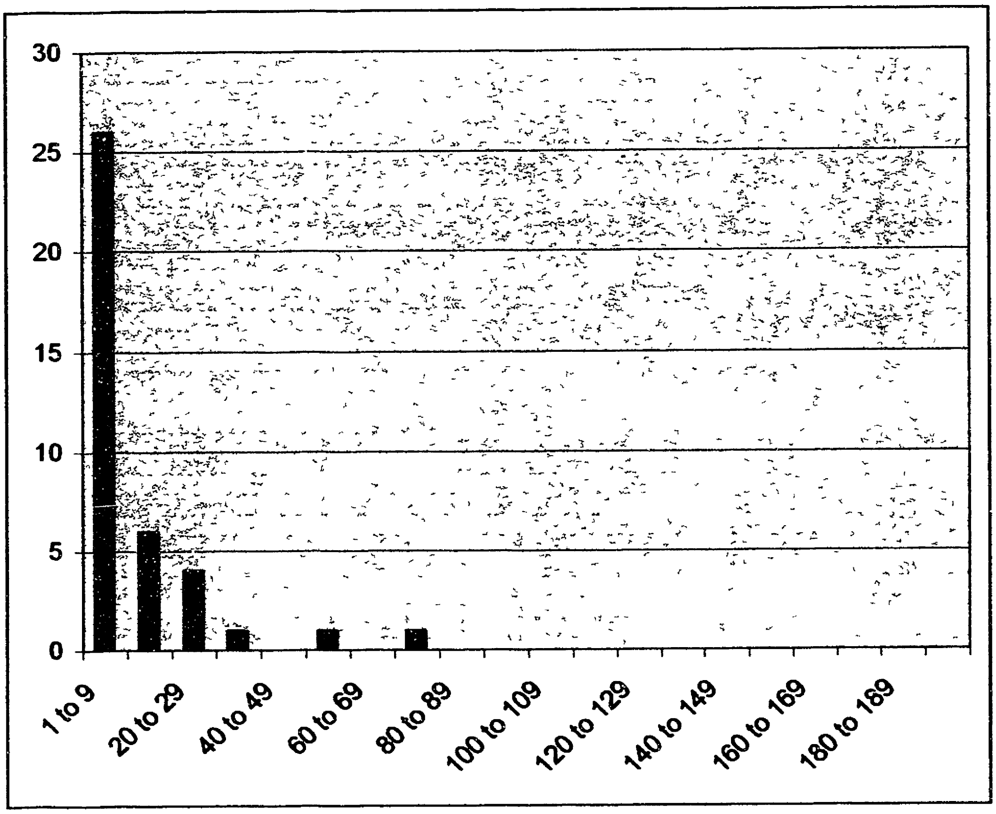


Source: Clarysse et al. (2001b)

Clarysse et al. (2001b) performed a sectoral analysis of the population and found that two sectors dominate. Roughly one third of the firms belong to the information technology – telecommunication (ICT) industry and almost another third are consulting firms. In the study of Surlemont and Pirnay (2001) based on data gathered in 1999, twenty percent of the population of firms belonged to the consulting sector compared to 29% in my study, which collected data until January 2001. This would indicate that the latest generation of firms created in 2000 tend to be mostly consulting firms. Studies conducted abroad show that starting as a consulting firm is a typical founding format for academic spin-off firms (Roberts, 1991; Segal Quince Wicksteed, 1990). Doing technical consulting is a way to obtain revenue in the short term and to gain acquaintance with the market for founders who generally have little and often no business experience.

Belgian academic spin-off ventures tend to stay small both in terms of personnel and in terms of revenue.

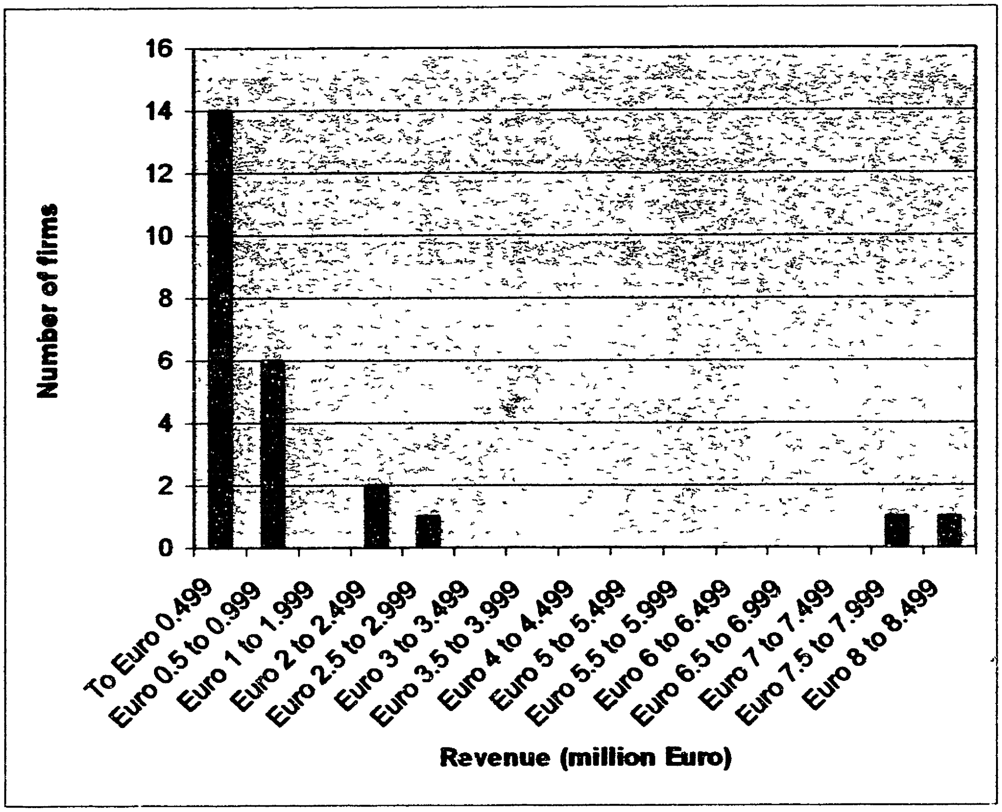
Figure 3.4.- **Distribution of personnel in firms founded after 1989**



N = 39 (number of firms for which this information was available)

Source: compilation of data from the Belfirst data bank of the National Bank

Figure 3.5. - **Distribution of revenue of firms founded after 1989**



N = 26 (number of firms for which this information was available)

Source: compilation of data from the Belfirst data bank of the National Bank

As mentioned in chapter 1, this is consistent with research in other European countries (e.g. Chiesa and Piccaluga, 2000; Mustar, 1997; Rickne and Jacobsson, 1999) and with characteristics of European new technology-based firms in general (Storey and Tether, 1998).

CHAPTER 4

THE CONTEXT FOR SPINNING-OFF NEW VENTURES FROM RESEARCH INSTITUTIONS IN THE LATE 1990S – EARLY 2000

I. INTRODUCTION

The purpose of this chapter is to understand the context in which spinning off new ventures from Belgian academic institutions emerged in the late 1990s and the mechanisms at play in this context.

As mentioned in chapter 1, Bresnahan et al. (2001) argue that existing theories about clusters of innovative activities are shaped by studies of successful regions. The theories can explain the dynamics of well-established clusters, such as Silicon Valley, in terms of network effects and the resulting agglomeration economies. However, they are unable to tell how nascent clusters emerge and reach the stage where they achieve increasing returns and positive feedback network effects. Based on a study of an emerging high tech cluster, for example, Feldman (2001) proposes that conditions supporting entrepreneurship followed, rather than led, the development of the cluster. The case of Belgium offers an opportunity to identify the mechanisms in play at an early stage of efforts to stimulate technology innovation through research-based entrepreneurship. These particular environmental conditions are important to understand by themselves and because the forms and development paths of entrepreneurial firms are strongly dependent of characteristics of their context (Romanelli, 1991).

This chapter begins by putting the changes that occurred during the late 1990s in historical perspective. It is followed by a description of initiatives in favor of technology transfer and the spinning off of academic ventures in the 1990s by governments, academic institutions, and the private sector. Finally, I propose an analysis of the late 1990s environment with regard to spinning off new ventures from research institutions.

In summary, in the mid to late 1990s, awareness grew among policy makers that the world was increasingly moving towards an "information society" and a knowledge economy. Concerns also grew that Europe was lagging in most technology sectors, as compared to the USA. As a result, the importance of technology innovation grew in the eyes of policy makers. Spinning off new ventures from research institutions was validated as a way to exploit research commercially after local technology-based firms, including academic spin-off firms, went public on the newly-created stock markets modeled after NASDAQ. These IPOS also validated an alternative model of entrepreneurship and new ventures originating from the USA.

Entrepreneurship appeared as an increasingly legitimate part of science, technology, and innovation (STI) policies. From then on, policy initiatives in Belgium multiplied in support of technology transfer and spinning off academic ventures. Pressures grew on universities to adjust to this new mission and show economic results of their research funding; this involved significant adaptation on their part. With public help, universities and research institutions created or reinforced technology transfer capabilities and formed early stage funds to invest in academic spin-off ventures. In the analysis section, I highlight that technology transfer from research institutions and spinning off ventures were new phenomena in the context of Belgium. The change was triggered by market forces, but the adaptation to the new context was policy driven. Policies consisted of replicating elements supportive of technology transfer and spinning off of academic ventures from developed high tech environments. However, while "conceptual" elements of supportive entrepreneurial clusters were replicated, operational skills needed to run them were not. Implementation of these policies, therefore, relied strongly on local capabilities and networks, which explains in part the heterogeneity of adaptation between regions and even research institutions within regions.

2. HISTORICAL BACKGROUND [15]

Prior to 1996–2000, spinning off new ventures from research institutions was not on the map in Belgium or the rest of Europe. Governments did not incorporate this type of technology innovation and transfer in their policies as it ran against widespread perceptions of the role of universities (Howell and McKinlay, 1999; Owens-Smith, 2001).

Appendix 4.1 summarizes characteristics of this period from the point of view of government policies, academic institutions, funding conditions, and academic-spin-off firms.

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[15] Main sources of information for this section are my own interviews (see Appendix 2.1); Clarysse et al. (2001); Capron and Meeusen (2000); Nauwelaers (2001); http://www.gimv be/ english; http://www.iwt.be/; http://www.imec.be/ english/; http://www.vito.be/english/; http://www.vib.be/ english/; http://www.mrw.wallonie.be/dgtre/

As reported in chapter 3, both Flanders and Wallonia were "old economy" regions that had chronically under-invested in R&D (Capron and Meeusen, 2000). After the two regions became autonomous, they made efforts to move towards higher technology industries. Flanders developed more focused policies and devoted more resources to them than Wallonia did; Wallonia's policies lacked focus and were limited by tax constraints (Capron and Meeusen, 2000). Three sectors became the priority of Flanders' STI policy: microelectronics, new materials, and biotechnology. The Flemish government created three specialized research centers to coordinate and conduct research in these domains and to organize technology transfer: Inter-university Institute for Microelectornics (IMEC), the Flemish Institute for Technological Research (VITO), and Flanders Inter-university Institute for Biotechnology (VIB). Two other institutions created during this period played a key role in the Flemish's government's STI policy. One is GIMV, the government's investment vehicle, which would become the major venture capital player in Belgium over time. The other is the Institute for Science and Technology (IWT), a government agency coordinating all aspects of STI policy and the link to private firms. In the early

1990s, the Flemish government started in a multi-year program to increase its R&D expenditures in order to reach the European average of 2% of Gross Regional Product. In short, a proactive STI policy was implemented in Flanders in the early 1990s that would positively influence the emergence of academic spin-off ventures in the late 1990s. (See Appendix 4.2 for a more thorough descriptions of the five key institutions mentioned above.)

Although the STI policy of the Flemish government increasingly focused on technology transfer in the 1990s, it only marginally included technology transfer by spinning off ventures from academic institutions. During this period, academic institutions, besides the three specialized research centers mentioned above, did not consider that technology transfer was part of their mission. Academic institutions were generally opposed to spin-off initiatives; academic spin-off ventures resulted primarily from individual initiatives of pioneering individuals. Only IMEC tried, largely unsuccessfully, to develop a pro-active spin-off policy and KUL provided selective, small seed funding to a few spin-off projects. (See Appendix 4.3 for a description of the characteristics of academic institutions during this period.) As mentioned in chapter 3, funding conditions for technology entrepreneurship were poor. Venture capital was primarily concentrated in Flanders and came from public sources (Manigart and Hijfte, 1999). No well-developed stock market for young firms existed until 1996.

In conclusion, by the mid 1990s, spinning off ventures from academic institutions was still not high on the agenda of STI policies in Belgium, even though the Flemish government had made technology innovation a priority. However, a well-articulated STI policy and the institutions that the Flemish government created to carry it out were in place and ready to incorporate entrepreneurship as a mode of technology innovation after this mode gained legitimacy in the late 1990s.

3. TURNING POINT IN THE MID-1990S

Two factors specifically validated entrepreneurship as a mode of technology transfer from academic institutions. These factors contributed to make technology innovation a higher priority for policy makers.

The first is the growing realization among policy makers, especially at the European level, that the world was moving towards an "information society" and a knowledge economy. The realization that Europe needed to adapt to this trend is reflected, for instance, in the European Summit of Feira in 1999. [16] A growing concern emerged among European policy makers that Europe was lagging behind in terms of technology innovation and economic leadership in high tech sectors compared with the USA (Bannock, 1998). In addition, it became clear that traditional policies had failed to solve the structural double-digit unemployment rate in the European Community [17] (European Commission, 1998). This happened against the backdrop of the phenomenal success of the technology sector in the USA and of the growth of NASDAQ in the 1990s (European Commission, 1998). Increasingly, the high tech clusters of Boston and Silicon Valley appeared as models of technology innovation. In this context, entrepreneurship gained legitimacy and appeared as a valid mode of technology innovation, notably by spinning off ventures from academic institutions (European Commission, 1998; OECD, 1999).

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16 http://europa.eu.int/ISPO/basics/i_europe.html

17 http://www.cordis.lu/finance/src/risk.htm

The following extracts from the 1998 "Communication from the [European] Commission to the Council and the European Parliament; Risk Capital: A Key to Job Creation in the European Union" [18] illustrates the above analysis:

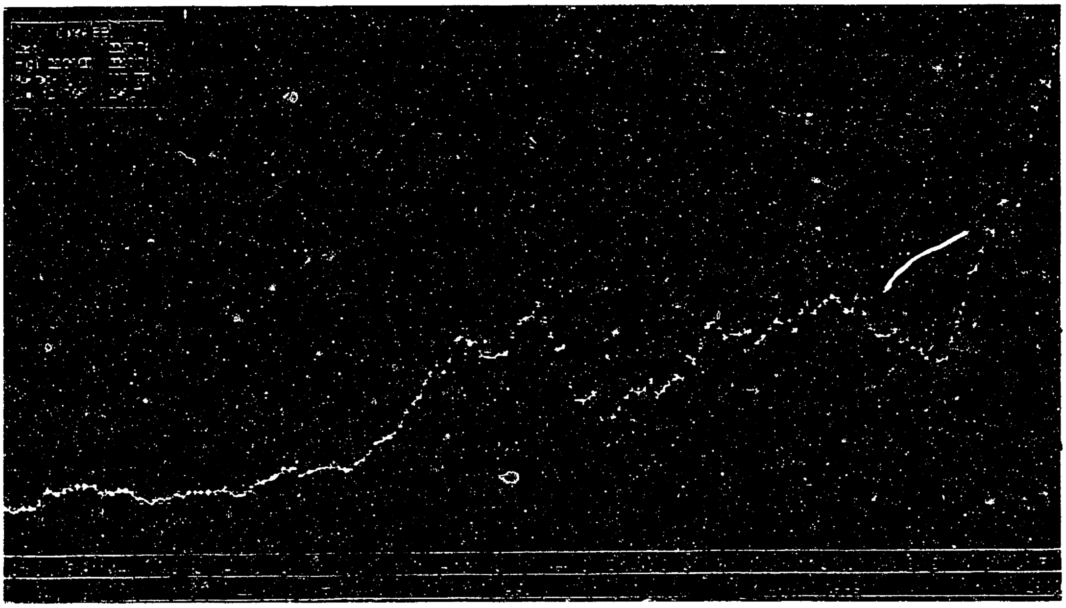
> In essence what is at stake is the creation of a new entrepreneurial culture in Europe. The real political challenge is to provide the tools, enabling technologies and financial instruments for a new generation of European entrepreneurs to start up and succeed...In recent months there has been a strong, emerging political consensus that if the European Union and the Member States are to create the jobs to reduce, sustainable and substantially, its unemployment levels, the Union must become far more entrepreneurial...Many good European ideas – themselves the result of expensive public investments in education and research – end up being developed in the United States where capital, know-how and the business environment are more conducive to their development and success. It means the migration and loss of some of Europe's best talent

[18] http://www.cordis.lu/finance/src/risk.htm

> and best ideas...European research institutes do excellent research and technology work but far too few new, dynamic companies are created to exploit their results. Regional or national schemes (e.g. science parks, innovation centers) are sometimes successful at spurring the creation of new technology based firms with an above average rate of survival. However most of the time, these companies tend to remain small (an average of 10 employees after 10 years of existence). (1, 2, 7, 17)

The second, and more specific, triggering factor, which helped integrate entrepreneurship into STI policies was the first successful IPOs of technology firms in the mid and late 1990s (Manigart and Hijfte, 1999: 20). These were made possible in the late 1990s by one of the strongest stock markets in history, fuelled in large part by the technology sector (See Figure 1.) A few Flemish firms, which had generally benefited from massive financial support in the form of public venture capital and subsidies for R&D, were ready to go public. First, because of the absence in Europe of a stock market for growing technology firms, Lernout & Hauspie, a flagship Flemish high tech firm founded in 1987, went public on NASDAQ in 1995 (EVCA, 1997). When EASDAQ, the first pan-European stock market modeled after NASDAQ, was founded in 1996, the first IPO was Innogenetics, a Flemish biotech firm often perceived as a spin-off from the University of Gent (EVCA, 1997). The same year, Plant Genetic System (PGS), a spin-off from a lab of the Rijks Universiteit Gent (RUG) was sold to Agrevo (a subsidiary of German multinationals Hoechst and Schering) for EUR 420 million (Clarysse et al., 2001; www.gimv.be).

Figure 4.1- **EASDAQ index from inception in 1997 to February 2000**



Source: Bloomberg

In 1997, ICOS, a spin-off of KUL, went public on NASDAQ and on EASDAQ. GIMV itself, the Flemish government's investment company, floated shares on the Brussels stock market in 1997. Two Walloon firms followed a little later; Ion Beam Application (IBA), a spin-off of UCL, went public in 1998 and Iris, also a spin-off of UCL, went public in 1999. All these firms had been founded in the early to mid 1980s. Finally, a younger spin-off venture of KUL, Netvision, founded in 1995, went public in 1999 on EASDAQ. [19]

Table 4.1. - **Early IPOs of science-based technology firms in Belgium**

Firms	**Year of IPO**	**Founding year**	**Spin-off of**
Lernout & Hauspie	1995	1987	Not an academic spin-off
Innogenetics	1996	1985	Not an academic spin-off
Plant Genetic System (PGS)	1996 (industry sale)	1982	RUG
ICOS	1997	1982	KUL
Ion Beam Application (IBA)	1998	1986	UCL
Iris	1999	1987	UCL
Netvision	1999	1995	KUL

These first IPOs, as well as the industry sale of PGS, triggered a realization among policy makers, university administrators, and financial institutions of the potential of technology entre-

[19] http://www.icos.com/; www.gimv.be; http://www.iba-worldwide com; http://www.irislink.com/: http://www.ubizen.com/ (Netvision changed its name into Ubizen in 1999) ; http://www.easdaq.com/

preneurship (Manigart and Hijfte, 1999: 20). These IPOs also represented a validation of a new model of entrepreneurship imported from the USA (Manigart and Hijfte, 1999: 20). In this model, ventures are not created to provide a substitute for a job, as with traditional small businesses known as SMEs (Small and Medium sized Enterprises). Ventures are formed to create capital gain for their shareholders and their management (Timmons, 1992: 8-9). The venture capital-backed project is the archetypical illustration of this model.

These events validated entrepreneurship as a mode of technology innovation and contributed in making it part of STI policies. This is evidenced by the multiple policy initiatives in the late 1990s in favour of spinning off ventures from academic institutions.

4. THE CONTEXT FOR SPINNING OFF VENTURES FROM ACADEMIC INSTITUTIONS IN THE LATE 1990s [20]

Following the events described above, the conditions for spinning off new ventures from academic institutions change dras-

[20] The main sources for this section are Nauwelaers (2001) and Capron and Meeusen (2000).

tically in the late 1990s. Entrepreneurship as a mode of technology innovation started to become part of STI policies; initiatives from policy makers and academic institutions in favor of spinning off ventures from academic institutions multiplied.

4.1. Policy initiatives

STI policy initiatives multiplied in the late 1990s and, in contrast to earlier periods, these policies included initiatives to support the spinning-off of new ventures from research institutions, thus changing significantly the context in which academic spin-off ventures were created and increasing the resources accessible to them.

Table 4.2. - **Summary of Government Policies Relevant to Spinning Off New Ventures from Universities and Research Institutions, 1996-2000**

	Flanders	**Wallonia**
R & D Expenditures	10% to 16% yearly increase to reach 2/2% of GRP [21]	Increase in late 1990s, but in 1999 still below European average of 1.4% of GRP
Regulatory Changes	• 1995 – 1998. Transfer of intellectual property of publicly funded research to universities and research institutions	• 1998. Transfer of intellectual property of publicly funded research to universities and research institutions • 1999. Decree enlarging the mission of the public investment company SRIW from restructuring to the creation of new firms.
Innovation Policy	• 1999. New innovation policy with new focus on spinning off ventures from research institutions. Includes: • New expanded role of IWT as "one stop" shop" of the innovation policy. • Subsidizing technology departments within universities • Subsidizing of business angel networks	• 1998. First Spin-off program subsidizing researchers with an entrepreneurial project. • 1998. Subsidizing of technology departments within universities. • 1998. Subsidizing of "valuators" in charge of promoting technology transfer to industry. • Wallonia Space Logistics program to stimulate research in space technology and technology transfer
Funding	• Growing role of GIMV. Including:	• 1999. Creation of investment fund FIRD

[21] GRP: Gross Regional Product

	Flanders	**Wallonia**
	• 1996. Creation of EASDAQ • Creation of VC fund IT Partners • 1997 – 1998. Co-invests in first two spin-off ventures of VIB • 1999. Co-invests in funds of universities of Gent, Antwerp, and Limburg	• 1999. Creation of investment fund Start-it

In particular, I would like to stress the innovation decree that the Flemish Parliament adopted in 1999, because it reflects the change in "spirit" well. This decree broadened the policy target, as well as the role of the implementing institution IWT, to cover technological innovation as well as science, research, and technological development activities. The decree acknowledges that, besides technology, non-technological elements such as: market orientation, financing, intellectual property, management, training, etc. are crucial elements of the innovation process (Nauwelaers, 2001: 91). IWT became the operator, the "one-stop-shop" for technology and innovation policy in Flanders. Its primary role was to fund research with industrial objectives, support technology transfer to firms, foster technology diffusion among enterprises, and deliver applied research funding to academic institutions.

Major innovations introduced by this decree include support to university technology transfer structures for collaborative projects between universities and enterprises, commercial exploitation of academic research, and creation of spin-off ventures. In addition, a network of university interfaces coordinated by IWT was set up. We can perceive in this approach the enlargement of the policy to aspects of management of innovation rather than strictly support to R&D, as well as references to academic spin-off ventures.

Wallonia adopted similar orientations. However, whereas Flanders could build on its earlier efforts of the first half of the 1990s, Wallonia's efforts to build a more proactive STI policy in favor of technology innovation only started in the late 1990s. It also used more traditional, less dedicated public organizations to carry this policy out. For instance, it did not have the equivalent of IWT, GIMV, or the three specialized inter-university research centers. In short, orientations were similar, but Wallonia was a relatively late entrant and used more traditional pubic policy instruments.

Nauwelaers (2001) summarizes the evolution of the Belgian STI policy:

> Moving from the "S and T" towards the "I" part of the STI concept, one can also conclude that Belgium is endorsing another crucial objective stated at European level during the Lisbon summit in 2000: transforming Europe into an innovative and knowledge-driven economy. Key objectives set to reach this ambitious goal are also part of Belgium's main policy orientations: improving interfaces in the innovation system, removing obstacles to the diffusion and exploitation of research results, encouraging the creation and growth of innovative enterprises (notably through the availability of risk capital), and supporting the evolution towards a society open to innovation. As shown above, the majority of the most recent policy choices go into this direction, showing the conviction of Belgian authorities at all levels that the renewal of the economic fabric needs this growing emphasis on innovativeness and on the knowledge-intensity of the economy. (91)

4.2. Initiatives from academic institutions

Many of the policy initiatives referred to above aimed at engaging academic institutions in technology transfer and commercialization. In chapter 1, I explained that this pressure was part of a general trend in Europe. Academic institutions themselves increasingly espoused this trend in order to justify their economic contribution to the public authorities, their primary funding source, which were overseeing them. Universities also saw in this new activity potential additional financial resources that would compensate for the budgetary constraints that they have been subjected to since the 1980s (Debackere, 2000). In the context of the strong financial markets of the late 1990s, launching new technology ventures probably seemed easier that it actually is.

There were two types of research institutions: universities and, in Flanders, specialized inter-university research institutes. My research focuses on the five largest universities and the two specialized inter-university research institutions which have spun-off new ventures. These seven entities account for 113 of 116 ventures spun-off from academic institutions.

Table 4.3. - **Universities and specialized inter-university research institutes**

FLANDERS	**WALLONIA**
Universities - Katholieke Universiteit Leuven (KUL) - Rijks Universiteit Gent (RUG)	- Université Catholique de Louvain (UCL) - Université de Liège (ULG) - Université Libre de Bruxelles (ULB).
Specialized inter-university research institutes Inter-university Institute for Micro-electronics (IMEC) Flanders Inter-University Institute for - Biotechnology (VIB). -	

Table 4.4. - **Differences between universities and specialized inter-university research institutes**

	Universities	**Specialized research institutes**
Age	Old	Young
Scope	Generalists	Specialists
Scale	Each university department is only one of a number of department in one domain in the region	Cover research in one domain in the whole region
Mission	Training and research	Research and technology transfer. They are policy instruments of the Flemish government

	Universities	**Specialized research institutes**
Technology transfer	No technology transfer orientation until the late 1990s	Founded with a strong technology transfer mandate
Budgetary situation	Under budget constraints	Well endowed

Proactive policies of spinning off ventures started in the second half of the 1990s. (See Appendix 4.5 for a detailed description of initiatives of these universities and specialized research institutions in favor of technology transfer and spin-off activities.) Institutions, such as IMEC, VIB, and KUL, began to get involved in 1996 at the earliest; others, such as RUG, UCL and ULG, started in 2000. One university, ULB, did not develop a proactive policy.

These policies generally started in universities with the creation of an investment fund with private and/or public financial partners, even before they had any technology transfer infrastructure or competencies. Even fairly small academic institutions that I did not study in detail, such as LUC, UAI, and FPM, created funds towards the end of the decade. This perhaps reflects the "irrational exuberance" of the late 1990s. These funds were dedicated to invest exclusively in spin-off ventures from each university. Specialized research institutes, in contrast, built privileged relationships with venture capital funds and built their technology transfer infrastructure earlier.

Technology transfer infrastructures and competencies were created and reinforced over the years between 1996 and 2000. This sometimes involved hiring people with related or unrelated industry background to head the new technology transfer department, as in the case of UCL and ULG, or, more frequently, people with policy background, such as in the case of KUL, VIB, and IMEC. This reflects the fact that the whole trend was primarily policy driven. The creation and strengthening of technology transfer units was instigated and subsidized by governments. Curiously, with the exception of VIB, efforts consisted first of supporting spin-off initiatives rather than licensing technology. This, too, can be seen as a sign of the excessive optimism of the late 1990s in the context of the strong financial markets.

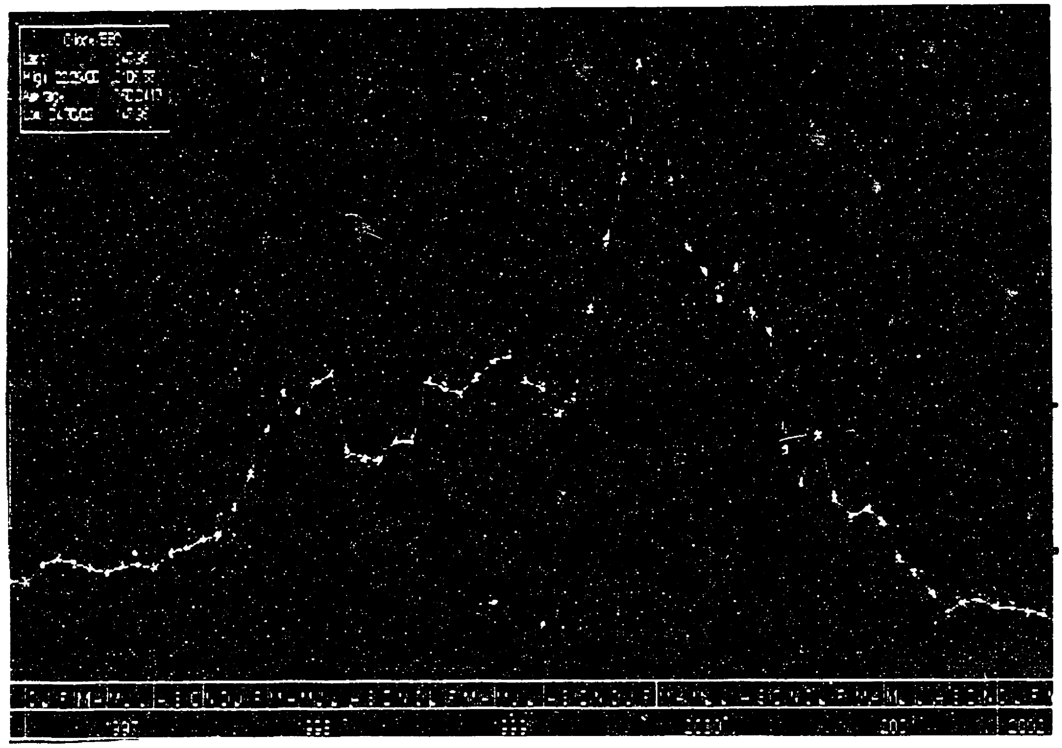
4.3. Private sector participation

The private sector plays a minor role in these developments of the late 1990s. It was primarily limited to financial institutions in Flanders, investing along side of universities and research institutions in new investment funds. In Wallonia, private financial institutions did not participate.

5. LATEST DEVELOPMENTS IN 2000 – 2001

By 2000 – 2001, the governments' new STI policies were well in place. Academic institutions, such as IMEC, VIB, and KUL, that had started early to develop policies in favour of technology transfer and spinning off ventures had strengthened their infrastructure to carry on this policy. Other institutions, such as RUG, that had been late entrants began to follow the trend. The most notable changes in early 2000, however, came from the collapse of the stock market, following the technology bubble in the second half of the 1990s.

Figure 4 2 - **EASDAQ index from 1997 to 2002**



The financial context of the late 1900s appears, in hindsight, to have suddenly made money easy to raise and led policy makers and research institutions to underestimate the difficulty of technology entrepreneurship As the stock market collapsed, funding sources became more conservative,

One sign supporting this view is that research institutions, excepting VIB, developed policies for spinning off ventures, before developing licensing policies and capabilities. Second, research institutions with limited experience in spinning off ventures developed overly ambitious plans. IMEC, for instance, decided in 1996, when it started its new proactive spin-off policy, to only spin off ambitious ventures eligible for venture capital from the start; it developed a privileged relationship with IT Partners, a venture capital fund. Achieving this result required a comprehensive and costly incubation process that IMEC was able to provide. However, as the financial markets collapsed and the venture capitalists became more conservative, spinning off firms that were immediately eligible for venture capital became increasingly difficult and IMEC started to experience difficulties raising funds for its spin-of ventures. [22]

Funding the seed stage, which was growing longer, of an increasing number of spin-offs became too expensive for IMEC, which partnered with local financial institutions in 2001 to create a seed fund.

In the late 1990s, spin-off ventures of KUL with no proof of concept obtained initial funding of EUR 250,000 to 370,000 from

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[22] One IMEC administrator declared in an article: "A critical analysis led to the conclusion that, a year ago, venture capital was there but now the risks are seen as too high. Venture capitalists want to see a complete business plan and a prototype product." http://www.eetuk.com/story/OEG20011022S0028

the Gemma Frisius Fund, the fund created by KUL and two banks. By 2000–2001, this funding froze and bankers in the Gemma Frisius funds required many more tangible signs of a viable business model before committing this amount of money. The movement towards a more conservative approach to funding ventures was probably even stronger among bankers participating in university funds in Flanders because these bankers did not have much experience in venture capital before the technology boom of the late 1990s.

The return to a more conservative approach to financing was perhaps particularly brutal for spin-off ventures from universities that set an up a fund later in 1999–2000, like RUG and the smaller LUC and UIA. These funds were set up as the financial markets were already declining. It took RUG almost two years to obtain funding for a spin-off. By the end of 2001, LUC and UIA had not spun off ventures with money from the fund they had created with banks.

Once the exuberance of the late 1990s had disappeared, investment funds set up to finance academic spin-off ventures turned out not to act as seed funding sources, but as traditional, later-stage venture capital funds. Since universities had no incubation capabilities to bring ventures to the venture capital stage, a financial gap developed, wherein spin-off ventures could no longer find seed funding.

This problem did not affect UCL's Sopartec fund because it did not have banking or public sector partners and was willing to seed fund small venture projects. Of the other universities, only KUL's LRD developed a strategy to cope with this situation. It seed funded spin-off projects internally before they were incorporated in a company. This involved small incremental investments of +/- EUR 30,000 to conduct a market study or build a prototype.

6. ANALYSIS

In this section I present analyses leading to a number of conclusions. First, data on the period prior to 1996 highlight that academic institutions were generally not oriented towards technology transfer and had no interest in spinning off ventures. The entrepreneurial climate and infrastructure were very weak. Technology transfer from academic institutions and entrepreneurship emerged only in the late 1990s. Second, considerable resources were devoted to these activities in a short period of time, five to six years.

Third, although the trend was triggered by market phenomena, particularly the first IPOs, the initiatives in favor of entrepreneurship and the transfer of technology out of academic institutions were primarily policy driven. One way to interpret policy initiatives, whether they are conducted by government bodies or by research institutions, is to see them as a replication of elements of environments that are supportive to technology transfer and entrepreneurship. Fourth, replication involved "concepts" such as investment funding and technology transfer units within research institutions, but it did not include the operational capabilities to put them to work. These needed to be build locally through experimentation; they were greatly mediated by local capabilities, primarily research institutions, which were left with most of the responsibility for implementing policies in favor of technology transfer and spinning off ventures.

6.1. Emerging phenomenon

Data on the period prior to 1996 show that policies did not include entrepreneurship as a mode of technology innovation. Academic institutions were not oriented towards technology transfer and certainly not towards spinning off ventures. The entrepreneurial climate and infrastructure were very weak with little venture capital and no stock market for young firms. Technology transfer from academic institutions and entrepreneurship first emerged in the late 1990s. The changes of the late 1990s involved a new model of research institutions and a new model of entrepreneurship. Such changes did not occur overnight; thus, it is useful to view them as an emerging phenomenon that developed in iterations, by a mix of replication of outside models and local experimentation.

6.2. Policy driven phenomenon

The above data show that the movement towards entrepreneurship as a mode of technology innovation in research institutions in Belgium was triggered by market factors, such as globalization, the success of the technology sector in the USA and, specifically, the first successful IPOs of Belgian technology firms. De-spite being triggered by these market events, initiatives in favor of spinning off ventures from research institutions were policy driven. Even "market events" such as IPOs were made possible because of public support of early ventures in the 1980s and early 1990s by the Flemish government and by the support of the European Commission to create a pan-European stock market. This institutionally-driven impetus originated in the growing wish of policy makers to move their economies toward high tech industries.

6.3. Replication of elements of supportive entrepreneurial context and substitution with local equivalents

We can interpret these policies in the late 1990s as a process of replications of supportive entrepreneurial elements and substitution with local equivalents.

Table 4.5. - **Summary of replication and substitution**

	REPLICATION	SUBSTITUTION
Law and regulations	• Transfer of IP to universities and research institutions • Stock options	
University – industry relationship	• Subsidizing research institutions with a strong mandate of technology transfer • Subsidizing university "Interfaces" • Subsidizing cost patenting • Partnerships with industry	
Governance	• Replication of venture capital model of firm by research institutions	
Capital markets • "Friends and family" • Business Angels • Venture capital • Stock market	• Subsidizing BA networks • Creation of stock market	• University and government funds • State sponsored VC • Subsidies for R&D
Social networks	• Entrepreneurship forum: Leuven Inc.; DSP Valley	• Intermediaries: hybrid public institutions

First, policy makers passed regulations allowing replications of key characteristics of supportive entrepreneurial contexts. They passed regulations similar to the USA's 1980 Bayh-Dole Act, transferring intellectual property of publicly funded research to universities and research institutions. Second, they cleared the way to allow stock options to be issued. These are key regulatory characteristics supportive of technology transfer and entrepreneurship. The Bayh-Dole Act has been credited for increasing patenting, licensing and partnership with industries in American universities (Owen-Smith et al., 2002). Similarly, stock options are a key component of growth-oriented ventures' governance systems in the USA (Sahlman, 1994).

Third, there was an attempt by policy makers to reproduce what was perceived to be an American model of university–industry relationships and technology transfer. In the absence of orientation towards technology transfer within universities, the Flemish government created two new research institutions with a strong mandate for technology transfer. The most striking example of replication is IMEC, although it started before the late 1990s. By the nature of their field and activity, the founders of IMEC had been exposed to the rise of the microelectronic industry in the USA. Administrators of IMEC recognized that they wanted to duplicate in Flanders, the university–industry collaborations on which the microelectronics industry was built in the USA. This model fitted the project of the policy makers, who wanted to build synergies between research and business with an impact on the regional economy.

However, in spite of having this American model in mind, they really had no idea on how to materialize this idea in practical terms. The founders tried to overcome this limitation by modeling IMEC after an institution in the USA: the Micro-Electronic Centre of North Carolina, located in Raleigh in the Research Triangle. One leader of the Micro-Electronic Centre of North-Carolina sat on the initial board of IMEC. IMEC even copied the North Carolina Center's building and hired its architect. In doing this, the founders of IMEC did not, according to my informants, try to create a well-functioning building, but tried to recreate an atmosphere similar to North Carolina's. In 1996, IMEC opened an office in San Jose in the heart of Silicon Valley and lists two addresses on its web site: Leuven in Belgium and San Jose.

VIB, founded in 1995, followed the same model. The market orientation of IMEC and VIB is also illustrated in the fact that they signed a five-year contract with their government spelling out their objectives. They also had to submit to a review at the end of the period; renewal of their funding is linked to achievement of their objectives.

In order to facilitate replication of the university–industry relationship model and technology transfer, in 1995 both governments subsidized the creation or the strengthening of entities within universities called "Interfaces," a combination industrial liaison office and technology transfer unit. Both governments also subsidized the cost of patenting.

It seems as if KUL moved even beyond the "model" towards a market orientation, based on an article by Debackere (2000) describing the functioning of KUL's technology transfer unit, LRD. The author, who is a professor at KUL and a director of LRD, describes its functioning as "managing academic R&D as a business":

> Universities, as incubators of entrepreneurial innovations, can create the context, structure and processes that facilitate venture creations. This requires them to manage their R&D activities, at least partially, as a business ... The case of K. U. Leuven R&D illustrates

> this approach and the tensions that have be managed along the way. (324)

Fourth, there were efforts at replicating the governance models typical of advanced entrepreneurial contexts in the USA, in particular the American model of entrepreneurship and its related growth-oriented model of venture. This model of entrepreneurship consists of growing ventures in order to create value for stakeholders (Timmons et al., 1992). This was a very unfamiliar idea in Belgium until the mid 1990s. The concept was diffused somewhat in the following years, but concrete competencies on how to implement it were still scarce.

The dominant model of entrepreneurship consisted in creating a small business, an SME, as a substitute to a job with no growth orientation (Donckels, 1993; Wtterwulghe, 1998). IMEC and VIB based their spin-off strategy on a replication of the venture-capital backed model of venture. They were better positioned to do that than universities because of IMEC's prior experience in spinning off ventures and their closer exposure to the original model.

IMEC and VIB are research institutions active in microelectronics and biotechnology, two industries originating in the USA that have been built on venture-capital backed projects. Also, since 1995-1996, the venture-funding arm of both research centers was GIMV, the Belgian organization with the most venture capital experience and largest network in venture capital circles.

Universities were more remote from the American model of entrepreneurship and growth-oriented firms; they were also more infused by the traditional SME model of venture. Over time, however, universities learned the differences between SMEs and growth-oriented ventures, pressuring their academic founders to submit proposals for spin-off projects that exploited greater opportunities than the traditional small boutiques that most of them had aspired to create. KUL offers such a clear case. The problem universities encountered in the process of replicating this model of venture is that founders were generally reluctant to embark in an entrepreneurial project beyond the creation of small "boutique" as keeping control of their firms was a high priority.

Fifth, we see clear efforts to duplicate the capital markets on which developed entrepreneurial clusters rely. Roberts (1991: 126-

128) describes the various types of funding that a technology venture needs to fund its successive stages of developments. These types initially include personal funds and money from "friends and family." Then, they involve more qualified private investors, "business angels." Venture capitalists get involved when the venture has a product and market validity to show. At later stages, commercial and investment banks play a role. Finally, a favorite "exit" for entrepreneurs and investors is to go public on a stock market.

Policy makers in Belgium tried to replicate these capital markets and, when local conditions did not allow it, they created substitutes. Starting with the earlier stage of a venture, they substituted the absence of early stage financing from "friends and family" and business angels (GEM 2000) with the creation of seed stage funds by universities and government agencies. In addition, they started to subsidize the creation of networks of business angels. The weakness of private venture capital for early stage investments of venture capital was substituted by public venture capital.

In Flanders, subsidies for R&D given to technology ventures served as virtual venture capital. Clarysse et al. (2000) calculated that subsidies received from IWT by Flemish academic spin-off ventures amounted to half their equity. [23] Governments, particularly the European Union, were instrumental in creating EASDAQ in 1996, the first pan-European stock market for young growth oriented ventures, which, as its name indicates, was modeled after NASDAQ.

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23 However, the distribution of subsidies was heavily concentrated in some firms

Table 4.6. - **Funding available to academic spin-off ventures in 2000**

Research Institutions	**Fund**	**Size** million EUR	**Private Financial Partners**	**Public Financial Partners**
FLANDERS				
VIB	Flanders Biotech Fund (1994) (*)	35		GIMV
IMEC	IT Partners (1996) (*)	50	(1)	GIMV
KUL	Gemma Frisius Fund (1997)	6.25	Investco VIV (2)	
RUG	Baekeland Fund (1999)	2.5	VIV	GIMV
LUC	Wendelen Fund (1999)	2.5	Investco VIV	
UIA	Antwerp Innovation Centre	3.3	VIV – KBC Invest (2) – Anchis (3)	GIMV
WALLONIA				
UCL	Sopartec (1999)	12.5	No partners	No partners
ULG	Spin-Venture (1999)	1		Meusinvest (4)
Financière de Mons	Université Poly-technique de Mons (1999)	NA	Individual investors	
FIRD (5)		12.4		

(1) Artesia Bank NV ; Balda N.V.; Bank Brussel Lambert N.V.; Bayfield N.V.; Beluga N.V.; C.B.S. Immo II N.V.; De Wilg G.C.V.; European Investment Fund; Gold & Diamond Mining Projects (Ghana) Ltd; HBK Spaarbank N.V.; Isep N.V.; KBC Bank N.V.; KBC Verzekeringen N.V.; Shulon Investments N.V.; Société Générale de Belgique S.A.; VDK Spaarbank N.V.;

Private Investors: Mr. Y. Van den Avenne, Mr. C. Van Hoo, Mr. Ph. Volcke. (IT Partner's Web Site)
(2) Subsidiaries of KBC and Fortis Banks
(3) Group of local private investors
(4) Subsidiary of SRIW, the government's investment company
(5) FIRD (Fonds pour l'Industrialisation des résultats de la Reserche) Funds for the Industrialization of Research Results
(*) Preferred financial partners of the research institution, but invest in other ventures besides the academic spin-off ventures of the research institution.

Sixth, there were a few attempts at replicating social networks supportive of an entrepreneurial cluster. As mentioned in chapter 1, developed, high tech entrepreneurial contexts in the USA rely on "cross-pollination" among a web of participants supporting entrepreneurial initiatives: research institutions, established firms, new ventures, suppliers, subcontractors, and various service providers, from financiers, lawyers and executive search firms, to technical consultants and entrepreneurial forums (e.g. Nohria 1992; Saxenian 1994; Lee et al. 2000; Kenney 2000). This is probably the most difficult aspect to replicate.

One initiative by research institutions appeared to duplicate entrepreneurship forums. In 1999, LRD, the industrial liaison and technology transfer unit of KUL, founded "Leuven Inc.," a non-profit organisation that wants to be a forum for the local entrepreneurial community fostering the flow of technical and non-technical knowledge. For this purpose Leuven Inc. organised special projects and events related to technology entrepreneurship, both for its members and the broader public. Leuven Inc. was created in partnership with a number of firms and local entrepreneurs. Leuven Inc. established a link with the Cambridge Network of Cambridge (UK) (Debackere, 2000: 327).

This was a unique initiative in Belgium. It is probably related to the fact that the two co-directors of LRD, Martin Hinoul and Koenraad Debackere, had experience respectively in Silicon Valley and Boston. This exposure probably made them more aware of the social dimension of technology entrepreneurship than other policy makers or representatives of research institutions. It was, in any case, made possible because the region of Leuven had a critical mass of technology ventures that other regions did not have.

Leuven has the highest concentration of technology start-ups, with academic spin-off ventures from KUL and IMEC, as well as other technology firms from KUL's scientific parks. It represents the only nascent technology cluster in Belgium. This achievement can be credited to the policies of these two institutions and to the policies of the Flemish government, which created IMEC in 1984. In 2000 Sopartec, the industrial liaison office and technology transfer structure of UCL, initiated meetings among its spin-off ventures, but with only twelve spin-off ventures, as opposed to forty three in Leuven, there is less of a cluster effect.

In 1998 IMEC formed a forum of firms around a technology, "DSP Valley," out of a European Commission research program. [24] It is a consortium of firms involved in digital signal processing (DSP) technologies which involves local firms and multinationals such as Alcatel and Philips. [25]

Two other initiatives by IMEC are important. They do not consist of establishing links within the local community, but of reaching out to other communities. In the late 1990s, IMEC opened an office in San Jose, the centre of Silicon Valley, which is the heart of IMEC's industry, microelectronics. IMEC also opened an office in "Flanders Language Valley" in 1998, a nascent high tech cluster specializing in speech recognition that has also benefited from massive assistance from the Flemish government.

In developed entrepreneurial clusters, service providers such as venture capitalists and law firms play the key role of intermediaries channelling resources, information and knowledge (Bygrave,

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24 http.//www.cordis.lu/esprit/src/results/ibp/ibp13.htm

25 Source: http://www.cordis.lu/esprit/src/results/ibp/ibp13.htm and interview of P. Simken by B. Clarysse and G. de Martelaer, July 11, 2001.

1987; Hellman, 2000; Suchman, 1994, 2000; Tyebjee and Bruno, 1984). In Flanders, some public institutions have partially assumed such an intermediary role, either by design or not. Capron and Meeusen (2000) call them "bridge institutions."

IWT, the Flemish government's agency in charge of the STI policy, which is often referred to as the "one stop shop" for technology innovation in Flanders, appears to act as such an intermediary.

Nauwelaers (2001) explains:

> IWT supports and stimulates industrial research and technology transfer in the Flemish industry. All companies established in the Flemish region, especially SMEs, can request IWT financial assistance in their projects and have IWT services at their disposal. Furthermore, IWT has been assigned a co-ordination mission of all technology transfer and innovation intermediaries in Flanders. [9]

IWT attempts to overcome the isolationism of universities and research institutions by organizing a forum of administrators in charge of Interfaces within research institutions. Exchanges at this level are important because the level of competency varies across universities and research institutions; late entrants can learn a great deal from institutions with more experience. IWT is also a major source of R&D subsidies to spin-off ventures, a kind of "quasi-equity" (Clarysse et al., 2001). In these capacities, IWT performs the role of a hub for allocating funding and circulating experience-based competencies.

GIMV, the Flemish government's investment company, also straddles a number of circles. First, it had been involved in virtually all venture capital investments in Flanders since the 1980s. Second, it was involved with almost all initiatives to provide financing for academic spin-off ventures. It was a shareholder in most of the funds set up by Flemish universities: RUG, LUC, UAI. It managed the Flanders Biotech Fund, which invested in the two spin-off ventures from VIB. It is a major shareholder in IT Partners, the privileged investor of IMEC. It can thus bridge spin-off initiatives that were otherwise isolated. Third, GIMV has a strong anchor in public sector and political circles. Indeed, it originated as the public investment company of the Flemish government and, in spite of going public in 1997, GIMV was still majority owned by the Flemish government in 2000. At the same time, being a publicly owned company quoted on the stock market, it exhibited a sort of hybrid "public/private" character. As a venture capitalist since the 1980s, GIMV has built a rich international network in the venture capital world. It has built its expertise notably by participating in syndicated investments with US firms and investing in US funds. It even sent staff members work in US venture capital funds (Manigart & Hijfte, 1999). By the end of the 1990s, GIMV was positioning itself as a European risk capital firm with its center in Flanders.

Moreover, IWT and GIMV were a breeding ground for people who would later take responsibilities in other institutions involved in technology transfer and academic spin-off ventures. [26]

The two specialized, inter-university research institutions, IMEC and VIB, can be seen as "network organizations" as well. First, they had their roots in public policy and were heavily financed by the Flemish government. Second, given the nature of

[26] For instance, R. Dekeyser and J. Bury, who were policy makers at IWT, would head VIB a few years later. M. Lambrechts of IWT joined Capricorn, one of the first private local venture capitalists. F. Bulens of IWT became the head of the GIMV biotech fund. Similarly, Johan Bil became head of the Interface unit at the Rijks Universiteit Gent (RUG) after five years at IWT. Some academics also hold positions at IWT and can influence policies this way. For instance, Koenraad Debackere of KUL became a board member of IWT. Hans Bracqonié, a former adviser to IMEC, became in a cabinet member of the Minister of Science and Technology in 2000. S. Nicolay was an investment manager at GIMV before joining IT Partners, the venture fund associated with IMEC.

inter-university institutes, they are an umbrella organization overseeing research in a number of labs in different universities and providing technology transfer capabilities. Through their strong mandate for technology transfer, they have close links to industry, particularly in the case of IMEC. Finally, through their privileged investment partners, IT partners and GIMV, they are connected to the local and international private equity world. IMEC also offered its spin-offs and associated university labs a direct gateway to Silicon Valley, through its office in San Jose.

Thus, public or semi-public organizations, such as GIMV, IWT, IMEC, and VIB, can be seen as a new type of public institution. They have their roots in the public sector, but they have a strong industry orientation and strong industry connections, as well as partnerships with the private sector. Highly international-oriented, their mandate incorporates a strong of sense of service to industry. Within Flanders, they are a place for policy makers, academics, and industry representatives to meet, acting as intermediaries among these parties to help the circulation of resources and knowledge in a highly fragmented context.

However, these public and semi-public institutions, which link participants involved in technology transfer and in technology entrepreneurship, primarily connect people at the policy and university/ research institution administrative levels. It is not clear whether the competencies built and exchanged at these higher levels trickle down to the ventures. For the ventures, an entrepreneurship forum such as Leuven Inc. is more helpful for accessing and exchanging relevant "bottom–up" knowledge. The limitation of a university-initiated forum, such as Leuven Inc., is that it is very local and, as such, reproduces the extreme fragmentation of Belgian society. KUL and IMEC have the advantage of a sufficient critical mass of technology ventures in their region, but other universities have not reached this threshold. Their ventures would greatly benefit from forums or other forms of networking that would cross university and regional boundaries.

No such organizations existed in Wallonia, which relied on traditional public institutions and on traditional universities to carry out its policies. The one exception to this assessment is the EUR 11 million Fund Start-it, founded in 1999 by the Walloon government with private institutional investors to provide expansion capital to technology start-ups.

6.4. Local experimentation

The policies of governments and of research institutions involved replication of what I call "concepts," such as venture capital funds and new models of research institutions, but the policies involved little replication of operational skills to put these concepts to work. Most of the measures reviewed above were initiated by policy makers in a programmatic, top-down process without much knowledge about the models of technology transfer and entrepreneurship that they were supposed to replicate. Considerable resources were made available, but practical knowledge were scarce.

I came across only a few attempts to import such skills from developed, high tech clusters in the form of hiring people or using consultants. The most notable exception is, however, not directly related to spinning off academic ventures. As mentioned above, in the 1980s and early 1990s, GIMV participated in venture capital funds in the USA and sent staff members to train with US venture capital funds, in order to learn the venture capital business.

In 1999 KUL hired Martin Hinoul as co-director of its industrial liaison office and technology transfer unit. He had been a civil servant representing the Belgian government in Washington and then in Silicon Valley, but he did not have operational experience in technology transfer and entrepreneurship.

LRD hired Koenraad Debackere as co-director. Professor Debackere had spent a year at MIT as a student in the early 1990s, but did not have operational skills either. The exposure in itself of these two individuals to developed high tech clusters seems, however, to have influenced the orientation of LRD, which was the pioneer among universities in developing a technology transfer and spin-off policy.

Why were there so few attempts to replicate operational competencies? This is a complex question whose answer can only be speculative. One reasonable answer is that, without a Belgian, high tech entrepreneurial tradition, policy makers and administrators of academic institutions underestimated the difficulty and complexity of starting technology ventures.

For the most part, however, operational skills were acquired through local experimentations as ventures and relied a great deal on local capabilities. Two examples illustrate this. Back in the late 1980s and early 1990s, IMEC, which had been built by replicating a research center in North-Carolina, tried to spin-off ventures. As IMEC representatives admitted in interviews, they did not know anything about technology entrepreneurship and strongly underestimated the resources needed to build a technology start-up, especially the resources for commercial development. None of the ventures spun-off during this period really took off.

In 1996, IMEC drew a lesson from this experience and decided that it needed to professionalize its spin-off process. It needed to be more selective and pursue only projects eligible for the venture capital funding which had then become available. IMEC established a partnership with a venture capital fund; it then hired outside managers and consultants to conduct the incubation and fund raising process, while providing the technical incubation itself.

A few years after IMEC initiated spinning off venture-capital backed firms, it experienced the limit of this model. Particularly, it realized that few venture projects qualified for venture capital, the most selective and costly form of funding, at the start (e.g.

Sahlman, 1990). They also learned that venture capitalists only invest relatively large amounts in ventures. Seldom are ventures worth such valuations at founding. This realization accelerated with the collapse of the technology bubble that started in 2000. Thus, IMEC learned that venture capitalists were not willing to pay valuations of EUR 1 million (their minimum investment) and they were forced to turn to other funding sources, such as smaller venture capital funds and business angel groups that emerged in the late 1990s.

IMEC's administrators also learned that only very ambitious spin-off projects can be eligible for venture capital from the start. They discovered that, in focusing on venture capital projects, only certain types of spin-off projects were exploited. Venture capital-backed model of ventures must meet specific criteria for high potential and quick time to market. Other projects, either with less potential or with longer development time, never got exploited. One IMEC administrator noted in 1999 that IMEC needed to distinguish between "IPO driven" spin-off ventures and those that were "niche players," whose exit is more likely to be an industry sale. As noted above, in 2001, IMEC created a seed fund with financial partners to carry spin-off projects to the venture capital stage.

This example illustrates a learning process among administrators of research institutions about technology entrepreneurship. The assimilation of lessons seemed to take a few years each time.

A similar learning process can be observed at KUL's LRD. In 1999, after one and a half to two years of actively promoting spin-off initiatives by providing small funding of EUR 30,000 to 60,000, LRD concluded that spin-off ventures needed more financial resources, in order to build a real business model and develop a product. It also concluded that founders needed to embark on more ambitious projects and started putting pressure on its founders to build business plans that pursued greater opportunities.

After another approximately two years and the collapse of the stock market, LRD realized that spin-off projects needed some incubation time before being spun off, instead of being spun off at a very early stage with no clear business model, prototype, or management team. Using the earlier model and following the stock market crash, ventures could no longer get funding. Thus, in 2001, LRD started to incubate small spin-off projects within its own structure before the projects were incorporated into a firm, financing them with EUR 30,000 to 60,000 of its own funds. During the incubation, the founders developed a business model, prototype, and, in some cases, found a few clients.

The fact that "conceptual" elements of developed entrepreneurial environments were replicated by policy makers and administrators of research institutions without the operational skills to put them to work explains, in part, the differences between regions and research institutions because the implementation of these elements was dependent on local competencies and networks.

This analysis of the replication by Belgian policy makers and research institutions of elements of a US-inspired model of academic technology transfer and entrepreneurship is consistent with Westney's (1987: 28) theory of the replication of foreign organizational models in terms of organizational sociology. As mentioned in chapter 1, she emphasizes that replication is always partial because information about the model is imperfect. Foreign ideas can also conflict with local values. In addition, organizations in the original model operate in an "organization field" among other organizations that they need to operate, which do not always exist in the replicating environment.

As the examples described above illustrate, information about the original models was indeed imperfect. This is the core of my argument about the replication of "concepts" versus operational skills. What is interesting in this case is how little effort was made to replicate operational skills. Technology transfer from research institutions and technology entrepreneurship as a mode of technology innovation were increasingly espoused, but little knowledge about these domains was imported. A university administrator stressed in an interview:

> the lack of model of an entrepreneurial firm in our environment represents a major problem. The idea of raising funds, growing a company, going public, etc. is simply alien around here. Our young graduates and researchers simply ignore it exists. Founding a company has been for a long time, at best, partnering with a couple of colleagues to do consulting. As a result, spin-off firms tend to stay small and take a very long time to take off..

Another reason why replication is always partial is that foreign ideas can conflict with valued local patterns and, thus, they can be rejected. Universities only adopted the mission of technology transfer for commercialization after strong pressures from policy makers. In 2000-2001, although university authorities espoused this new orientation, there was still no consensus on this point within universities. With regard to ventures, this aspect will appear more clearly in chapter 6, where I show how dominant the SME model of new venture was in the late 1990s. For example, the same university administrator mentioned above stated that a growth-oriented venture goes against the strong desire of founders to maintain control.

A third obstacle to full replication of a foreign model is that organizations need to operate in tandem with other organizations that provide needed resources and services or exert formal control. For instance, in the absence of an entrepreneurial community or service providers that form a key support infrastructure to new ventures in developed entrepreneurial high tech clusters, Belgian academic spin-off firms had to experiment alone instead of being able to borrow existing relevant knowledge from their local environment.

Westney (1987: 223) also argues that "an initial period of emulation of foreign models gives way to a period of divergence;" therefore, emulation always produces innovation. In the Belgian case of adopting of American models of research valorization and entrepreneurship this innovation is not yet clear but it is the likely outcome of the local experimentation to make policy-induced measures work.

CHAPTER 5

ANALYSIS OF THE PROCESS OF SPINNING OFF NEW VENTURES FROM RESEARCH INSTITUTIONS

INTRODUCTION

Chapter 4 analyzed characteristics of the context in which firms were spun-off from research institutions in the late 1990s. It concluded that this context was characterized by the emergence of new policies, new roles for research institutions, and a new model of an entrepreneurial venture that were largely driven by policy makers. These new practices and organizational models were adopted through replication of foreign models of university–industry relationship and entrepreneurship as well as through local experimentation with these new models. In this context, how does the process of spinning off new ventures from research institutions actually work? This is the question that this chapter addresses.

The findings are that, in spite of the improvements in the conditions for research valorization, research institutions still needed to develop significant new organizational capabilities to translate their new resources into spin-off ventures. This analysis shows that spin-off processes vary depending on the organizational characteristics of research institutions. It shows that they are complex processes that can require key changes in the culture and structure of research institutions. Spin-off processes were not static during this period, but evolved as research institutions learned from their experience.

This chapter starts with the identification of key steps in the spin-off process, based on my observations. In a second section, I present the actual spin-off process in five research institutions. Next, I identify the main patterns of these spin-off processes, compare them, and discuss their implications.

Data for this chapter come primarily from interviews with administrators of research institutions and entrepreneurs, as well as archival data such as annual reports, brochures, web sites of research institutions, and secondary data.

1. ROAD MAP TO ANALYZE SPIN-OFF PROCESSES

In studying the spin-off process of several universities and research institutions in the late 1990s, I observed several stages and identified steps that could be seen as generic or archetypical, thus representing a useful road map for analysis.

- First, the spin-off process started with the origination of the projects. Two modes of origination existed. Most commonly, academics took the initiative of submitting a project to their research institutions' technology transfer unit. Alternatively the technology transfer unit conducted a proactive technology opportunity search, trying to identify technologies with a commercial potential.
- Second, there is an intellectual property assessment, to see if patents have been already filed for the specific technology and, if not, perhaps filing one or more patents. This step involves examining the choice between options of commercialization, primarily the choice between licensing and commercializing through a spin-off venture.
- Third, research institutions selects the spin-off project based on its intrinsic potential and comparison with alternative projects.

- Fourth, a business development plan is created.
- Fifth, a fund raising process is initiated. Research institutions channel their spin-off process towards some forms of funding process.
- Sixth, a new selection process occurs that generally involved parties outside the university or the research institutions.
- Seventh, once funding is obtained, the venture can formally be incorporated; at this point the research institution or another party can provide start-up coaching.

It is difficult to separate these steps of the process from two contextual factors that greatly influence the process: the organization of research and the organization of technology transfer within the university or the research institution. The organization of research includes, for example, the specialization of research and the extent to which it includes applied research or not, partnerships with industry. Second, as emphasized in chapter 4, the spin-off process depends on the organization of technology transfer. In the late 1990s, research institutions started to build or to strengthen technology transfer units.

Table 5.1.- **Summary of the steps of a proactive spin-off process**

1.	Origination of the spin-off projects
2.	Intellectual property assessment and protection
3.	Selection of the spin-off project by research institution
4.	Incubation or business plan development
5.	Fund raising process
6.	Selection by funding source
7.	Support the start-up process

Of course, in reality the full process seldom happens as described above and phases may overlap somewhat..

Of the seven research institutions referred to in chapter 4, I describe the spin-off process of five of them below: IMEC, VIB, KUL, UCL, ULG. I leave out RUG and ULB because they did not have a spin-off policy in place by the end of 2000, when I finished my data collection.

2. DESCRIPTION OF SPIN-OFF PROCESS IN FIVE RESEARCH INSTITUTIONS

2.1. IMEC: Institute for Microelectronics [27]

Three main factors distinguish IMEC's spin-off process. One is its proactive technology opportunity search, in contrast to other universities. Second, its selectivity which was made possible in part by a technology transfer unit with twenty members and a policy of only spinning off ventures that could be eligible for venture capital. IMEC carefully compared the merit of licensing versus spinning off a venture. A third characteristic is the long technical and business incubation that could last up to two years. IMEC let its scientists informally refine the technology while the technology transfer team helped scientists write a business plan and enlist the help of outside consultants and/or managers with domain expertise to complement in-house expertise.

After 2000, when it became more difficult to raise venture capital for a first round of funding, IMEC set up a new seed fund with financial partners. After incorporation, ventures started to op-

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[27] My main sources of information for this section are my interviews at IMEC and with founders of IMEC spin-off ventures (see list in Appendix 2.1); Clarysse et al. (2001); http://www.imec.be/; http://www.it-partners.be/

erate commercially under the management leadership that conducted the business plan development and fund raising processes or the founding team of academics reinforced by managers with business backgrounds.

Table 5.2. - **Spin-off process at IMEC**

	1996 – 2000	**2001**
Organization of research	• Specialists research institution that spans several labs in one domain • Strong fundamental research • Strong research collaborations with industry.	Same
Research valorization and technology transfer	• Strong unit (20professionals) • Strong IP capability	Same
1. Origination of spin-off projects	• Proactive opportunity technology search • Open to individual initiatives	Same
2. Intellectual property assessment and protection	• Strong and growing IP capability	Same
3. Selection of the spin-off project by the research institutions	• Very selective: only choose projects susceptible of meeting criteria of venture capitalists	• Broader selection criteria
4. Incubation or business plan development	• Technical incubation: IMEC • Business incubation: outside consultants and / or experienced managers hired from industry • Duration: 12-18 months within IMEC	• Similar, but with help of a new seed fund

	1996 – 2000	2001
5. Funding process	• Apply directly for venture capital	• Two step process • Apply to proprietary seed fund • Apply for venture capital
6. Selection by funding source	• Very selective and competitive	• Seed fund: no data • Venture capital: same
7. Support with start-up process	• Comes from management team, venture capitalists, and board • No direct IMEC involvement, but venture benefits from its network	• Similar, but additional support from seed fund partners

2.2. VIB: Flanders Institute for Biotechnology [28]

Similarly to IMEC, the VIB origination of spin-off projects resulted from a proactive technology opportunity search. A strong technology management assessment preceded the selection of a technology. Spinning off a technology, as opposed to licensing it, required that it represented a "technology platform;" i.e. a technology allowing a number of commercial applications, with sufficient potential to attract venture capital from the outset. Business plan development and fund raising from venture capitalists, which could last twelve to eighteen months, was outsourced to experienced managers who were hired, first as consultants then as ex-

28 My main sources of information for this section are my interviews at VIB and with founders of VIB spin-off ventures (see list in Appendix 2.1); Clarysse et al. (2001); http://www.vib.be/frame.cfm, http://www gimv.com/

ecutives after founding. Thus, VIB's process was very similar to IMEC.

Table 5.3. - **Spin-off process at VIB**

	1997 – 2000	2001
Organization of research	• Specialists research institution that spans several labs in one domain • Strong fundamental research • Strong research collaborations with industry. • EUR 7 million in 1997	Same
Research valorization and technology transfer	• Strong unit (7 professionals) • Strong IP capability	Same
1. Origination of spin-off projects	• Proactive opportunity technology search • Open to individual initiatives	Same
2. Intellectual property assessment and protection	• Strong and growing IP capability	Same
3. Selection of the spin-off project by the research institutions	• Very selective: only choose projects susceptible of meeting criteria of venture capitalists	• Broader selection criteria
4. Incubation or business plan development	• Technical incubation: IMEC • Business incubation: outside consultants and / or experienced managers hired from industry • Duration: +/- one to several years within IMEC	• Similar, but with help of a new seed fund

	1997 – 2000	2001
5. Funding process	• Apply directly for venture capital	• Two step process • Apply to proprietary seed fund • Apply for venture capital
6. Selection by funding source	• Very selective and competitive	• Seed fund: no information • Venture capital: same
7. Support with start-up process	• Comes from management team, venture capitalists, and board • No direct IMEC involvement, but venture benefits from its • Network	• Similar, but additional support from seed fund partners

2.3. KUL: Katholieke Universiteit Leuven [29]

KUL was at the forefront of technology transfer and spinning off new ventures among universities. It is the only university which attempted to develop a proactive technology opportunity search, but without success. This probably indicates the difficulty of implementing technology transfer in a traditional university structure that crosses several domains, in contrast to specialized research institutions such as IMEC and VIB. In the period from 1997 to

[29] My main sources of information for this section are my interviews at KUL and with founders of KUL spin-off ventures (see list in Appendix 2 1), B. Clarysse, the interview recording of M. Hinoul and K. Debackere in 1999 by B Surlemont and F. Pirnay, KUL's 1999 publication "KUL Spin-offs;" http://www.kuleuven.ac.be/admin/lr/niv3pbis/SpinOffs/; Debackere (2000), Clarysse et al. (2001).

1999, LRD spun-off ventures at a very early stage because its infrastructure and capabilities were weak. Generating quality spin-off projects seemed to have been a major challenge, as with other universities. Initially, LRD did not seem to exercise much selectivity but pressured its founders to submit and develop more ambitious projects.

With the burst of the technology bubble of the late 1990s, the bankers in the Gemma Frisius Fund became more reluctant to fund such early stage projects. LRD then started to fund the seed stage of spin-off projects internally and carry them to the level of development where they would be eligible for funding from the Gemma Frisius Fund. The importance of the seed stage was acknowledged and a two-step funding process was initiated. As Debackere (2000) claims, the achievement of KUL with regard to technology transfer and spinning off new ventures was probably facilitated by the particular structure of LRD, which is administratively a distinct entity from the university with its own financial means.

Table 5.4. **Spin-off process at KUL**

	1997 – 1999	2000 – 2001
Organization of research	• Traditional university structure • Contract research managed by separate structure (LRD) • Creation of horizontal "research divisions"	Same
Research valorization and technology transfer	Five professionals IP capability	Same
1. Origination of spin-off projects	• Proactive technology opportunity search – mixed results • Advertising of resources for spin-off projects • Largely initiated by individual researchers	Same
2. Intellectual property assessment and protection	• Emergent capability: 3 part-time professionals • Fund for IP	Same
3. Selection of the spin-off project by the university	• By pushing founders to submit more ambitious projects	• Selection through incubation
4. Incubation or business plan development	• No incubation, but growing support with business plan development. • Beginning of advising role of local nascent entrepreneurial community (Leuven Inc)	• Incubation inside the university (LRD) structure during seed stage: product development, market study, prototyping, and first client.

	1997 - 1999	2000 - 2001
5. Funding process	• Proprietary fund with banking partners • Investment of EUR 60,000-370,000 • Business plan showing rapid positive cash flow is required	• Two stages • Seed funding by university (LRD) 30,000 – 60,000 • Funding from proprietary fund with banking partners: EUR 200,000 – 370,000 • Non competitive funding process
6. Selection by funding source	• Non competitive funding process • Pressure not to raise fund outside the university fund	• Non competitive funding process • Higher selection than in period 1 and focus on later stage projects
7. Support with start-up process	• Very little. Board representation of LRD and banks	• Growing involvement of local entrepreneurial community

2.4. UCL: UNIVERSITÉ CATHOLIQUE DE LOUVAIN [30]

Typical of universities, no proactive technology opportunity search existed at UCL, which depended on initiatives of researchers to generate academic spin-off projects. Also, typical was the fact that, without incubating capabilities, ventures were spun off at a very early stage. The policy seemed to target generation of spin-offs rather than selecting and targeting ambitious projects. UCL provided various sizes of funding depending on the spin-off project,

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[30] My main sources of information for this section are my interviews at UCL and with founders of UCL spin-off ventures (see list in Appendix 2 1), Clarysse et al. (2001); Capart (2001), http://www ucl ac.be/recherche/valorisation html

which varied in their ambition. It required owning a majority of shares in ventures and excluded other investors. Because UCL had no financial partners and controlled its own fund, it could follow a flexible funding policy and provide seed funding as well as expansion finance. Its own funding was often coupled with the First Spin-off subsidy of the Walloon government. As the university was the funding source, it was exposed to conflicts of interest.

Table 5.5. **Spin-off process at UCL**

	1999-2000 (no significant change over the time period studied)
Organization of research	1. Traditional organization for a university 2. First partnership with industry in 2000
Research valorization and technology transfer	3. 1999. Fund and one person unit in support of spin-off ventures 4. 2000. Extension to responsibility of technology valorization and transfer, as well as "strategic partnerships with industry
1. Origination of spin-off projects	5. Initiatives of researchers
2. Intellectual property assessment and protection	6. Yes, when relevant
3. Selection of the spin-off project by the university	7. Weak selection. Priority on generating ventures.

	1999-2000 (no significant change over the time period studied)
4. Incubation or business plan development	8. No incubation 9. Minimal business plan development
5. Funding process	10. Various amounts depending on project 11. Controlling stake 12. Pressure to exclude other investors 13. Proprietary fund
6 Selection by funding source	14. Weak
7 Support with start-up process	Very minimal (monitoring)

2.5. ULG: UNIVERSITE DE LIEGE [31]

No technology opportunity search existed. The university experienced difficulties motivating research faculty to license and spin off technologies. Similar to other universities, their business plan support was weak, thus ventures were spun-off at an early stage. Generating spin-off ventures seemed more of a priority than selectivity. ULG's focus was on providing small seed funding.

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[31] My main sources of information for this section are my interviews at ULG and with founders of ULG spin-off ventures (see list in Appendix 2.1); Clarysse et al (2001), Surlemont and Pirnay (1999); Pirnay (2001); http://www.ulg.ac be/entreprises/english/index.html

Table 5.6. **Spin-off process at ULG**

	1999-2000 (no significant change over the time period studied)
Organization of research	• Traditional organization for a university • First partnership with industry in 2000
Research valorization and technology transfer	• 1999. Creation of a seed fund • Responsibility of research valorization given to Interface, the industry liaison office. • Hiring of a director; one person to support of spin-off projects, and one person with IP expertise
1 Origination of spin-off projects	• Initiative of researchers
2. Intellectual property assessment and protection	• First experiments
3. Selection of the spin-off project by the university	• Weak selection. Priority on generating ventures.
4. Incubation or business plan development	• No incubation • Minimal assistance with business plan development
5 Funding process	• Small seed funding of EUR 32,000 to 125,000 provided by Spin Venture • Often coupled with First Spin-off subsidy
6 Selection by funding source	• Weak selection Priority on generating ventures.
7 Support with start-up process	• Very minimal (monitoring)

3. DISCUSSION

3.1 Comparison of spin-off processes

We can distinguish two patterns among these spin-off processes. One pattern was followed in specialized research institutions; the second was more typical of the process going on in universities. KUL, in its latest development, seems to represent an intermediate process, departing from the two dominant patterns.

Table 5.7. **Characteristics of the two processes of spinning off ventures from research institutions**

	Specialized research Institutions IMEC and VIB	**Universities KUL (<2000) UCL ULG**	**KUL (2000-2001)**
Organization of research and research valorization	• Institutes span several labs in the same domain. • High-level fundamental research and strong contacts with industry.	• Level of research probably more variable. • Weak industry orientation	

	Specialized research Institutions IMEC and VIB	**Universities KUL (<2000) UCL ULG**	**KUL (2000-2001)**
Technology valorization and transfer	• Strong capabilities	• Weak but emergent capabilities (UCL – KUL) • Problem of scale for most	• Good capabilities
Origination of spin-off projects	• Formal and systematic technology opportunity search	• Relies on initiatives of researchers [32]	
Selection by research institution	• Strong selection capabilities	• Weak selective capabilities Concern was more to generate projects	• Selection by incubation
Incubation and business plan development	• Long technical incubation • Business incubation of up to 1.5 year with the help of to consultants and experienced managers	• No incubation • Minimal business plan development	• Business incubation
Funding process	• Until 2000: exclusively venture capital - competitive funding process. • Starting 2001: seed funding with proprietary fund	• Non competitive funding process - proprietary funds	• Two steps process
Selection by funding source(s)	• Very high	• Concern was more to generate projects	• Selection by incubation

[32] Technology opportunity search is apparently very difficult to perform in universities.

	Specialized research Institutions IMEC and VIB	**Universities KUL (<2000) UCL ULG**	**KUL (2000-2001)**
Firm founding	• After long incubation and with refined business model	• At very early stage	• After incubation
Start-up coaching	• Experienced Management • Financial backers • Board	• No start-up coaching	• No data

The spin-off process followed by the specialized research institutions relied on a strong incubation period of up to one and half years for business incubation and up to several years for technical incubation. Ventures were only founded at a stage when they had a technology that was intellectually protected, a business plan that demonstrated its strong market potential, a convincing business model to exploit it, and finally, a management team able to carry out this project with the help of venture capitalists, board members from industry and other advisers.

In contrast, the spin-off process followed by universities typically involved no incubation or assistance in business plan development. Ventures were founded at a very early stage when the entrepreneurial project was still vague and its main asset consisted of scientific knowledge. Thus, the business development phase happened, for the most part, after founding, while ventures operated as a business. After following this process for a few years, KUL realized the importance of preparing the business project and evolved towards a process with an incubation period.

The processes were not static, but grew in sophistication over time as research institutions learned from their experience. For instance, IMEC initially (starting in 1996) focused exclusively on spinning off venture that targeted significant capital from the outset. It later learned valuable spin-off projects existed which did not fit the criteria of venture capitalists at founding. IMEC also recognized the need for a seed fund.

Based on this analysis, there is another, more synthetic, way to conceptualize the spin-off process can be the following, as summarized in Figure 5.1. [33] The various steps in the process could be divided into three phases. A phase of "origination" of the spin-off project anchored in research and including the identification of technologies with commercial potential. This phase stops when the academic institution selects the technology for a spin-off

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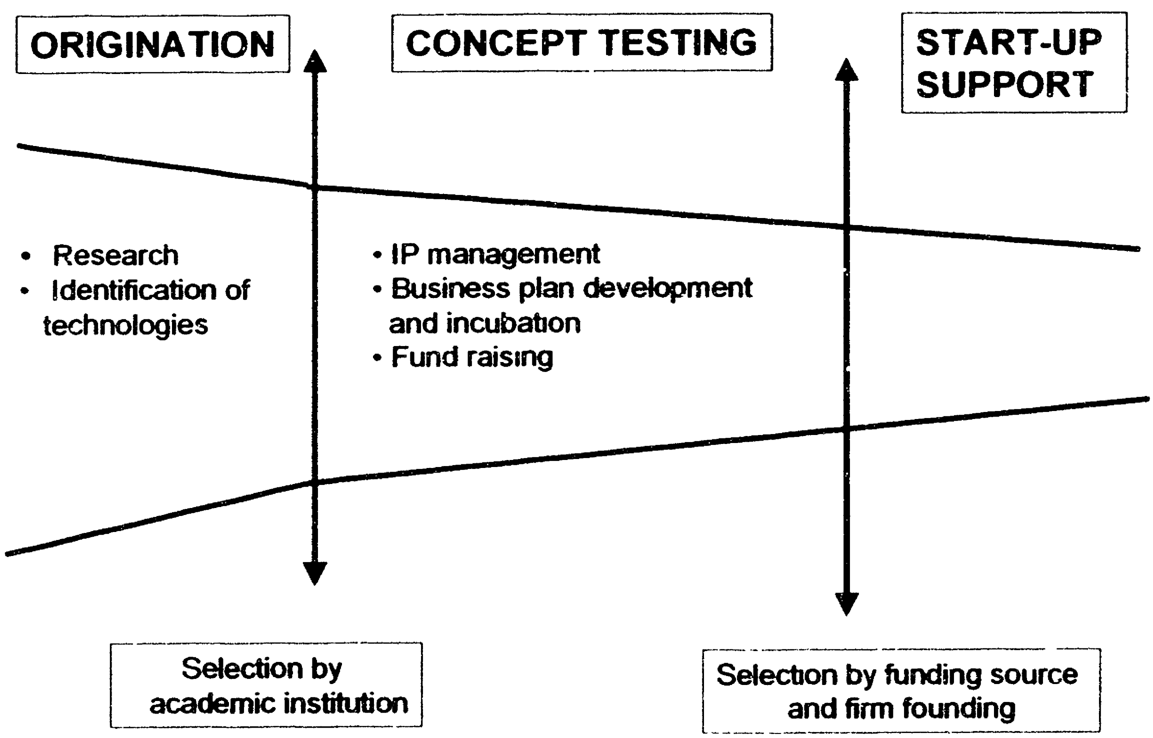
[33] I am indebted to Bart Clarysse and Ans Heirman of the University of Ghent for visualizing the spin-off process this way.

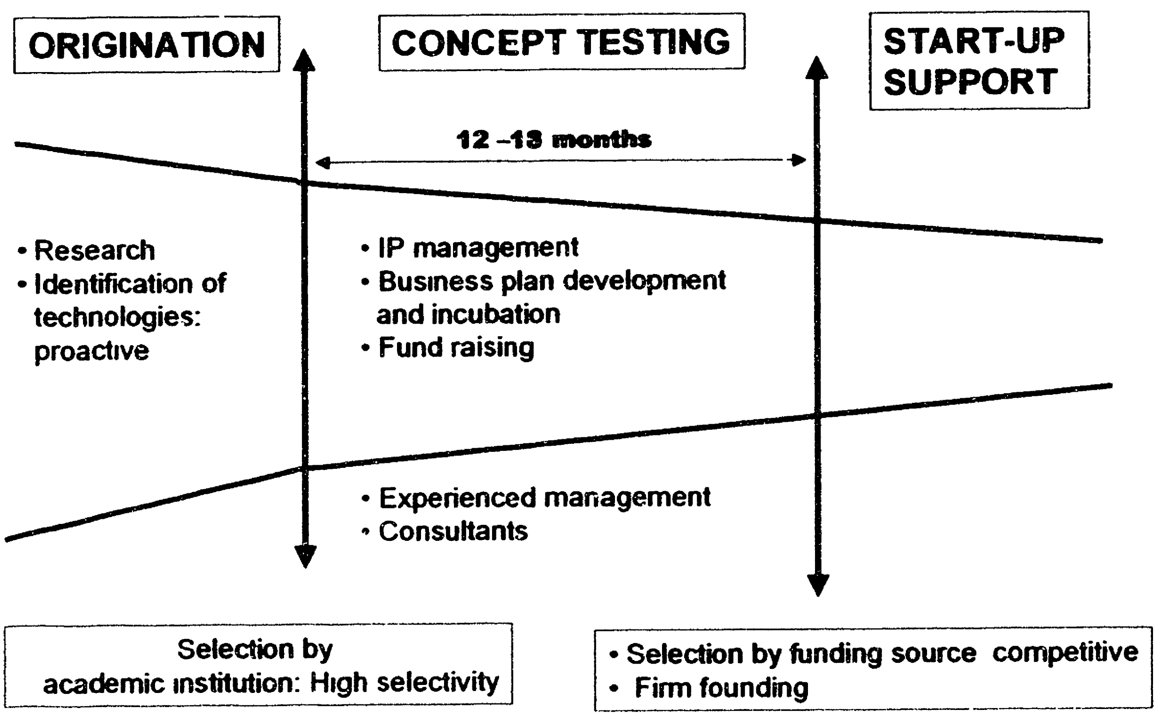
project. The second phase of technical and business "concept testing" including the intellectual property management, business plan development and/or business plan incubation, and the fund raising process. This phase stops when the firm is founded. At that point, the third phase of "start-up support" begins.

Figure 5.1. - **Reconceptualization of the academic spin-off process in three phases**



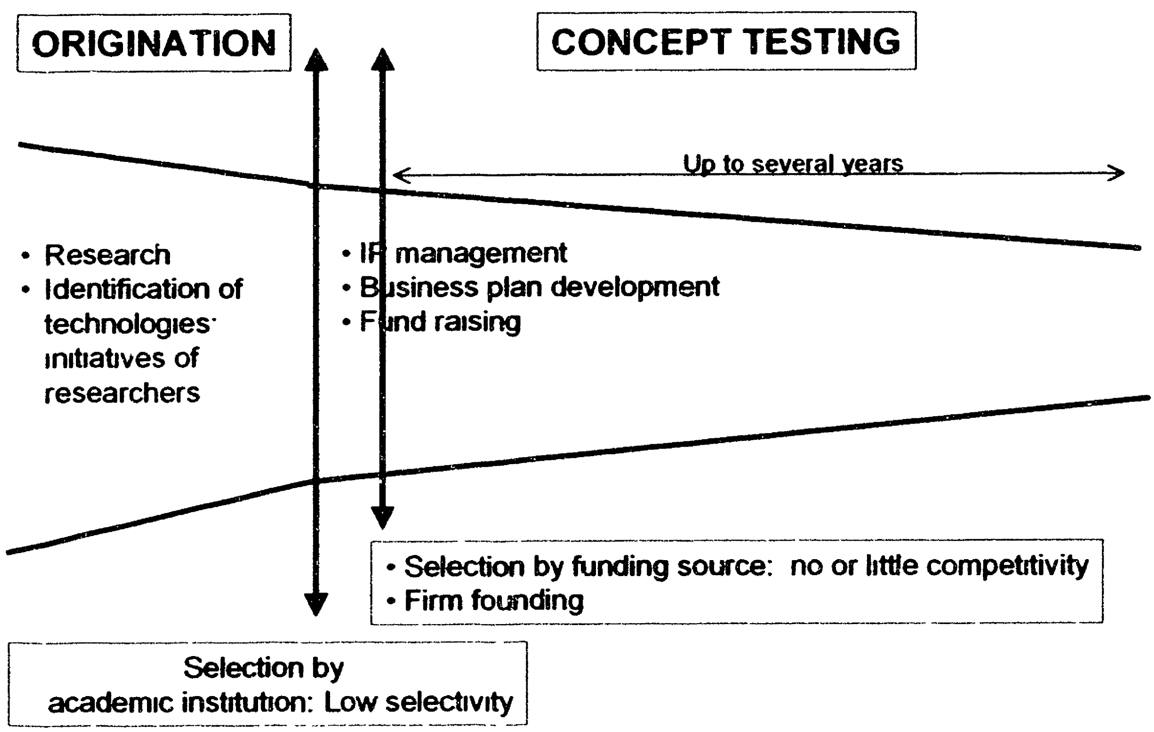
With this representation, the differences between the spin-off processes of specialized research institutes and universities can be highlighted.

Figure 5.2. - **Spin-off process of specialized research institutes**



The above figure highlights the proactive, technology opportunity search characterizing the origination phase in specialized research institutes. It puts forward the high selectivity of the institutes in choosing spin-off projects and the extent of the concept-testing phase before the venture was founded, involving the help of experienced management and outside consultants. Only after this concept testing phase, which lasted twelve to eighteen months, and competitive selection by venture capitalists was the venture founded.

Figure 5.3. - **Spin-off process of universities**



The above figure highlights that ventures spun off by universities were founded at an early stage after little business development and no incubation. As a result, most of the concept testing had to be done by the founders, after the venture was created, with little support. Universities did not have the capability to support them and there was no entrepreneurial community from which they could borrow knowledge.

Why did the two types of academic institutions adopt such different spin-off strategies? First, IMEC and VIB were more generously endowed than the universities. Also, selection and support are probably easier to exercise for a specialist organization than for a generalist organization such a university. Third, IMEC had experience with spinning off ventures in the 1980s and early 1990s; thus, it learned that without strong support, notably in terms of funding and management, spin-off ventures tend to stay small boutiques. Fourth, IMEC and VIB are active in industries that originated in the USA and were built on the venture capital-backed model of firm. IMEC and VIB's processes are designed to spin-off firms meeting the very high criteria of venture capitalists.

3.2. Analysis of the spin-off processes in terms of selectivity and support

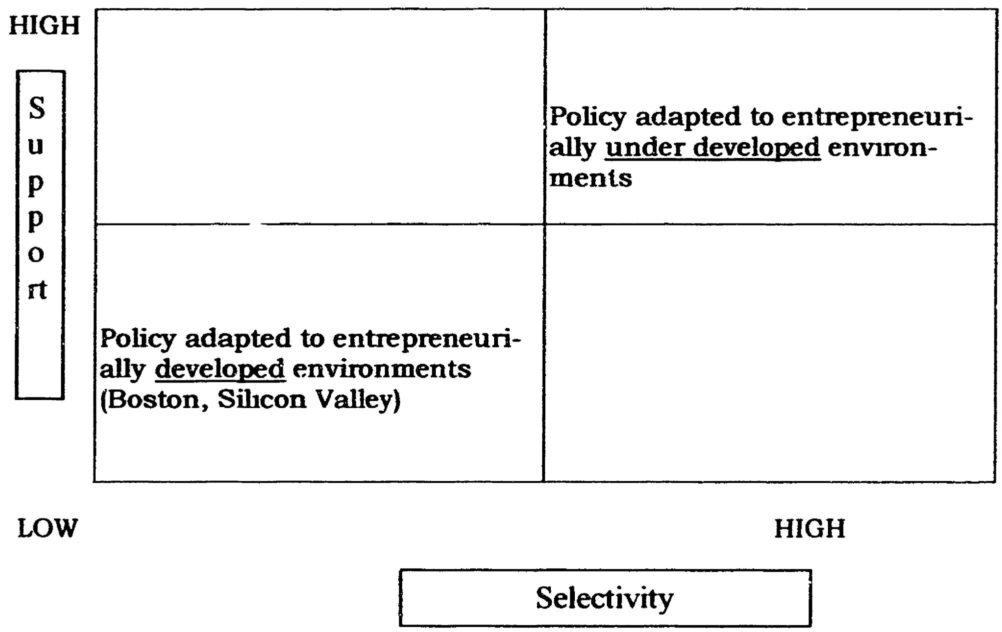
As reported in chapter 1, Roberts and Malone (1996) consider selection and support to be the two fundamental dimensions of a spin-off process. The observed Belgian processes could indeed be summarized in terms of levels of selection and support. The process adopted by specialized research institutions involves high selection and high support, while the process adopted by universities (except KUL starting in 2001) is one of low selection and low support.

Roberts and Malone (1996) further argue that only two spin-off strategies work in terms of support and selectivity: either high support-high selectivity or low support-low selectivity. The low support-low selectivity policy consists of spinning off many ventures, but with little support. It reduces the cost of spinning off, but seeks safety in numbers. "Choice is left to external agencies (such as venture capital funds) who are generally felt to have greater experience and expertise in 'picking winners' and less potential for conflicting objectives than the R&D organization" (Roberts, 1996: 41).The high support-high selectivity consists of spinning off a few well-supported ventures. It relies on picking potential winners and supporting them to increase their chance as much as possible.

On the other hand, the policy providing low support-high selectivity runs the risk of under-investment in a narrow portfolio. The policy of high support-low selectivity is seen by the authors as the most risky because most of the investments risks are then made with low potential ventures.

Further, the authors argue that low support-low selectivity policies are more fitted to entrepreneurially developed environments, while high support-high selectivity policies are more efficient in entrepreneurially underdeveloped environments. In developed contexts, such as Boston or Silicon Valley, there is a strong entrepreneurial community that has the capability to select the best entrepreneurial projects and allocate resources to them. Thus, the spin-off process follows a "business pull" process in which research institutions can adopt a fairly passive strategy. In contrast, in underdeveloped entrepreneurial contexts, where there is no strong entrepreneurial community, research institutions need to be more proactive and provide incubation capabilities to their spin-off projects. There is a “technology push” process in which research institutions exercise selection and provide support.

Figure 5.4. **Academic spin-off policies and types of entrepreneurial environments**

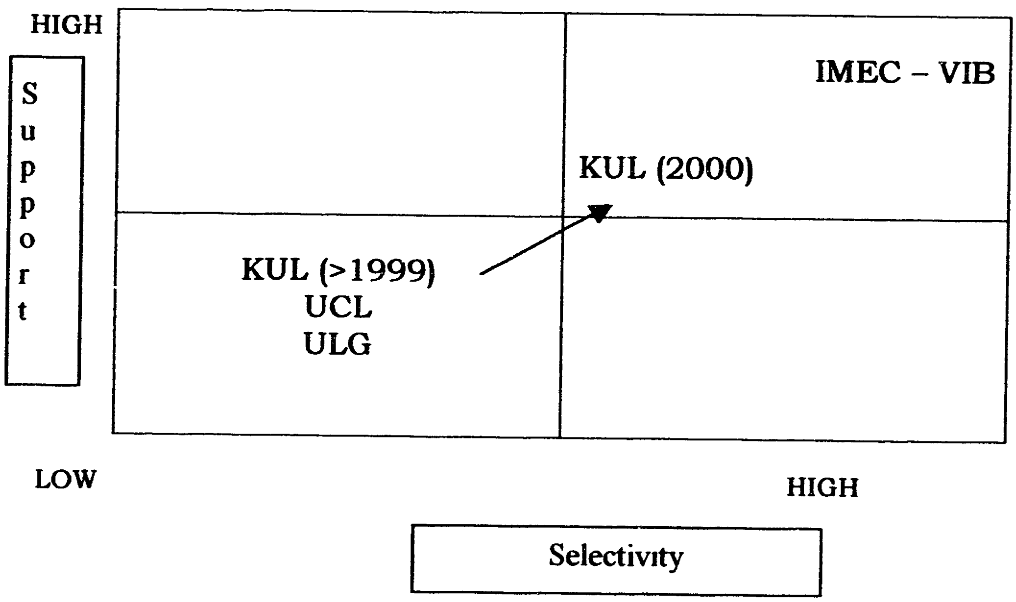


Source: Adapted from Roberts, E. and D. Malone (1996).

My observations support this view; I believe that it is an ideal situation. This study, however, highlights an important practical aspect: the difficulty of starting a high support-high selectivity spin-off policy in such an environment. First, as the examples of IMEC and VIB illustrate, starting a high support-high selectivity spin-off policy requires considerable resources. It also requires competencies that do not exist in traditional research institutions. Implementing them involves considerable cultural and structural changes. In underdeveloped contexts capabilities for selectivity and support are scarce, both inside and outside research institutions.

Unless research institutions are richly endowed and have a particular specialization, as in the case of IMEC and VIB, they will likely be forced to start with a low support-low selectivity strategy. Indeed, the case of the Belgian universities shows that they did not have enough resources to provide a high level of support. In turn, a support infrastructure can only be justified if there is enough flow of spin-off projects, which typically is not the case when research institutions initiate a spin-off strategy. Building such a support infrastructure requires a certain scale that excludes a great deal of research institutions. Selection capability is also difficult to build from the outset in such a context, as it requires experience. Thus, I would suggest that we could represent the Belgian situation as follows.

Figure 5.5. **Ranking of academic spin-off policies in terms of selectivity and support**



Source. Adapted from Roberts, E. and D. Malone (1996)

In light of the case of KUL, a research institutions can, with the right policies and the acquisition of necessary resources, start in a low support-low selectivity position and gradually move towards more selectivity and more support. We should note, however, that IMEC, VIB, and KUL are the three research institutions with structures that depart from traditional universities. So, it remains to be seen whether traditional universities will be able to follow the same trajectory and how fast. One alternative for universities which lack scale would be to pool resources to spin off ventures or to pool sectoral efforts.

4. CONCLUSIONS

This analysis shows how complex spin-off processes can be is; it is not enough to simply set up a seed fund, but they involves a number of other steps. Spin-off processes also vary across academic institutions. There seems to be two archetypes of spin-off processes depending on the academic institutions capabilities. The first, practiced by specialized research institutes, involves a proactive technology opportunity search phase and an extensive concept-testing phase before ventures are founded. It can be characterized as a high selectivity and high support policy. The second type, practiced by universities, leaves the initiation of projects to individual researchers and provides limited support for concept testing before ventures are founded. Most concept testing needs to be conducted after founding. This type of spin-off process can be regarded as a low selectivity and low support policy. The example of the most recent developments at KUL indicate that, as academic institutions and their partners learn from their experience, variations on these two archetypes of spin-off process may emerge in the future, although options are limited by organizational constraints of universities and the lack of entrepreneurial community.

Adjusting to the new mission of technology transfer and spinning off ventures has deep implications on the internal structure and culture of research institutions. It also involves changes in their external network because they need to collaborate more with other parties such as industry or funding sources. Institutions that seem to have adjusted best to this new mission are the specialized research institutions IMEC and VIB, as well as KUL; that is, institutions that have departed from the traditional structure and culture of universities. Note that IMEC and VIB are direct products of the Flemish government's STI policies of the 1990s. This illustrates that successful research valorization by spinning off ventures from research institutions has its roots in adequate STI policies. However, STI policies are not the whole story, as differences between KUL, which spun-off fifteen ventures between 1997 and 2000, and RUG, another Flemish university, which spun off none, illustrates. This suggests that specific organizational structures and cultures of research institutions matter. Leadership of strong personalities probably also matters, as the proactive roles of M. Hinoul and K. Debackere at KUL suggest.

Finally, spin-off processes have implications for the types of firms that are spun off. One implication that we can draw from this analysis is that research institutions in different positions in the support/selectivity matrix are usually to spin-off different types of ventures. The policy of universities in the low support-low selectivity quadrant has particular implications for the ventures that they spin off. Their ventures are spun-off at a very early stage of development with only have a vague idea of how to commercialize their technology. As a result, they must adopt a transitory business mode, in order to have revenue while they refine their business model. This transitory mode is often a consulting activity. Second, without incubation and without competencies from an entrepreneurial community, founders must learn mostly by experimentation.

CHAPTER 6

ARCHETYPES OF ACADEMIC SPIN-OFF VENTURES

1. INTRODUCTION

This chapter explores the characteristics of academic spin-off ventures, which emerged in the environment and following the spin-off processes that I described and analyzed in the previous chapters.

I first present a theory perspective of firm formation. Then, I present my analysis of characteristics of ventures in the period prior to 1996, in order to highlight the difference, but also to stress how the SME model of venture was dominant until 1996 and how the growth oriented model of venture was new. A third section is devoted to the analysis of characteristics of spin-off ventures in the period of the late 1990s. I identify three types of ventures. Finally, in section 3, I discuss differences among these types of ventures and the evolutions that we can perceive during the short period of time under review.

2. TYPES OF VENTURES IN THE LITERATURE

The literature on academic spin-off firms in Europe and the OECD survey highlight the heterogeneity among academic spin-off firms; the majority remain "small boutiques" while only a few firms grow significantly (Callon, 2001; Clarysse et al., 2001; Mustar, 1997). This is in contrast to American-developed high tech clusters where ventures have grown to become dominant global firms. The American literature takes the growth orientation of technology ventures for granted (e.g. Eisenhardt & Schoonhoven, 1990; Kazanjian, 1988), but in Europe it is atypical. Small- and medium-sized enterprises (SMEs) and growth-oriented new ventures are different models of ventures that follow a different path.

2.1 Characteristics of SMEs

SMEs represent essentially a substitute for a job (Lee et al., 2000: 94; Storey, 1994; Timmons et al., 1992: 9). They are also instruments to pursue "lifestyle" objectives such as independence, or, in the case of technology ventures, dealing with cutting edge technology (Lee et al., 2000; Roberts, 1991; Timmons et al., 1990).

These firms are indeed often referred to as "lifestyle" ventures (Timmons et al., 1990: 9). The management structure of SMEs is typically thin and dominated by their founders (e.g. Storey, 1994). Management and ownership overlap, so that these firms are also referred to as "managed-owned" enterprises. The founder of an SME and his or her family generally own all the shares of the firm (Wtterwulghe, 1998: 34). Because of the overlap of the firm with the owner's personal or family assets, economic objectives are mixed with non-economic objectives (Wtterwulghe, 1998: 86). Any business decision by the founder has implications, not only at the business level, but also for the family (Wtterwulghe, 1998: 36).

In such a context, keeping the firm under strict personal or family control is a major priority of SME owners (e.g. Donckels et al., 1993). It translates into an aversion of outside capital and even of debt by SME owners (e.g. Storey, 1994) with the result that SMEs are often under-capitalized. The desire of owners of SMEs to keep control is often an impediment to taking advantage of growth opportunities, which most SME owners do not rank as a priority (Curran, 1986; Donckels et al., 1993; Gibb & Scott, 1986; Storey, 1994: 114; Wtterwulghe, 1998).

Control can also be motivated by issues of prestige and social position in the local community (Laufer, 1975). These concerns too can interfere with growth and profit maximization. Further, because of the overlap between ownership and management, the latter is not accountable to outside shareholders and is thus not under pressure to maximize profit (Wtterwulghe, 1998: 86). SMEs thus essentially appear as a vehicle for self-employment (Timmons et al., 1990: 9).

In sum, SMEs are characterized by low capitalization, closed ownership, weak management, no or low growth orientation and, as a result, small size (e.g. Donckels et al., 1993; Storey & Tether, 1996; Storey, 1994; Wtterwulghe, 1998). "The dominant group of small businesses are those which are small today and, even if they survive, are always likely to remain small-scale operations" (Storey, 1994: 114).

However, SMEs have an important economic and social impact. Based on data from the European SME Observatory of the European Commission, Wtterwulghe (1998: 29) highlights that in 1997 99.8% of firms of the European Union could be considered SMEs. Approximately 93% of firms were micro-enterprises of less than 10 employees, 5.9% were small firms (less than 50 employees), and 0.9% were medium size firms. In addition, 65.7% of the 111,410,000 people employed in the European Union worked in an SME. In Belgium, 80% of the businesses were controlled by their founder or their family and 70% of companies were managed by their founders or by heirs of the founder (Wtterwulghe, 1998: 34).

2.2 Characteristics of growth-oriented new ventures

The second archetype of new venture is the growth-oriented venture that emerged in the 1970s in the two American high tech clusters of Silicon Valley and Boston (Roberts, 1991; Saxenian, 1994). Its emergence coincides for the most part with the rise of the venture capital industry in the early 1970s (Sahlman, 1990; Suchman, 1994).

Whereas SMEs are a substitute for a job, growth oriented ventures are geared towards creating value for their founders and their shareholders through the realization of capital gain. This appears clearly, for instance in the following quote from Timmons et al. (1990):

> In the idea of entrepreneurship is the idea of value creation and distribution, not just for the owners, but also for other stakeholders, such as partners, customers, suppliers, employees, and backers... This ability to generate sufficient income or potential for capital gain is a critical measure of success and separates those business which fail or which merely survive as a job substitute from those which succeed" and "entrepreneurship implies the promise of expansion and the building of long-term value and durable cash flow streams as well. (8, 9)

In an often-cited quote, Miller (1983) underlines the hazards and creative challenges entrepreneurial firms face. He suggests that an "entrepreneurial" firm is one that "engages in product market innovation, undertakes somewhat risky ventures, and is first to come up with 'proactive' innovations, beating the competitors to the punch" (Miller, 1983: 771). The, largely US-based, literature on technology entrepreneurship takes the growth orientation of start-ups for granted (Eisenhardt and Bird Schoonhoven, 1990; Romanelli, 1989).

Growth-oriented technology start-ups appear to prosper in very particular environments composed of research institutions, established firms that lead their fields, a high density of other new ventures, entrepreneurship forums, and various types of service providers, such as venture capitalists and law firms. This context has been conceptualized as a particular "ecology" (Saxenian, 1994), an "eco-system" (Bahrami and Evans, 1995), or a "habitat" (Lee et al., 2000). The multiple interactions among these various actors helps resources and information circulate efficiently (Suchman, 1994) and creates a "cross-pollination" (Saxenian, 1994) among them. In such a context, Brown and Duguid (2000b) write that there is a great deal of "knowledge in the air," which allows mutual benchmarking.

Growth-oriented ventures, especially those that are backed by venture capital, represent a minority of firms. However, because of their growth orientation and their innovativeness, some have had a considerable impact, rewriting the rules of their own industry or creating whole new industries, as with the case of biotechnology and personal computers. Glassman (1998) points out that some of the largest capitalization of the US stock markets include companies that did not exist thirty years ago, such as Microsoft, Intel, Cisco, WorldCom, and Dell.

This concept of entrepreneurship that was born in the high tech clusters in the USA against the backdrop of the rise of the venture capital industry is particular and representative of one specific institutional environment. This concept involves the partnership of entrepreneurs and investors, as well as a number of service providers, in contrast to the SME model that is relatively closed to outsiders. The partnership of these groups is bound by the growth prospects of the venture, whereas the founder and in some cases his close relatives or associates are bound by their desire for independence. Finally, the concept of entrepreneurial firm discussed above involves an exit to allow the investors and the entrepreneurs to cash in at some point, usually in the form of an industry sale or of an IPO. In contrast, the logic of an SME is continuity, in order to maintain independence and the founders' source of income.

This model of new venture is still scarce and unfamiliar in Europe (European Commission 1998, 2000). Research and policy reports stress that European technology start-ups tend to fail to grow and stay small "boutiques" (Downes and Eadie, 1997; European Commission, 1998; Mustar, 1995; Stankiewics, 1994). For instance, Storey and Tether (1998: 936) published a literature review on new technology-based firms and academic spin-offs in Europe in which they report that in no study did the average employment of the firms, which survived for 10 years, exceed their employment at start-up by more than 20. They write that "in Europe, there is an absence of extremely fast growing firms comparable to the United States. The evidence suggests that fastest growing firms create hundreds rather than thousand jobs in a decade" (938).

In the mid 1990s, interest grew for the growth-oriented new venture model and their model of entrepreneurship (e.g. European Commission 1998, 2000). In Europe, few firms have, however, emerged in the late 1990s that have followed this new archetype of new venture (e.g., EVCA, 1997). Among them, there are some Belgian academic spin-off firms and science-based ventures, such as, Ion Beam Application (IBA), ICOS, Innogenetics, Plant Genetic System, or Ubizen.

I find these two archetypes of new ventures among academic spin-off firms. Prior to 1996, the large majority resembled SMEs. After 1996, more growth-oriented firms emerged. Some adopted the high growth orientation typical of start-ups of developed entrepreneurial clusters, of which the venture capital backed start-up is the archetype. Others represented a more hybrid form in which growth was not as central until after a few years of founding. I label this group "prospectors."

3 CODING OF VENTURES

The technology SMEs and the high growth oriented start-ups are my baseline models. As a result, I rank firms along four dimensions that characterize differences between the organizational models of technology SMEs and high growth oriented start-ups:

capitalization, ownership structure, level of management, and growth orientation.

3.1 Capitalization

I score capitalization, as well as the other dimensions, on a scale of three.

- 1 indicates that the firm is incorporated with the minimum legal capital, a characteristic common to technology SMEs. This minimum legal capital for the two most common types of legal commercial entities is either EUR 6,250 or EUR 62,500.
- 2 indicates a capitalization of a multiple of the minimum legal capital.
- 3 indicates a capital of EUR 1 million or more, which seems to be amounts that generally only venture capitalists invest.

3.2 Ownership

Firms differ greatly in terms of ownership structure. Traditional SMEs tend to be closed to outside investors; firms starting with the support of venture capitalists founders retain only a small share of the ownership. There are, however, intermediate situations where firms have outside capital from non-venture capital sources, such as industry, or more typically in the last few years, from seed investment funds set up by academic institutions in partnership with traditional private or public financial partners.

- 1 indicates that the ownership of the firm is closed to outsiders.
- 2 indicates that the ownership includes non-venture capital investors, such as funds related to a research institution.
- 3 indicates that venture capital firms are the primary investor in the firm.

3.3 Management structure

SMEs tend to have a simple management structure dominated by one or two founders. Technology SMEs tend to be characterized by founders with a technical background (e.g. Mustar, 1995; Storey and Tether, 1998). More ambitious start-up projects need a stronger management team with more variety of expertise (Eisenhardt and Bird Schoonhoven, 1990; Roberts, 1991).

- 1 indicates that management of the firm is composed of technicians only, without business experience.

- 2 indicates junior business experience in the management team, or experience in another sector.
- 3 indicates senior business experience in the industry of the start-up.

3.4 Growth orientation

As mentioned above, growth is a low priority for SMEs compared to keeping control of the firm, or being able to deal with cutting edge technology. On the other hand, growth is inherent to the American model of technology start-up, in particular to venture capital-backed firms.

- 1 indicates no growth orientation identified, for instance, by comments of founders stating that they want to stay a small firm or that maintaining control over the firm is more important than growth.
- 2 indicates intermediary cases where founders do not reject growth, but it is not a current priority.
- 3 indicates a high growth orientation, such as in the case of firms that go instantly global or firms that try to raise venture capital.

4 DATA ANALYSIS OF FIRMS FOUNDED PRIOR TO 1996

4.1 Characteristics of firms at founding

For this group of older firms, I would like to distinguish between their characteristics at founding and their characteristics as they evolved over the years.

Table 6.1. **Coding of founding characteristics (prior to 1996)**

FIRM	**(1)**	**(2)**	**Capital**	**Ownership structure**	**Management**	**Indications of Growth**	**Types at founding**
ICOS	1982	KUL	1	1	1		SME
Iris	1983	UCL	1	1	1	1	SME
Frontier Design	1979	ULG	1	1	1		SME
Gamma	1983	ULG	1	1	1	1	SME
Eurogentec	1985	ULG	1	1	1	2	SME
Belsim	1986	ULG	1	1	1	1	SME
DAP	1988	KUL	1	2	1	1	SME
Sinvaco	1988	RUG	1	1	1		SME
Androme	1989	LUC	1	1	1	1	SME
Tri-consult	1989	KUL	1	1	1	1	SME
Biocode	1989	ULG	1	1			SME
Materialize	1990	KUL		2	1	1	SME
IMO	1991	KUL	1	2	1	1	SME
Metalogic	1991	KUL	1	2	1	1	SME
Easics	1992	KUL	2	2	1	1	SME
Epas	1992	RUG	1	1	1	1	SME
Destin	1993	LUC	1	2	1	1	SME
Stag	1994	DNH	1	1	1	1	SME
Neurotec	1994	UCL	1	2	1	1	SME
ISMC	1995	KUL	1	1	1	1	SME
Krypton	1995	KUL	1	1	1	1	SME
Netvision	1995	KUL	1	1	1	1	SME
Microbel-cap	1995	ULG	1	1	1	1	SME
Eurogenet-ics	1984	OTHER	2	2	1		Outlier
Polyflow	1984	UCL	1	2	1		Outlier
Hypervi-sion	1990	KUL	3	2	1		Outlier
OWS	1988	RUG	2	2	1		

.(1) Founding year
.(2) Academic institution

This table shows that out of twenty-seven firms founded prior to 1996, twenty-three were founded with the characteristics of an SME. Of the four other firms, three do not clearly fall into either category; they are outliers, or special cases. In appendix 6.1, I give details about these three firms and I explain why I believe they are outliers. Finally, I did not rank one firm, Organic Waste System (OWS), because I did not have enough information to make a reliable assessment.

4.1.1 Analysis of the firms founded following an SME model

SME is the dominant model for these early academic spin-off firms at founding. Twenty out of twenty-three firms exhibit at least three out of four characteristics of SMEs. The three firms that exhibit less than three characteristics of SMEs out of four are: Biocode, Materialise, and Easics. The reasons why I ranked them as SMEs are the following. Information about management and growth orientation was not sufficient to make a sound judgment in the case of Biocode. However, in light of characteristics of the weak management structure and of the limited growth orientation in later years, I estimated that it was fair to assume that the firm started as an SME. Materialise had a low management structure and no growth orientation, but it had outside funding and I could not obtain the information about its capital at founding. Materialize was one of the early ventures that KUL supported with small funding in the order of EUR 32,000 to 62,500. This outside funding did not change the character of the firm, because KUL was a passive investor during this period before 1996. One of the major concerns of Materialise's founder after the firm took off was to buy KUL out in order to gain full control of the firm. It seems thus reasonable to consider that Materialize was established as an SME, in spite of outside funding. Finally, Easics is a similar case of one of the early KUL spin-offs that received funding from the university. The particularity is that Easics started with EUR 200,000, much more capital than what KUL usually invested. To compensate for this higher investment risk, Easics committed to a very conservative strategy based on a consulting business model.

Characteristics of SMEs that seem particularly dominant are capitalization, management structure, and growth orientation. Firms tend to be founded with EUR 6,250 to 62,500, the minimum legal capital to create the most common forms of companies. Their founding team tends to be composed only of scientists with no business experience. Although it is sometimes difficult to assess with reliability, their founders do not exhibit signs of growth orientation and in some cases are overtly opposed to growth for fear of loosing control of the firm either in terms of ownership or in terms of sharing management responsibilities. These features correspond to an archetypical SME.

There is, however, some variation, particularly in terms of ownership structure. Whereas the ownership of SMEs is typically controlled by its founder and his family, seven out of twenty-three firms have outside shareholders. In each case the investor is the academic institutions from which the firm was spun-off. In five out of the seven cases the investor is the KUL. As we saw above in chapter 4 and 5, this university had had a passive support role for academic spin-off firms until 1997 through its unit Leuven R&D (LRD). Besides firms funded by KUL, Neurotec received EUR 12,500 from UCL and Destin received EUR 25,000 from LUC, the university from which it spun-off, and the same amount from IMEC. Thus, the amounts invested by the academic institutions were very small. They were not provided in view of funding a stage of development in a growth policy, but they were provided to allow firms to initiate an activity that was subsequently supposed to finance itself. So, the logic behind these financings were closer to an SME rationale than to a logic of a growth oriented venture.

For this group of firms founded in the 1980s and 1990s it is, of course, more difficult to assess retrospectively their growth orientation at founding with reliability than to assess the other indicators. Out of the twenty-three firms, I was able to rank the growth orientation of nineteen. Eighteen out of them exhibit either no signs of growth orientation or a resistance to growth. In one case, Eurogentec, I could clearly identify signs of growth orientation, even if they did not impact the organizational format of this company at founding.

Streamco is a case representative of technology SME of this period. [34]

Streamco was founded in 1992 by Professor Keler, a professor of microbiological ecology and technology in one of the Belgian universities, and three of his research assistants. Based on its expertise in microbiologic processes, Streamco helps firms solve envi-

[34] The names of the company and of its founders was altered in order to maintain anonymity

ronmental problems, such as water purification. In the mid-1980s, Professor Keler's lab was increasingly called upon by industry to help solve environmental problems. This new demand, combined with university budget restrictions which limited career opportunities for his researchers, led him and three of his researchers to set up a commercial structure to meet industry needs, while also securing for themselves more promising career opportunities in the private sector.

After considering the new venture for a year, the founding parties established Streamco in 1992 as an extension of the "commercial work" already performed within the university lab. The founders first considered setting up a non-profit organization, which offers some tax advantages, but finally settled upon a commercial enterprise. They formed their company with EUR 32,000, the minimum capital required by law in 1992. Choosing to incorporate with the minimum legal capital and trying to maintain this level is typical of founders of SMEs. Only the founders were shareholders and board members, and they were strongly opposed to outside capital, since independence was a key part of their project. This case thus illustrates the closed ownership structure of this type of firm. It also illustrates the minimal management structure. Initially, they operated out of the university lab and used its equipment. Later, they moved to the university's scientific park, where there was an "incubation center." This structure was limited, however, and still was in 2000, to provision of space for start-ups firms and did not provide business coaching. Nevertheless, Streamco remained there for eight years, and thus kept strong connections and a strong identity link with the university.

While the founders did not exclude growth, they welcomed it only on the condition that independence from outside shareholders still be maintained. In practice, however, they recognized that they were not adopting a proactive marketing strategy. Rather, they concentrate more on technical issues than on commercial ones. As one founder said, Streamco' main investment was in its laboratory, because "that is the heart of the firm." In 1999, Streamco, which started with three founders, had fifteen employees. Its original capital of EUR 31,250 grew to EUR 250,000 by internal financing. One founder commented that the reason for increasing the capital to this level, was that it was the minimum required to be able to bid for certain governmental projects. This example again illustrates the closed ownership mode of governance at the heart of this type of firm and the priority of independence over growth.

4.1.2 Analysis of the firms not following an SME model

The firms categorized as outliers are described in appendix 6.1.

In only one firm, Eurogentec, I could clearly identify signs of growth orientation, even if they did not impact the organizational format of this company at founding. [35] The founder wanted to create a biotech firm modeled after the leading US biotech companies of the time, such as Chiron and Genentech. This unusual entrepreneurial project in the context of Belgium in the 1980s, can be directly related to the prior professional experience of its founder, Professor Martial of the University of Liege (ULG), when he was an Assistant Professor at the University of California in San Francisco in the late 1970s and early 1980s. Martial witnessed the birth of the biotech industry in California and declares that he wanted to duplicate the model of a biotech firm such as Chiron with which he had collaborated. However, without the context of a developed high tech and entrepreneurial cluster, in particular professional venture

[35] http://www.eurogentec.be/hp/hp.htm

capital and high-tech entrepreneurial expertise, it would prove to be extremely difficult to do.

Eurogentec's story is very similar to the case of Innogenetics, a firm that I did not include in the list above because it is not an academic spin-off firm. [36] It is, however, a research-based firm that is comparable in many ways to academic spin-off firms. Innogenetics was founded in 1985. Its founder, Hugo Van Heuverzwijn also declares that he was strongly influenced in launching his biotech start-up by his working experience with Biogen, a major US biotech firm, including in the USA. Not only did H. Van Heuverzwijn want to replicate the model of American biotech firms, he also wanted to replicate the forms of industry – university collaborations that were common in the USA, but that were unknown in Belgium. Right from the outset, he tried to raise funds from individual investors and from GIMV, the venture vehicle of the Flemish government.[37]

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36 http://www.innogenetics.com/

37 A third biotech firm, Plant Genetic System, which I could not interview because it had been sold in the meantime, also tried to replicate from the start the American model of growth oriented start-up, notably by raising funding from an industrial group and from GIMV

The two firms had in common a strong exposure to the USA and its unique form of entrepreneurship due to the experience of their founders and due to the nature of their business. Indeed, the young American biotech industry has been built on start-ups backed up by venture capital.

4.2. How did firms evolve over time?

In this section, I examine how the same firms evolved after founding and what their characteristics were in 1999-2000.

Out of this group of twenty-seven firms founded before 1996, sixteen can still be considered SMEs in 1999-2000, compared to twenty-three that were categorized as SMEs at founding (see appendix 6.2). Thus, the large majority of firms founded as SMEs kept this format over time. Five firms departed from the original SME format: Eurogentec, Icos, Iris, Frontier Design and Netvision. With the exception of Eurogentec, described earlier, they made this choice after a few years under pressure of an external event. In the case of ICOS it was the arrival of a manager from industry. The triggering event at Iris was the interests of a holding company to commercialize the new venture's technology. With Frontier Design it was the partnership with a Belgian working as a Professor at Stanford University. With Netvision, it was the need to finance growth and the choice of going public that imposed standards on the firm in line with the American model of growth oriented technology start-ups.

Specifically, the reorientation of these firms can be linked to some form of exposure to the USA and to its peculiar model of entrepreneurship and of growth firms. For Eurogentec, it was the direct experience of the founders. In the case of ICOS, one founder had experience in the USA. With Frontier it was the connection with the Stanford University professor. In the case of Iris, it was the desire to start a venture capital activity from its investor AVH whose new CEO came from the USA, where he had worked with Bankers Trust. The stock market modeled after NASDAQ explains the link to the USA in the case of Netvision.

Such firms and their supporters were pioneers in many ways. They could not rely on any models to guide them on how to build a growth-oriented venture. In addition, there were almost no competencies available locally to help temporarily. Investors were also pioneers venturing for the first time into the investment of technology start-ups. A number of them retreated precipitously after only a few years. It seems that both entrepreneurs and financiers underestimated the resources needed to grow a technology venture.

As a result, these firms had "several lives." They went through a succession of crises due to a number of reasons: their investors withdrew from the venture capital activity; their business model turned out not to work; they got close to bankruptcy. With an insufficient capital base, firms were vulnerable to any disruption in the market; some merged unsuccessfully, or were acquired. Management bought out the investors who grew impatient and had lost hope in the future of the firms.

4.3 Conclusions

The interest of studying characteristics of spin-off ventures created prior to 1996, is to highlight that the dominant archetype at founding of new venture among academic spin-off firms was the SME model. Academic spin-off firms tend to be founded with the minimum legal capital. The qualitative data from interviews suggest this is not due only to the lack of risk capital available but because the founders created their firm as a substitute to a job and wanted to maintain their control. Occasional small outside funding provided by universities did not change the "SME character" of the firms because it was a fairly passive and did not pressure founders to pursue more ambitious projects and adopt a more growth-oriented approach. This analysis thus shows how the SME model of venture was dominant and its corollary how the growth oriented model of venture and of entrepreneurship was new, even in the mid-1990s.

5 DATA ANALYSIS OF FIRMS FOUNDED IN 1996 AND LATER

I gathered data on twenty firms founded between 1996 and 2000 and examined their characteristics at founding using the same criteria as for firms founded prior to 1996.

Table 6.2 - **Coding of founding characteristics (1996 and later)**

Firm	**(1)**	**(2)**	**Capi -tal**	**Owner-ship Structure**	**Mana-ge ment**	**Indica-tions Of Growth**	**Type at founding**
Optidrive	1997	KUL	1	2	1	1	SME
Optimal De-sign	1997	RUG	1	1	1	1	SME

Firm	(1)	(2)	Capi -tal	Owner-ship Structure	Mana-ge ment	Indica-tions Of Growth	Type at founding
Oligosense	1998	UAI	1	1	1	1	SME
Lambda X	1996	ULB	1	1	1	1	SME
Lasea	1998	ULG	1	1	1	1	SME
Unisensor	1998	ULG	1	1	1	1	SME
Horpi sys-tem	1999	ULG	1	2	1	1	SME
Micromega	1999	ULG	1	2	1	1	SME
Elsyka	1997	VUB	1	2	1	1	SME
Septentrio	2000	IMEC	3	3	2	3	VC backed
Coware	1996	IMEC	3	3	3	3	VC backed
Fillfactory	2000	IMEC	3	3	3	3	VC backed
CropDesign	1998	VIB	3	3	3	3	VC backed
Metis	1998	KUL	2	2	1	2	Prospector
Metris	1999	KUL	2	2	1	2	Prospector
Ansem	1998	KUL	2	2	1	2	Prospector
Eyetronic	1998	KUL	2	2	1	2	Prospector
Telemis	1998	UCL	3	2	2	2	Prospector
Octalis	2000	UCL	2	2	2	2	Prospector
Mithra Pharmaceut-ical	1999	ULG	2	2	3		Prospector

.(1) Founding date
.(2) Academic institution

Of the twenty firms, nine are ranked as technology SMEs and eleven are ranked as growth-oriented firms. Of these eleven, four closely replicate the venture capital-backed model of growth-oriented firms. Seven firms present moderate growth orientation and intermediary characteristics. I propose to call this group prospectors.

5.1 SMEs

Of the nine SMEs, five had all four characteristics selected as representatives of SMEs and three had three characteristics out of four. In all three cases, the characteristic missing was the closed ownership structure, because the ventures benefited from funding from their academic institution. This did not, however, affect their character of SME, because the funding source was fairly passive. The availability of external funding by academic institutions is characteristic of the period of 1996 to 2000. I provide an example of SME founded after 1995 in appendix 6.3.

5.2 Venture capital–backed firms

A change comparing to the preceding period is that eleven firms were founded with signs of growth orientation. Four of them had clear signs of high growth orientation. They also exhibited a high initial capitalization of EUR 1 million or more. Their ownership structure was opened and their investors included venture capital firms. Finally they were launched with experienced management to lead them. These ventures followed closely the venture capital backed model of a firm that is familiar in the USA, particularly in its developed high tech clusters of Boston and Silicon Valley.

Fullsoft provides a good example of such type of venture. [38] It was founded in October 1996 by researchers at one of specialized research institutes. Fullsoft provides tools for hardware and software co-design that cuts overall cost and integrated circuit design time in half the time required by traditional design methods, and speed new products to market. Before formally starting the firm, the founders cultivated their technology and their business idea at their research institute for one year. While still working on their research projects, they prepared their firm's launch by developing their technology and studying their market.

The research institute supported their project notably by providing external consultants from the USA, helping them to raise funds, providing their first client, and, overall, providing credibility. Thanks to this incubation period, the firm started with a product

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[38] The names of the company and of its founders was altered in order to maintain anonymity

and a client. "Right from the beginning in 1996, we wanted to become big," said a founder. The firm raised an initial round of capital of EUR 4 million from two local and one American venture capital firm. In 2000, it had capital of EUR 14 million. Although this project of becoming big quickly "ran against the Belgian culture," the founders believed in it because of the role models provided by firms in their sector and because of the need to have a critical size to deal with their clients, which are typically multinationals such as IBM and Matsushita.

The research institute also pushed the founders to opt for an ambitious entrepreneurial project. Early on, the firm established a presence in Silicon Valley, in a move to immediately become a "born global" venture. Experienced managers were hired in the USA, notably with the help of the American venture capitalist. The firm adopted a product orientation right from the start. This did not rule out consulting, but consulting was conducted "in order to gain the trust of our clients."

We find in Fullsoft's example the characteristics highlighted in the coding. The venture was started right away with more than EUR 1 million of capital provided by professional venture capitalists. It had from the beginning an experienced management team alongside scientists and it exhibited a very high growth orientation.

5.3 Prospectors

Seven firms presented moderate growth orientation, but characteristics that were different from venture capital-backed firms and from SMEs. Six out of seven had an intermediate capitalization that represented a multiple of the minimum legal capital that SMEs generally start with and that was generally in the range of EUR 200,000. Only one firm had a higher capitalization than EUR 1 million. Its ownership was open, to at least one outside investor, who would typically be not a professional venture capital firm but a fund created by the academic institution from which they were spun off. All firms presented this characteristic. Similarly to SMEs, however, those ventures were started by a team of academics with a technical background. The founding team would either include no business experience, or only minor experience. This was the case of six firms out of seven. Founders would exhibit moderate growth orientation, but growth would not appear as a major priority in the short term. This was the case of six firms out of seven. I did not have enough information to code one firm with enough confidence.

I believe that this group represents a distinct type of venture that I propose to label "prospectors." They were spun-off from academic institutions at an early stage when their founders only had a vague business model and when their main asset was some scientific knowledge. They may be typical of growth-oriented ventures spun-off from academic institutions in environments where there is no entrepreneurial community to support them and where academic institutions have no incubation capabilities.

Magnes was founded in May 1998 by two researchers from a lab of University Y, which specializes in the generation and use of high magnetic fields for scientific experiments. [39]Magnes builds on this expertise to produce industrial magnetizers.

While the two founders were still researchers, people in industry regularly asked if they would sell equipment similar to that which they had created for their research work. They could not do this within the context of the university, but it triggered the idea that they might be able to do it in the context of a firm, especially

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39 The names of the company and of its founders was altered in order to maintain anonymity

since their employment contract at the university was about to expire. Around the same time, they read an article in the university newspaper about spin-off firms and the resources of the university's industrial liaison office to support such initiatives. 1997 coincided with a change in policy at University Y from a passive support to academic spin-off firms to an active support. It translated among other things into the creation by University Y with financial partners of an investment fund, the first early stage investment fund created by a Belgian university to finance academic spin-off firms.

The pre-founding period lasted from the spring of 1997 until May 1998. Once the founders started exploring the idea of forming a company in 1997, they met with the industrial liaison office of their university, which reacted very positively and encouraged them do more "homework" by following a template of business plan that it provided. They went back to the industrial liaison office in October 1997 and were given useful support, which helped them elaborate upon and consolidate their business plan, according to the founders. In coordination with the investment fund, this development forced the founders to enlarge their focus beyond the scientific lab market and into the industrial market.

Magnes was founded with EUR 200,000, a higher capitalization than the typical EUR 62,500 of SME firms. The founders each invested EUR 12,500, which represented an important financial effort on their part, while the balance, 75%, was provided by the University and the investment fund. In addition, they were awarded 1,000 shares out of 2,500 of a special category of shares ("founders' shares") for their contribution in setting up the project. Furthermore, the founders were given an option to buy out Leuven R&D in the future, which would give them the opportunity to eventually own the same stake in the firm as the investment.

The board of the company is composed of the founders, a marketing professor from the university and a professor of management of technology representing the industrial liaison office and thus the university, and a banker representing the investment fund. [40] The capitalization is higher than that of the traditional SME and the ownership structure is more open. The attitude or the culture of the founders is also radically different. In contrast to the founders of technology SMEs, for instance, who were opposed

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[40] The shareholders of the fund are the university and two local banks.

to outside investment, the founders of Magnes declare that, without the industrial liaison office and the investment Fund they could not have realized their project and they certainly could not have concretized such an ambitious one. Interestingly, they stress the contribution of Leuven R&D and the Gemma Frisius Fund not only in terms of provision of capital, but also in terms of advice and valuable introductions in industry.

The firm is composed of the two founding scientists. Thus, like SMEs the management structure is quite weak. However, their culture is completely different from that which I described in founders of technology SMEs. The founders are aware of their lack of experience and are eager to learn from outsiders. They cite the contribution of the university, in particular the industrial liaison office and the representatives of the investment fund who sit on their board and serve in an advisory capacity. They do not exclude outside capital. At this stage, they actually do not need a larger or more comprehensive team, since they are still primarily in a learning phase. Indeed, they are engaged mostly in market exploration and product development. They also try to define clearly what their product line needs to be. It seems that their shareholders realized this and gave them until early 2000 to go through this stage.

The product and market focus are still vague because of the early stage of the firm and the learning process, which consists largely of learning by experimentation.

In terms of business model, Magnes' founders, like so many academics turned entrepreneurs, initially wanted to be a consulting firm. However, they quickly changed their mind because, during the pre-founding incubating period of 1997–98, they realized that firms which have problems with magnetic issues want a piece of equipment to solve them; consulting alone is inadequate to meet their needs. The founders also realized that consulting, with training and follow-up on problems, grows as a byproduct of selling equipment. Clients who order big pieces of equipment want consulting along with their purchase, or capital investment.

Until the time of the interview, they have been doing either consulting or they have produced tailor-made equipment, but they realize that they need to start producing small batches of equipment in order to gain economies of scale and increase leverage. They envision that they will reach this stage in one to two years perhaps. Ultimately, their aim is to produce a large series of small equipment. Further, they believe that having a line of products provides legitimacy.

The founders' initial model was one of a small firm with a couple of employees. Initially, they also targeted the academic market, because "this is the one we knew the best." While working on their business plan, however, the people from the industrial liaison office and from the investment fund pointed out that this market was too small and pushed them into targeting the industrial market instead. The founders acknowledge that without the industrial liaison office and the investment fund, they would have pursued the academic market and would have developed a less ambitious business plan.

One of the ideas of their business plan is to grow incrementally, first locally, then more internationally. It is important, they realized to build an industrial track record before approaching bigger clients and entering the industrial market more aggressively. The academic market thus became no longer an end in itself, but a step towards gaining entry into the industrial market. They learned in the process that almost all of their competitors were active in either the scientific market or the industrial one, but that few, if any, crossed the border between the two. They see this interstitial area as a potentially rich area to exploit.

One way they tried to penetrate the industrial market was by talking to lead users and learning about their needs. This is an idea that the professor of marketing sitting on the Magnes board introduced. The incremental growth strategy from the local market towards the international market indicates the founders' international orientation, even if it is only potential at this stage. Their attitude is very different from founders of traditional SMEs, who tend to be happy with serving the local market.

The example of Magnes highlights that it is different in many ways from SMEs in that it wants to achieve more than being a small boutique, growth is not a priority and it is not even something that the firm can achieve, because it was started with such a narrow asset base. The founders' only asset is their scientific knowledge. Since the founders have no business experience, since there are no entrepreneurial competencies available in their local environment and since the university is supportive, but does not have much business coaching capabilities to offer, the founders have to learn most business knowledge by themselves by experimenting. They need to learn basic business skills and they need to refine a viable business plan. This way of building knowledge is slow, as their investors seem to have understood when they gave them two years to experiment.

Image ware provides another example of a prospector that is a little different, because it is more aggressive. [41] However, we find the same strong characteristic of exploration by trial and error in the absence of entrepreneurial competencies in their local environment from which they can borrow. Image ware was founded in 1998 by two researchers of the Department of Electrical Engineering of University Z. Image ware specializes in high-quality 3D acquisition systems that use low-cost, off-the-shelf hardware components.

The origin of the firm is a breakthrough achieved by one of the researchers in 1996 when he managed to develop an algorithm to overcome the practical obstacles to implement a well-known theoretical concept for 3D acquisition. The two researchers decided in 1996 to launch a firm to commercialize this know-how. They

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[41] The names of the company and of its founders was altered in order to maintain anonymity

managed to negotiate the exclusivity of the license owned by the university. They finally started Image ware in 1998. They invested themselves in the firm, along with the professor who heads the department, and the university's investment fund. In total, Image ware started with EUR 275,000. Its management team was composed of four engineers. The father of one researcher, who had a background in finance, worked part time in the firm to "take care of management."

From the start, Imageware' technology was awarded a number of prizes by industry bodies. Through these awards, Image ware was brought to the attention of an American media company, which challenged Image ware to capture a moving actor with a triple setup of cameras, something that had never been achieved before and that the American company only planned to developed in 2000. Image ware met the challenge successfully and was offered an office in Los Angeles.

Although Image ware had an excellent technology-base, it would need to do a great deal of learning in terms of market research and business strategy before being able to translate the advantages of its technology into growth opportunities. Indeed, probably based on the enthusiasm generated by their technology, Image ware' founders first thought that there were numerous markets for their technology, including realistic character generation for games, high-end special effects for the movie industry, consumer-oriented products (such as low-cost sculptures of people), reverse engineering for manufacturing, medical applications, and especially e-commerce imaging.

In reality, they found out that the potential was more limited. One of the members of the founding team explained that they expected to be able to enter various markets, but realized after a while that "not everybody was ready yet" for their technology. The main disappointment came from what seemed to be the most promising market: Internet and electronic commerce. Eyetronic had made an alliance with a computer manufacturer to penetrate this market. It turned out that electronic commerce companies were not much interested in 3D images for their web sites. Besides, their use turned out to raise technical problems due to the large size of these images and to the limited use of broadband Internet connections. As a result of this experience, in 1999, Image ware had to refocus its strategy and decided to concentrate on television and video games. It also decided not to pursue opportunities in the medical sector but to sign, instead, an agreement with an American university to use its technology in this area. In the absence of coaching and of management input, the founders thus made progress by trial and error.

At the time of the interview, in mid 1999, the founders said that they needed more capital and it was much easier to obtain funding than in the past. They stressed, however, that they were taking their time to raise more funds because they wanted to carefully choose their investors in order to stay in control of the company. In late 1999, Eyetronic raised its capital from EUR 275,000 to EUR 1.7 million by raising money from undisclosed sources. Before the increase in capital, the board of directors only included the two founders and a Professor from the university. At the end of 1999, the company had a staff of eleven people and revenues of EUR 425,000.

Imageware' case reflects the attributes of prospectors stressed earlier. A smaller starting capitalization than venture capital firms in the range of EUR 200,000 to 300,000; a university fund as outside investor; an inexperienced management team; and moderate signs of growth orientation.

Without incubation or support from an entrepreneurial community, founders who adopted a growth orientation and tried to build a firm beyond a small boutique needed to use a transitory business model as their main way to complement their scientific expertise with market knowledge. They needed to learn both basic business and management skills, as well as to develop distinctive competencies that would allow them to build a competitive advantage. It presented the challenge of operating as a business, while at the same time performing a great deal of development work. With few models or templates available, they needed to experiment by themselves, for instance, with refining their product, with selecting a market niche, and with finding a viable business model in general. Their learning process was characterized mainly by experimentation. This is in contrast with ventures founded in a developed entrepreneurial context, which could learn more by borrowing from existing templates that circulate through service providers (Suchman, 1994, 2000; Hellman, 2000) and personnel mobility (Lee et al., 2000; Saxenian, 1994).

6. TYPES OF VENTURES AND THE SPIN-OFF PROCESS

The detailed analysis of cases of spin-off ventures, such as those presented above reveals that different types of firms were spun off by different types of academic institutions and followed different processes. Venture capital backed firms were spun off from specialized research institutes, after a long process of incubation, while SMEs and prospectors were spun off from universities at a very early stage without incubation and even little business coaching.

6.1 Venture spun off from specialized research institutes

In chapter 5, I underlined that IMEC and VIB distinguished themselves by organizing research which was strongly oriented to industry, technology valorization and transfer; they also had a spin-off process characterized by high selectivity and high support under the form of a lengthy incubation. The objective of these two research institutes was to spin off ventures that would be eligible from the outset for venture capital. Indeed, these research institutes did spin-off the only venture capital backed businesses in my sample.

The firms spun off by IMEC pursued commercial opportunities with high potential and closely replicated the US model of venture capital backed firms. The characteristics of the ventures can be related to the characteristic and the policies of the research institutes. They were selective in the choice of spin-off projects. They only chose the technologies that they expected had the most commercial potential. Once a promising technology was identified, the research institution "incubated" commercially the project for twelve to fifteen months in different ways. In the case of Fullsoft, described above, it allowed the team of scientists to refine its technology within the Institute's lab. It helped with the intellectual property management and with the business plan. The research institution hired consultants to assess the market potential and other issues.

In the case of other IMEC and VIB spin-offs, the research institutes hired outside managers with domain experience. This incubation allowed firms to approach the financial market at a more advanced level of development than academic spin-off firms and directly approach venture capital firms that do normally not finance early stage ventures. This was true in the late 1990s as long as the financial markets were strong. Starting in 2000, this strategy became more difficult, at least for IMEC, as will be discussed in a later section below.

6.2 Firms spun off by universities

Chapter 5 stressed that universities, with much less capabilities in research valorization and in support for entrepreneurship, tended to spin-off ventures at an early stage of development. Firms spun-off at an early stage became SMEs or prospectors.

Traditional universities had fewer incubating resources than IMEC and VIB and much less supportive networks. They were, in the late 1990s, only starting to build their research valorization capabilities. However, risk capital for academic spin-off firms had suddenly become abundant and universities were under pressure to commercialize their research. They may also have anticipated the additional income that IPOs of successful academic spin-off firms could provide (Debackere, 2000: 323). With relatively few entrepreneurial projects being submitted by their academics, universities were more concerned about generating spin-off ventures than about selection. With their lack of experience, universities may have underestimated the difficulty of "growing up" a technology venture. This is what IMEC said about its early experience in the 1980s and early 1990s. It may be especially the case in the context of the "irrational exuberance" of the technology boom of the late 1990s. Thus, with little business support to offer, universities spun off ventures at a very early stage of development, when their main asset was some form of scientific knowledge, but without a concrete idea on how to commercialize it and turn it into a viable business model.

The ventures could have spent their funding to build a plan for a viable business: perform product development, conduct market studies, and build a prototype (Roberts, 1991: 126). However, this was not an option, because the founders were scientists without business experience or a sense of the market. They could not draw help from their university sponsors nor from a community of technology entrepreneurs, because it did not exist. In addition, universities and their financial partners required quick, positive cash flow and did not allow ventures to "burn" their initial funding in order to reach the stage where they could show, for instance, a prototype and a market study showing the relevance of their business model to raise another round of funding. As a result, as ventures were spun-off and funded at an early stage, the only option of founders was to adopt a transitory business model that would provide revenue and experience. This transitory mode generally consisted of performing contract-based work, often in the form of consulting, that was a close extension of the commercial work they had performed in their lab.[42]

Some ventures never intended to go beyond the stage of contract based work of a small boutique. Of the twenty firms in my sample that had been founded after 1995, nine illustrate such cases that are similar to traditional SMEs. Outside funding from a university was still fairly passive so that the main drive of these ventures was the personal lifestyle motivations of the founder(s). Growth orientation was either rejected by these founders because it conflicted with their lifestyle objectives, as with Elsyka (see appendix 6.x), or it was not considered because of the lack of infor-

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[42] Segal Quince Wicksteed (1990), who studied the technology cluster around Cambridge University call this a "soft start."

mation and concrete competencies to implement such a project, as other cases suggest

However, as some universities, in particular KUL, and their partners gained a little more experience in spinning off ventures, they put more pressure on founders to pursue more ambitious entrepreneurial projects consisting of targeting greater business opportunities. [43] Also, increasingly, founders themselves would spontaneously choose to go beyond the small boutique model, as the growth-oriented model of venture diffused, although they did not have much knowledge on how to do this.

As the examples of prospectors reviewed above illustrate, they need to go through a "gestation period" of experimentation that can sometimes last a few years. This is why I propose to label these ventures "prospectors." During this period, ventures do not appear very different from traditional SMEs for an outside observer. The difference lies primarily in the attitude of the founders. For founders of ventures following a prospector model, the transitory contract-based business model is treated as a learning opportunity, whereas for SME founders, it is an end in itself. Therefore,

[43] Source: 1999 interview recording of M. Hinoul and K. Debackere from KUL's LRD by B. Surlemont and F. Pirnay

SMEs and prospectors may not be easy to distinguish, especially at their early stage without rich qualitative data collection and analysis. A challenge for founders of prospectors is not to fall in a "consulting trap," i.e. become complacent with the consulting, small boutique mode (Roberts, 1991).

7. DISCUSSION ON THE MODELS OF SPIN-OFF VENTURES

I propose that the prospector model of venture is typical of growth-oriented academic spin-off firms that emerge in environments such as like Belgium. When new financial resources are available for spinning off ventures from academic institutions, when the latter do not have developed research valorization and/or entrepreneurial coaching capabilities, and when there is no strong entrepreneurial community, entrepreneurs need to experiment a great deal. They cannot borrow existing knowledge under the form of ready-made templates because entrepreneurial competencies are still so scarce in their environment. As a result, they need to go through an intermediary period of gestation consisting of building-up skills and developing a valid business model.

I also propose that prospectors are more representative of academic spin-off firms and research–based ventures in general. Indeed, innovative technologies seldom have a clear market waiting for them. Sometimes they even need to create their own market, which can take years. We may underestimate the fact that the firms spun off by IMEC and VIB were based on the exploitation of technologies that had been in development for years with considerable financial resources. The time between the completion of an innovative product development and the beginning of substantial sales can be fairly long for high-tech products (Kohli et al., 1999).

Thus, an initial gestation period is, and will be, the main source of knowledge building for founders of spin-off ventures given the context and the nature of innovative technologies that they are trying to commercialize. The need to grow fast early on may have been overplayed by the hype of the late 1990s, the Internet boom in particular, and by the growing role of venture capitalists for whom time is of essence in determining their return on investment (Freeman, 1996). There is danger in skipping the gestation period. When important resources are devoted early on to a course of action, it may be difficult to back away in case of misjudgment, or at least the opportunity cost may be high.

Debackere (2000: 327) supports the view of the merit of learning by doing in what I call the gestation phase. Spin-offs should develop both 'focus' as well as 'complementary activities' as soon as possible in their life cycle. Moving from a business plan to a business model is therefore critical. It helps the companies to generate cash flow and to develop a unique value network that attracts customers as well as potential partners and investors. The development of complementary activities further allows spin-offs to adapt their behavior to their newly discovered market environment. As they develop these complementary activities, they learn by doing. This learning while experimenting 'with' and 'in' the market is more valuable than any well-developed and long studied business plan. It actually helps to modify and to grow the business plan into a business model.

This is not to say, however, that this period could not be shortened. The direction in which KUL's LRD is moving indicates a possible way to do this. In 2000, after the burst of the technology bubble, LRD started to realize that it was increasingly difficult to obtain from the Gemma Frisius Fund, which it had created with two banks, valuations of EUR 200,000 to 370,000 for spin-off projects coming out the lab without a clear business model and no proof of concept. As a result, LRD started to incubate spin-off projects within its own structure, before the projects were incorporated into a firm, with small seed investments in the range of EUR 30,000 allowing the candidate founders to build a prototype, to conduct a market study, or do other forms of concept testing. This process allows the founders to approach the Gemma Frisius Fund with more proof of concept and a more tested business plan that justifies the value of its investment.

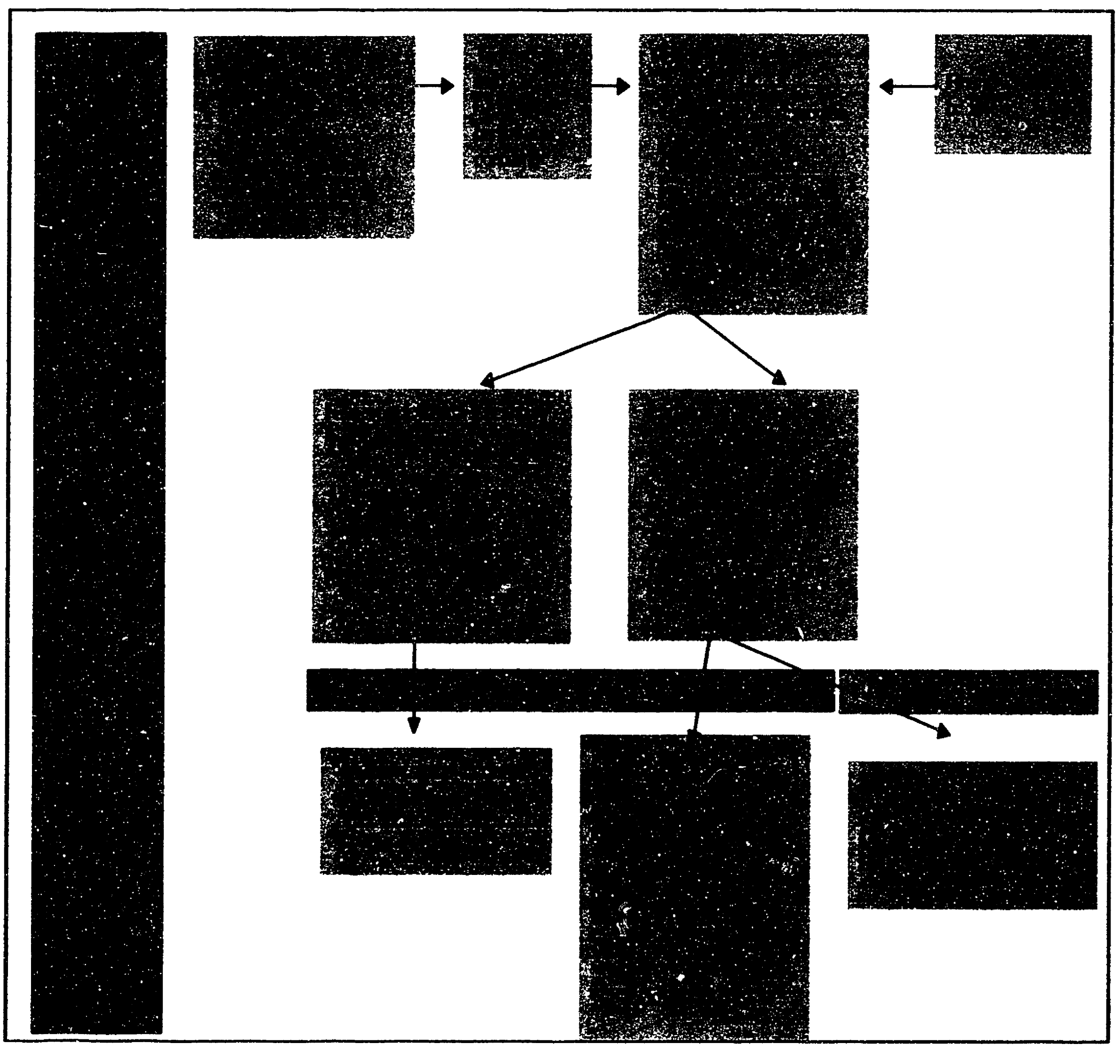
It is likely that universities and their partners will become increasingly selective, putting pressure on spin-off ventures to pursue more ambitious opportunities; while the SME model of venture will become harder for founders to justify. On the other hand, the model pursued by IMEC and VIB, spinning off ventures that immediately qualify for venture capital, also hit its limits with the burst of the technology bubble. After some spin-off projects were turned down by its usual venture capital partners, IMEC's administrators admitted that, besides "IPO driven" spin-offs, there were "niche players," whose exit was more likely to be an industry sale.

The common trend in the cases of the latest developments at KUL and IMEC is the recognition of the importance of the seed stage in the founding process of academic spin-off firms, which had been overshadowed by the particular context of the technology bubble of the late 1990s. I would argue that we can frame these data as the replacement of one model of entrepreneurship by another. The traditional model, embodied by the examples of the majority of firms founded prior to 1996, was an "entrepreneur-induced model of entrepreneurship." Firms were founded by entrepreneurs following their own particular motivations related to lifestyle choices (Timmons et al., 1992: 9), among which substituting for a job was one of the most common. The organizational model of venture corresponding to this model of entrepreneurship was the small business, or SME. The dominant concern in this model was the independence of the entrepreneur. In the late 1990s, following the changes described in the previous chapters, a new "investor-induced" model of entrepreneurship was promoted with its related model of growth-oriented venture, following the increase in availability of risk capital; this reflects, more generally, the diffusion by replication of an American model of entrepreneurship. I call this model investor induced, because most its characteristics are related to the presence of external investors and to meeting their interests. For instance, the focus on growth is so central to these models because time determines the rate of return of investors (Freeman, 1996).

CHAPTER 7: DISCUSSION AND IMPLICATIONS

1. SUMMARY OF FINDINGS

Figure 7.1 Summary of findings



In this thesis, I examine how spinning off new ventures from academic institutions in an environment outside developed high tech clusters affects models of ventures. I begin this chapter by summarizing my findings. In the second section, I discuss the contributions of this thesis, orientations for future research and practical recommendations.

1.1. Interest in spinning off new ventures from academic institutions in Belgium is recent and policy driven

I found that, prior to the late 1990s, there was little interest in spinning off ventures from research institutions. Academic organizations did not consider technology transfer from academic institutions for commercialization as part of their mission. Governments did not incorporate this method of technology transfer in their policies. Risk capital was scarce and there was no entrepreneurial community to support academic spin-off ventures. The dominant model of new venture was the SME; growth-oriented models of venture and entrepreneurship were unfamiliar.

Thus, spinning off new ventures from academic institutions began recently. I found that, starting in the mid-1990s, interest in spinning off ventures grew as a primarily policy-driven phenomenon. I believe that the sudden interest in spin-off ventures from academic institutions is related to the growing awareness that the world is moving towards a knowledge economy with the related imperative of technology innovation. In the mid-1990s, the creation of stock markets modeled after NASDAQ and the successful IPOs of a few local science-based ventures in Belgium validated entrepreneurship as a mode of technology innovation; this triggered policy initiatives in favor of spinning off ventures from academic institutions. Entrepreneurship became part of new STI policies.

1.2. Policies consisted of replicating elements of advanced high tech entrepreneurial clusters

Supportive policy initiatives from governments and academic institutions multiplied rapidly between 1995 and 2000. They can be seen as the replication of elements of environments that are supportive of technology transfer and entrepreneurship, mostly inspired by the success of high tech clusters such as Boston and

Silicon Valley. These initiatives replicated laws and regulations regarding transferring ownership of results of publicly funded research to academic institutions and allowing the use of stock options. They also included the creation of new academic institutions with a strong mandate of technology transfer. Subsidies were also given to traditional universities to create a technology transfer infrastructure, including support for spin-off ventures.

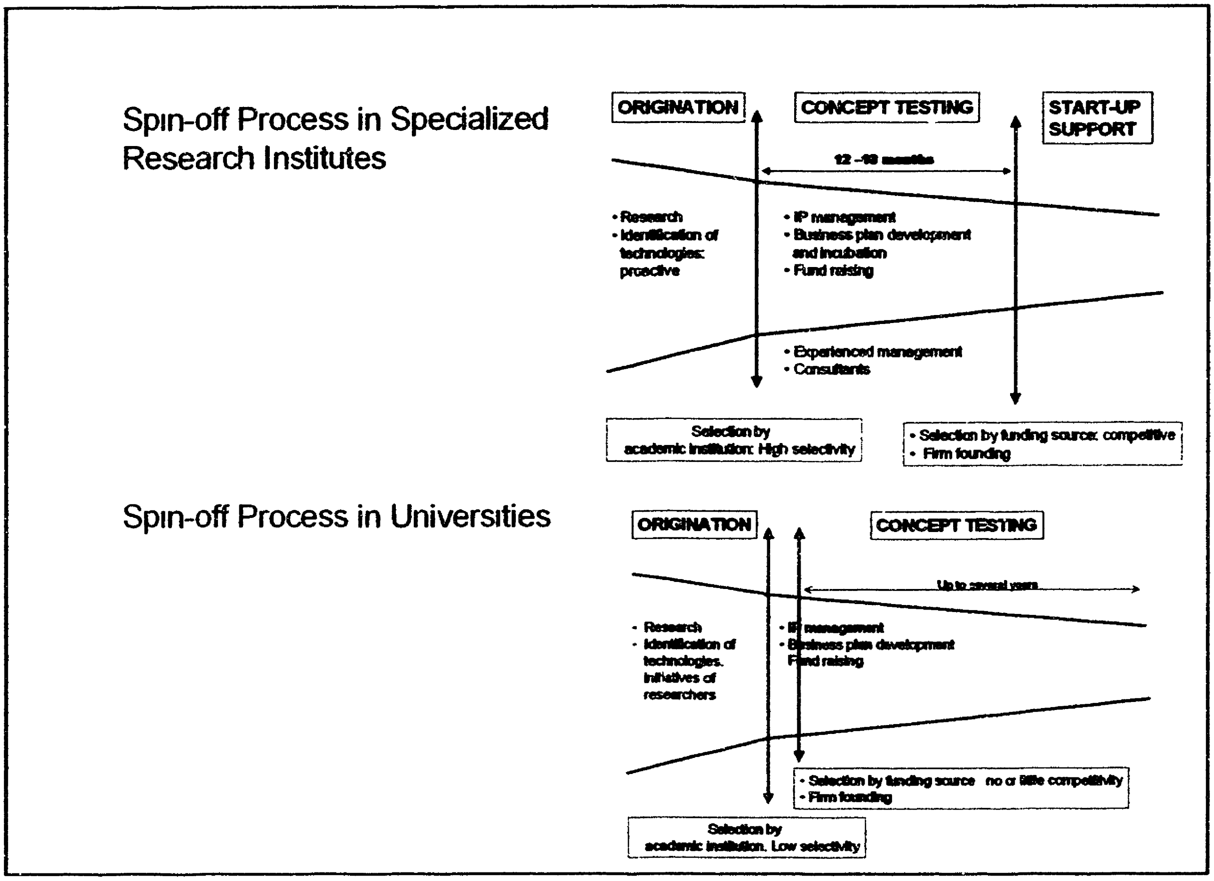
Capital markets of supportive entrepreneurial contexts were also replicated. For instance, a stock market modeled after NASDAQ was created. When strict replication was not feasible, substitution with local equivalents occurred. In the absence of early stage, informal venture capital from "friends and family" and "business angels," university seed funds were created as a substitute. The weakness of venture capital was also compensated for by public venture capital. Within five years, more than EUR 40 million was made available to finance spin-off ventures.

Limited attempts were made at replicating the networked social structure supportive of high tech entrepreneurial activities or at substituting the structure with local equivalents. One exception was the efforts of KUL and IMEC to create the entrepreneurship forum "Leuven Inc." In terms of networking capabilities, a few public or semi-public organizations in Flanders, such as GIMV, IWT, IMEC, and VIB, started to play a role of local intermediary, facilitating the circulation of resources and knowledge. GIMV, IMEC and VIB also provided links to developed high tech clusters, which helped diffuse the unfamiliar model of growth-oriented entrepreneurship.

I argue that replication involved mostly "concepts," such as venture capital funding or models of academic institutions oriented towards technology transfer, but did not involve replication of operational resources to put these concepts to work. Operational capabilities to run technology transfer departments within academic institutions, manage investment funds, or support academic spin-off ventures, were largely acquired through local experimentation. As a result, operational capabilities to adjust to new models of technology transfer and entrepreneurship were dependent on local conditions, which explains differences in academic institutions within and between regions.

1.3. Patterns of spinning off new ventures: two archetypes

Figure 7.2. Patterns of spinning off new ventures



The two patterns of spin-off processes coincided with the two types of research institutions. One group was composed of two specialized research institutes in Flanders that were umbrella organizations overseeing various laboratories in microelectronics and biotechnology. The other group was composed of traditional universities.

The specialized research institutes had been created recently by the government of Flanders as instruments of its STI policy with a strong mandate of technology transfer. Their spin-off process included a strong technology transfer unit, proactive technology opportunity search, strong intellectual property capabilities, high selectivity of spin-off projects, business plan development handled by outside consultants and experienced managers, and competitive fund raising exclusively targeted to venture capitalists. Ventures were founded only after a business incubation process of one to one and half years.

In contrast, the spin-off process in universities included technology transfer capabilities that were only starting to be put in place, no active technology opportunity search, weak selectivity, limited business plan development, and less competitive fund raising. Ventures were created without an incubation at a very early stage, when the business model still needed a great deal of development and founders still needed to learn basic business and management skills. Most of the concept testing of the business model had to be made after the firm was founded, during a transitory gestation period.

1.4. Archetypes of academic spin-off firms

What types of ventures emerged in such a context?

Table 7.1. - **Summary of types of spin-off ventures**

	Growth-oriented ventures	Non growth-oriented ventures
Incubation	Venture capital-backed	
No incubation	Prospector	Technology SME

The new resources and support infrastructure put in place in the late 1990s allowed an increase in the founding of academic spin-off firms. A few ventures, spun off by specialized research institutions that benefited from intensive incubation, adopted a high-growth orientation right away, becoming "pure" venture capital-backed firms from the outset. Consistent with the venture capital-backed model, these firms needed to meet specific criteria of very high market potential and fast time to market.

Other ventures spun off by universities at a very early stage could only adopt a basic business model of contract-based work, often technical consulting. Some of these ventures never intended to go beyond this business model and became technology SMEs with no growth orientation. However, increasingly, universities put pressure on founders to move beyond the SME model and pursue opportunities with higher potential. Also, information about the growth-oriented model of venture had diffused in the late 1990s and more founders opted spontaneously for this model.

Increasingly, founders of ventures spun off at an early stage by universities tried to build a firm that was going to be more than a substitute for a job. For these founders, the initial, basic contract-based work represented a source of revenue, as well as their main source of knowledge building. Indeed, given their lack of business experience, without incubation capabilities from their university or an entrepreneurial community to support them, these founders could not borrow much relevant business and entrepreneurial knowledge from their local environment. They had to learn basic business and management skills largely by experimenting. They also had to build distinctive competencies and find a valid business model by trial and error, a slow process. As a result, these ventures went through a transitory, or gestation period, before they could develop a viable business model with high potential and growth objectives. During the transitory period, the contract-based model provided revenue and, if well managed, opportunities to integrate market knowledge into their original scientific knowledge. I label this model of venture "prospector."

2. DISCUSSION

2.1. The emerging nature of the phenomenon

Considerable financial resources and infrastructure were built in Belgium over the last years, but competencies about technology transfer and entrepreneurship were still scarce. Transferring technology from academic institutions by spinning off ventures was new in Belgium in the late 1990s; the growth-oriented concept of entrepreneurship was also unfamiliar. Elements of advanced high tech clusters were replicated, such as venture capital funds and favorable regulations, but replication involved little operational competencies on how to put these elements at work. As a result, academic institutions adjusted to their new mission largely by experimentation.

Similarly, most ventures, when they developed beyond the traditional SME model of venture needed to experiment a great deal with management practices and business models because they could not rely on much incubation; coaching from universities and local entrepreneurial communities had not yet emerged. There were also few interactions among ventures and academic institutions. Therefore, I propose that we can frame the object of the study as an emerging phenomenon. Indeed, as mentioned in chapter 1, in emerging organizational fields, organizations operate in relative isolation and as standards to guide action are not yet clear, individuals and organizations need to experiment a great deal (Aldrich, 1991; Lawrence, 1981; van de Ven and Garud, 1989).

2.2. The need for knowledge creation and circulation

Framing the phenomenon this way highlights the issues of the scarcity of knowledge, knowledge creation and knowledge circulation. Overcoming the lack of operational knowledge about technology transfer and entrepreneurship thus appears to be a major challenge for beginning the practice of spinning off ventures from academic institutions.

Knowledge can be acquired by local experimentation or vicariously by exploitation of existing knowledge (March, 1991). The data show that local knowledge about technology transfer and entrepreneurship is slowly being produced, but, as is typical in an emerging environment, it does not circulate well due to fragmentation. Data also suggest that replication of models of technology transfer from advanced high tech clusters is limited to "concepts," such as venture capital funding or regulations, but involves little to replication of operational knowledge. Therefore, it appears that the further emergence of technology transfer by spinning off ventures from academic institutions requires mechanisms for acquisition and circulation of relevant knowledge. I see three ways to acquire such operational knowledge.

First, create concrete links with developed high tech clusters. Such links have indeed been reported to contribute to the emergence of underdeveloped entrepreneurial regions (Breshi and Malerba, 2001). Concrete contacts are needed with distant, developed high tech regions because knowledge does not travel well and its transmission requires interpersonal contacts (Jaffe, 1989).

Second, establish outside links to other emerging regions, as well as developed high tech clusters. Indeed, starting a cluster is quite different than sustaining an existing one (Bresnahan et al., 2001). Other emerging regions may share common issues with Belgium. Regions slightly more advanced may have recently solved the problems that less advanced regions are confronted with. This commonality faced by regions where technology entrepreneurship is emerging appears every time I address audiences from such regions. A comment I often hear is that the description I give of Belgium is similar in many ways to what people experience in Finland and Italy.

A third way to acquire relevant operational knowledge about technology transfer and entrepreneurship is through production and sharing of local experiences. Successful high tech regions exhibit a high level of embeddedness of local firms in dense networks supporting close social interactions and knowledge sharing and institutions building trust and encouraging relations among actors (Breshi and Malerba, 2001). It is thus important that technical innovation occur within a richly interconnected social structure (Aldrich and Zimmer, 1986; Nohria, 1992: 258). Such exchange of local experiences should also assure that the replication of foreign practices adjusts to local conditions.

Forums, such as entrepreneurship forums, can play a useful role in facilitating interconnection (Kanai, 1989; Nohria, 1992). Intermediaries also play a critical role in helping knowledge circulate in a population of organizations (Suchman, 1994, 2000) and across groups otherwise disconnected (Burt, 1992). For instance, in the emergence of Silicon Valley, lawyers and ventures capitalists played a key role in spreading organizational models and best practices (Rogers and Larsden, 1984; Suchman, 1994). In an emerging entrepreneurial context like Belgium, venture capitalists and lawyers involved with entrepreneurial companies are still scarce, but other actors could possibly play such an intermediary role. As mentioned earlier, some public and semi-public organizations in Flanders already play this role to a certain extent.

My recommendation is thus to promote knowledge creation in technology transfer and entrepreneurship, as well as to create circulation mechanisms in the form of local exchange of experiences and external linkages to developed entrepreneurial regions, as well as other emerging regions.

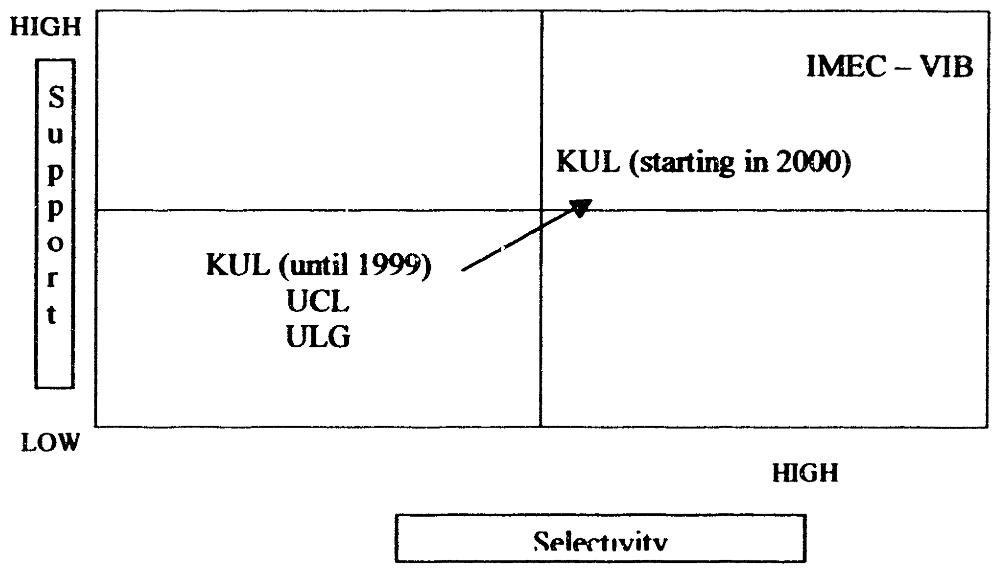
The increase in relevant knowledge about technology transfer and entrepreneurship and the improvement of circulation should also improve the efficiency of financial resources and infrastructure put in place in recent years. Indeed, venture funding, for instance, is only efficiently used if it is infused with sufficient expertise on how to grow a technology start up.

Initiatives to develop external and internal linkages should result in accelerating the local learning process; promoting the institutionalization of roles, best practices and standards; and, thus, contributing to the emergence of an organizational community related to research and high tech entrepreneurship (Suchman, 1994, 2000). This author further argues that the reduction of uncertainties resulting from institutionalization attracts in turn new financial resources and initiates a virtuous cycle contributing to the distinctiveness of the region (Suchman, 1994). The objective should be to reach the stage where these exchanges yield increasing returns and the positive feedback network characterizing established technology clusters (Breschi and Malerba, 2001).

2.3. Discussion on the spin-off process at the level of academic institutions

Roberts and Malone (1996) contributed to the emergent study of academic spin-off policies by framing them in terms of support and selection. They propose that effective policies differed in developed and underdeveloped entrepreneurial environments. As already mentioned, they suggest that effective spin-off policies in underdeveloped environments require high selection and support which translates into strong incubation. The present study agrees with this view. In addition, by looking into the spin-off process within academic institutions in an underdeveloped entrepreneurial environment. I build on Roberts and Malone's view. This thesis shows that only specialized research institutes develop the policies of high selection and support suggested by Roberts and Malone (1991), while universities develop policies of low selection and support.

Figure 7.3. Ranking of academic spin-off policies in terms of selectivity and support

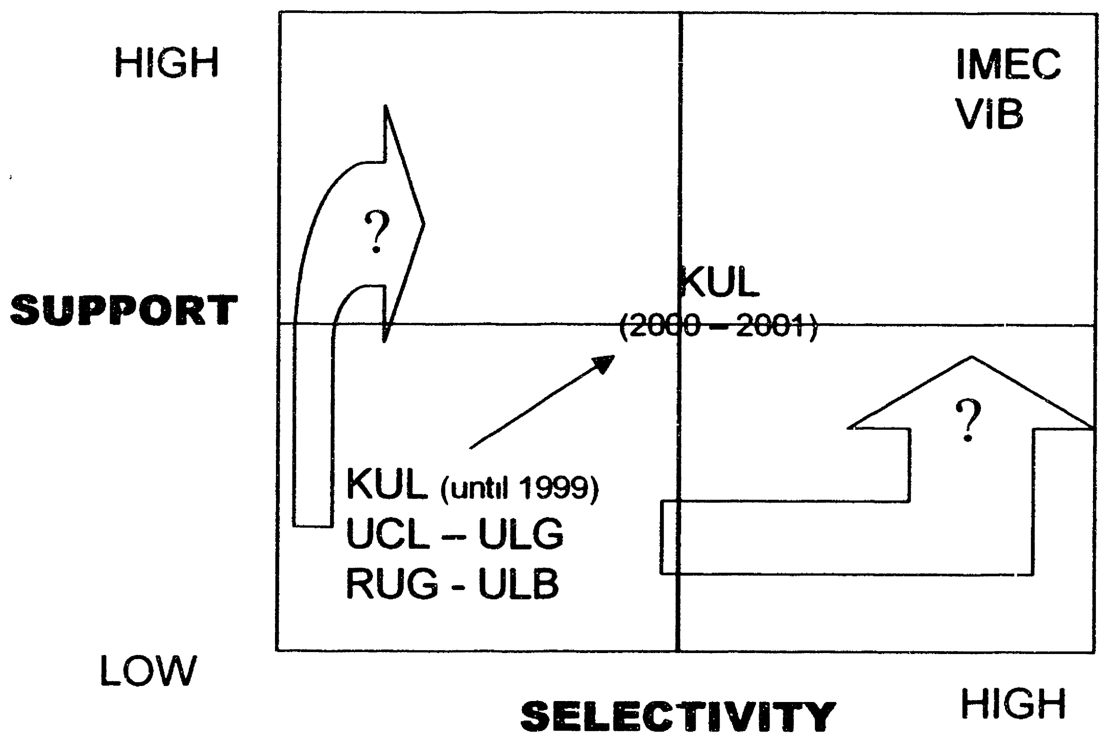


Source Adapted from Roberts, E and D. Malone (1996)

Thus, spin-off policies of high selection and support were developed only in academic institutions with a certain scale in Belgium; the policies appear to fit specialist institutions better than generalists, such as universities. Indeed, the examination of the incubation processes shows a complex, multi-stage process requiring considerable resources, capabilities, and networks. A certain scale, which most universities do not have, is needed to provide incubation.

One university, KUL, managed in 2000–2001 to provide more support and became more selective. Does this mean that it is only a matter of walking the learning curve, that soon the other universities will follow this path towards higher selectivity and higher support?

Figure 7.4 - **Development paths of academic institutions in terms of selectivity and support of their spin-off process**



I doubt it; most other universities are smaller and have a more conventional organization of technology transfer than KUL. None benefit from the nascent entrepreneurial community in KUL's region of Leuven. It is thus likely, in my view, that most universities will experience great difficulties evolving towards higher selectivity and support for ventures by themselves. Given the complexity of the spin-off process and the resources and capabilities that it requires, I would argue that universities should join forces to achieve the scale necessary for high selection and support policies.

The policies followed by academic institutions have an impact on the types of ventures they spin off. In particular, as a consequence of universities spinning off ventures at an early stage, firms could only start operating with a basic business model; they needed to do most of the concept testing after founding. As a result, ventures took the form of technology SMEs or prospectors.

2.4. Discussion of the venture level

At the firm level, this study shows that academic spin-off ventures can cover different realities, from traditional SMEs at one end of the spectrum, to prospector firms, to high growth-oriented, venture capital-backed firms at the other end. This finding is important because it shows that in the early stages of firm formation in emerging entrepreneurial environments the alternative to SMEs is not necessarily the high growth start-up perceived to be the successful model in developed high tech clusters, as implied in the (largely US-based) literatures in organization theory, strategy, and entrepreneurship (e.g. Eisenhardt and Bird Schoonhoven, 1990; Romanelli, 1989). The alternative is likely to be a venture spun off from an academic institution at an early stage that needs to go through an initial, transitory gestation period consisting of building basic business skills while testing viable business models, before it can have growth ambitions; i.e. a prospector firm. I derive from this analysis a number of propositions.

First, the analysis of spin-off processes in academic institutions concluded that most of them followed a policy of low selection and low support. Low selection implies that there will be a high heterogeneity in the quality of spin-off ventures. Low support from the entrepreneurial community means that the main learning process among spin-off ventures with real commercial potential will be experimentation, not borrowing templates of knowledge from their local environment, and will, thus, be relatively slow.

Second, the typical growth model of venture in a developed entrepreneurial cluster, involving phases rapidly succeeding each other (Kazanjian, 1988; Roberts, 1991), does not generally apply in an emerging entrepreneurial context such as Belgium. In a context with founding teams with low business experience, academic institutions with weak incubating capabilities, and an absence of entrepreneurial community, we are more likely to witness an initial transitory phase before ventures can have growth ambitions.

My third proposition is that the particular growth path of prospectors, characterized by a slow start, may also be related to the particularities of research-based ventures. Innovative technologies require long development sometimes and often do not have clear product applications and identified markets. Some even create entirely new markets.

Fourth, this prospector model of venture may be or may become the most common model of growth-oriented, science-based venture emerging in underdeveloped entrepreneurial contexts, such as Belgium, where founders have little or no business experience, academic institutions have little or no incubating capabilities, and entrepreneurial communities are weak.

My fifth proposition is that it is more important for prospectors to succeed in their transitory phase than to grow fast early on. In order to do that, they must first operate for a period as a business and as a project developer. Second, they need to avoid falling into a "consulting trap," whereby their founders feel comfortable operating as a small "boutique" and forego a more ambitious project.

The sixth proposition is that, in this prospector model of venture, the absence of pressure, notably from venture capitalists, to grow at all costs may represent an opportunity for these ventures to gradually incorporate specifications in their product that meet customer needs and progressively adjust their business model until they find the best one. This way, they incorporate market knowledge, based on real experience, to their original scientific competencies, not a priori assumptions of a business plan. Such a gradual process is easier to adjust or even reverse if at some point a wrong choice is made or if market conditions change, than in the case of ventures, which adopt early on a high growth model funded by venture capital. In this model, high sunk costs makes it difficult to change a course of action. A well-managed transitory period could represent a stronger basis for building a sustainable business in the long run than a model focusing too much on high growth early on, especially for research-based ventures. It would also allow founders to create and capture more value themselves and abandon less to venture capitalists.

Seventh, we should broaden the perspective on academic spin-off ventures beyond their ability to grow and examine what other valuable roles they may play, particularly those that do not grow. Mustar (2001), for instance, suggests that academic spin-off ventures' main function is to be conduits between public research and established firms.

2.5. Contributions to research

This thesis contributes to the nascent research on the phenomenon of spinning off ventures from academic institutions in environments other than advanced high tech clusters. First, by looking into the spin-off process and identifying steps that it involves untangles the phases composing the spin-off process and highlights that a comprehensive proactive spin-off process requires considerable resources and capabilities, necessitating a certain scale on the part of the institution conducting it. Second, the thesis contributes to this new body of research by proposing two archetypal spin-off processes. Third, it provides insights about possible links between spin-off processes and the forms spin-off ventures adopt at early stages. Finally, it proposes that academic spin-off ventures represent various realities and that three archetypes of ventures can be distinguished. In particular, it shows that growth oriented ventures do not necessarily take the form of those commonly seen in advanced high tech clusters which exhibit a high growth orientation from the start.

At a more theoretical level, this study illustrates aspects of Westney's (1987) argument on the replication of foreign organizational models, which I presented in chapter 1. In particular, Westney proposes that replication is always partial in part because information about the original model is always incomplete. The case examined in this thesis supports this assertion. It provides an interesting insight in proposing to distinguish between knowledge about the foreign organizational concepts and operational knowledge necessary to put such concepts at work.

Acknowledging the emerging nature of this phenomenon addresses the lack of operational knowledge about technology transfer and, especially, entrepreneurship's impact on growth opportunities of academic spin-off ventures. This analysis complements existing explanations for why technology ventures do not often grow outside developed high tech clusters. Some attribute the problem to institutional factors, particularly "structural deficiencies;" i.e. problems such as tax disincentives or regulations representing obstacles to entrepreneurship (European Commission 1998). Others propose that certain cultures are less entrepreneurial, for instance, the stigma of failure is higher (OECD 1999). While I admit the validity of these explanations, my analysis, suggests that lack of operational knowledge about technology transfer in academic institutions and growth-oriented entrepreneurial practices by founders and their supporters, due to the emergent nature of the phenomenon, explains the lack of growth-oriented ventures.

In examining the early stages of firm formation, this study contributes to the study of how organizations emerge, an area of organization theory and of entrepreneurship where our knowledge is still low (Aldrich, 1999; Katz and Gartner, 1988).

2.6. Generalizibility

This thesis studies a small sample in one specific environment, so one could question the ability to generalize the findings. However, based on more limited data gathered on the same topics in other European regions (Clarysse et al., 2001c), I believe that several aspects of this study can be generalized. First, the change in environment in favor of entrepreneurship as a valid mode of technology innovation occurred in other regions where data were collected. [44] As mentioned in chapter 1, this change reflects the realization that the world is moving towards an information society and knowledge economy, where entrepreneurial firms are a necessary part of the innovation process (Audretch and Thurik, 2001).

Second, this evolution was strongly policy driven. The timing of these policies differs across regions between 1995 and 1999, but they shared many commonalities; Howells and McKinley (1999) also report such resemblance. Policies could also be interpreted as replication of elements of high tech clusters in the USA. For example, in France, the spin-off process appeared largely centralized

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[44] Aachen (Germany); Baden-Wurstenberg (Germany), Emilia-Romana (northern Italy), Central Netherlands (The Netherlands); Cambridge (UK); Île de France (France); Munich (Germany).

around large research institutions such as INRA. In Germany, the regional states were the main drivers; they used specialized agencies to handle the management of spinning off activities rather than relying on universities. In the two cases in Italy, there was a higher reliance on universities, as in Belgium. The replication of "concepts" with little replication or no operational knowledge about technology transfer and entrepreneurship appeared to be a phenomenon common to these regions. Similarly, the acquisition of operational knowledge occurred locally by experimentation. We witnessed almost no exchanges with other institutions or regions involved in the same endeavor.

Third, most spin-off processes involved newly available, early stage funding from pubic sources, but little or no incubation capabilities or entrepreneurial competencies. As a result, most academic ventures were spun off at an early stage and, thus, took the form of SMEs or prospectors, with the number of prospectors increasing over time.

There is a valid case for proposing that the prospector model of academic spin-off venture is representative of growth-oriented ventures in environments where technology transfer from academic institutions and entrepreneurship are new and emerging. I predict that this model of venture will become more prevalent following the collapse of the financial markets in technology sectors and the ensuing more conservative approach of funding sources of risk capital. More difficult funding conditions should further force ventures to go through a transitory period of experimentation.

2.7. Future research

The study conducted in this thesis is explorative, because so little was known on the topic when I started. A number of insights would require further investigation. One obvious question that this study raises is to what extent are these observations specific to Belgium. As mentioned above, limited data collected in other European countries (Clarysse et al., 2001c) indicate numerous overlap with Belgian data. However, this would need to be confirmed by further investigation.

I see two areas where more in-depth analysis could yield useful knowledge. First, this study represents a first attempt at understanding the spin-off process and identifying phases composing it. Thus, it represents a first step in modelizing the process, both in the case of academic institutions providing incubation and in the case of others that did not. We need to better understand the phases of the process, their interrelationship, and their impact on firms. The typology of the processes could certainly be refined. The recent evolution of KUL towards more incubation, coaching and the development of the Leuven region point, perhaps, to the emergence of a spin-off process that is intermediary between the exhaustive incubation of IMEC and VIB and the absence of incubation and coaching of other universities. One endeavor, trying to refine the initial conceptualization of the academic spin-off process, is being conducted by a network of European researchers [1] in the "STRATA" research project funded by the European Commission.

Also at the level of academic institutions, Professor Roberts, a member of my thesis committee, suggested that it would be worthwhile to examine what kind of research yields more or better spin-off projects. His research in the Boston area showed that spin-off ventures came predominantly from applied research, as opposed to fundamental research. This could indeed be useful information, notably for policy makers who fund most academic research. It could also be useful for academic institutions in their effort to identify research findings with commercial potential.

Further untangling the early stages at the firm level would provide useful knowledge, particularly for understanding the transition or gestation phase of prospectors. As mentioned above, this is a critical phase of development for research-based ventures in an underdeveloped entrepreneurial environment. A better understanding of this phase and its challenges should be useful for candidate entrepreneurs, existing ventures, and parties that support them. Establishing links between this gestation phase and the spin-off process should yield interesting results to both entrepreneurs and policy makers at the government and academic institution level.

From a theoretical point of view, closely studying the process from invention to production should contribute to improving our knowledge on how a certain type of new organization emerges. A research thesis is currently being conducted on this topic by Nathalie Moray of the University of Ghent/ She follows six spin-off projects from their invention stage to their production stage over a period of two years. She combines this real time data collection with retrospective data analysis of matched pairs of ventures.

Also at the firm level, the transition from the transitory gestation phase, dominated by concept testing, to the stage when a venture starts to experiment with growth is critical because these two phases require different resources and capabilities and market conditions may change. A doctoral candidate at the University of Ghent, Ans Heirman is currently studying this aspect using a questionnaire based data collection method. Her research combines a resource-based theory of the firm and an industrial economics perspective.

3. PRACTICAL RECOMMENDATIONS

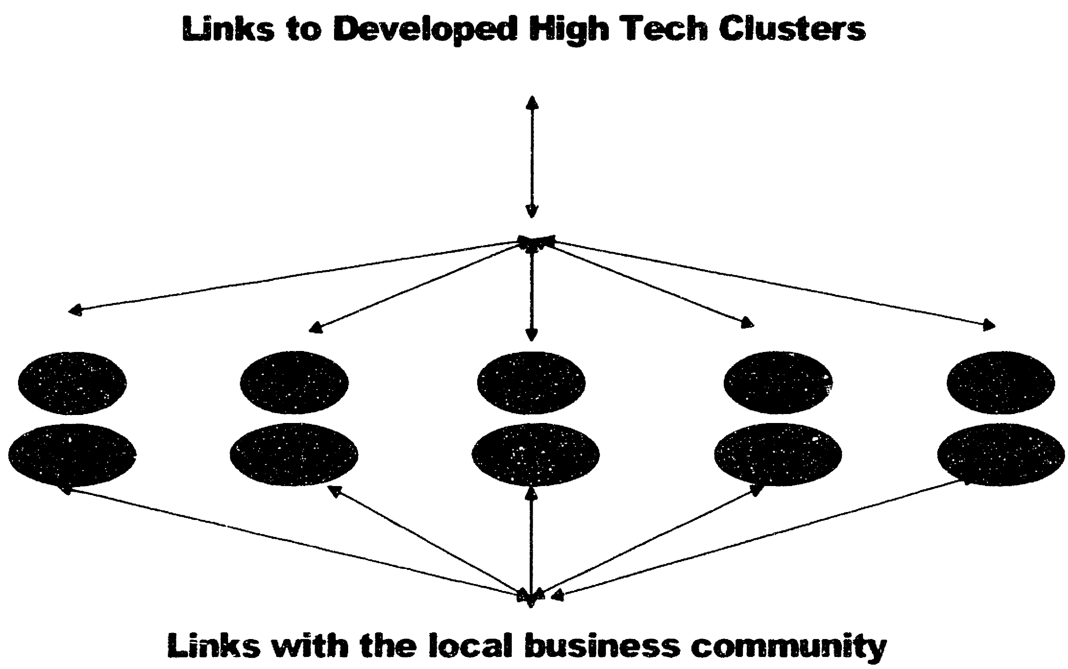
3.1. General recommendation

My study suggests that, at this stage, considerable resources and infrastructure have been put in place within a few years, but that operational knowledge of technology transfer and entrepreneurship is missing, as is circulation of that knowledge. Therefore, it appears that the further emergence of technology transfer by spinning off ventures from academic institutions requires mechanisms for acquisition and circulation of relevant knowledge.

Forums and intermediaries are particularly needed for circulation of local knowledge because of the high fragmentation of the Belgium system. In Flanders, some local linkages exist at the policy and academic levels thanks to what I call "hybrid" public organizations, but networks are needed at the firm level beyond subregional ones such as Leuven Inc.

Second, I recommend that local institutions join forces in order to achieve the necessary scale and to establish collectively external links to developed and developing high tech clusters. Currently most local actors, such as universities and firms, do not have the scale to establish outside linkages. Establishing such linkages with other regions requires collective initiatives. Locally, I recommend linkages across institutions involved with spinning off ventures and high tech entrepreneurship in general. Given the increased regionalization in Belgium, these initiatives would probably need to be conducted at the regional level instead of at the national level.

Figure 7.5. **Building of knowledge**



3.2 Recommendations at the policy level

I would suggest that policy makers and administrators of academic institutions clarify that spinning off ventures is the most efficient mode of technology transfer from academic research to industry. In some cases licensing, consulting, or training existing established small or medium firms may be more efficient than launching a new venture with all its "liabilities of newness." This is especially true in environments where academic spin-off ventures are spun off with little support.

The Belgian case shows that only "supply side policies" have been implemented, subsidizing factors supportive of academic spin-off firms. No "demand side" policies have been tried, such as stimulating the demand for technologies to be commercialized, or stimulating the emergence of a strong private investment sector. This debate does not even exist. It may be that supply side policies should be used in the initial phase to put in place a basic infrastructure to trigger technology transfer and spinning off ventures from academic institutions. However, it seems to be time to integrate the relevance of demand side policies in the policy debate and consider the argument of Cooke (2001). He attributes the innovation gap between Europe and the USA to the large involvement of the public sector in the provision of innovation support services and infrastructure that the market seems unable to supply. He suggests government to consider the policy option of stimulating the growth of a strong private investing sector.

Within these supply side policies, the assumption was made in Belgium that academic institutions must be the primary actor involved in the process of spinning-off ventures, but most of them seem inadequately equipped to do so. In other countries, an alternative formulae have been tried that was not known or considered in Belgium. [45] Another assumption was that academics need to become entrepreneurs. This can be explained by the weakness of local entrepreneurial communities and the lack of job mobility, but imaginative ways to involve more participants from the business sector must exist. Thus, a second recommendation would be to engage the business community, even if the high tech sector is minimal.

No attention seems to have been given to stimulating the emergence of service providers to the entrepreneurial community, such as lawyers, accountants, or executive search firms. In developed high tech clusters, however, they play a key role in providing specific resources (Lee et al., 2000) and acting as "pollinators" diffusing information and best practices (Suchman, 1994, 2000). The emergence of service providers requires a critical mass of entrepreneurial initiatives or their practice may not be viable. The linkages

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[45] One reason why this is so in Belgium is probably that relying on academic institutions fits into the regional, sub-regional, and even confessional segmentation of society

and forums recommended above could possibly create this critical mass by overcoming local fragmentation.

The organizations, such as GIMV, IWT, IMEC, VITO, and VIB, created by the Flemish government to carryout its STI policies merit attention. I described them as "hybrid" public organizations because they have strong industry orientation and industry connections, partnerships with the private sector are highly internationally oriented, and their mandate incorporates a strong sense of service to industry. One of them, GIMV, is even partially owned by the government and quoted on the stock market. Within Flanders, they play the role of a hub for policy makers, academics, and industry representatives to meet as they are intermediaries among these parties. They also represent a link to outside circles, such as the international venture capital community. This is certainly the case of GIMV, IMEC, and VIB. These various forms of intermediation help the circulation of resources and knowledge in a highly fragmented context. They reflect a new "generation" of public organizations more fitted to the "new economy" and an alternative to traditional policy organizations to conduct STI policy. I would thus recommend policy makers to consider such alternative organizations for conducting STI policy while stressing that they cannot be built overnight.

Finally, this study suggests that strong, local venture capital organizations, such as GIMV, play a key role in linking local spin-off ventures to the international venture capital community and advanced high tech clusters. GIMV played this role with a number of ventures such as Coware, Cropdesign, and Devgen. It helps firms access venture capital in excess of what is available locally and tap into additional sources of knowledge and supplemental networks that can be critical when operating in global markets, such as technology markets.

3.3. Recommendations at the level of academic institutions

At the level of academic institutions, the examples of IMEC, VIB, and KUL suggest that academic institutions with non-traditional university structures seem to be better at developing supportive technology transfer and spin-off processes. Traditional universities are at a disadvantage; they experience more difficulties adjusting their structure and culture because they are older organizations with a great deal of rigidity. Their generalist structure makes it more difficult to identify research with commercial potential and to incubate than in specialist organizations. Finally, most universities are small and lack the scale to afford the infrastructure needed to effectively spin off ventures. One way to overcome some of these obstacles would be that universities pool resources. Unfortunately, the direction adopted goes in the opposite direction. The level of research performed in universities may also be an issue (Capron and Meeusen, 2000).

When a country or a region has certain strengths in research, the cases of IMEC and VIB suggest that this type of structure has advantages. However, such centers need significant support and commitment from governments to provide more scale by covering research in a whole industry. However, bringing all research within one research institute for the whole region is probably only possible for certain domains. The choice of such domains by policy makers is challenging because public policies have generally failed elsewhere in such top-down intervention (Breschi and Malerba, 2001: 823). These authors suggest that government policies can play a better role in accommodating the formation of new firms, investment in education, and the provision of support infrastructures.

A pattern appears in the involvement of academic institutions with academic spin-off ventures. They started by spinning off modest entrepreneurial projects following the SME model. In a second stage, after such ventures did not really take off, they targeted more ambitious projects, which were made possible by the favorable funding conditions of the late 1990s. Finally, the most advanced academic institutions with regard to spinning off ventures, such as KUL and IMEC, realized the importance of the seed stage and incubation. The learning curve that academic institutions experienced suggest that relatively late entrants in this activity of spinning off new ventures could learn from early entrants, such as KUL, and that the exchange of experiences across academic institutions would be especially beneficial to the latter group.

This thesis identified two major spin-off processes: one involving an extensive incubation period, the other consisting of spinning off ventures at a very preliminary stage. The latter was characteristic of most universities, except KUL in the most recent years. As long as most universities do not have resources and capabilities to incubate ventures, efforts should be made to help firms move through their transitory or gestation period. Instead of providing incubation, such efforts would consist of providing coaching in the form of an advisory board, mentoring, and access to consultants.

The most visible examples of academic institutions that successfully spun off ventures are research universities such as MIT, Stanford, and Cambridge (UK). Obviously, only a few academic institutions are able to produce world-class research leading to disruptive technologies. There is a need to evaluate the potential of other academic institutions to produce research and spin off ventures with major commercial potential.

At this point in Belgium, it seems that all academic institutions have similar ambitions modeled after top research universities. However, for some of them, such ambitions may be somewhat exaggerated. But they may play other useful roles in supporting entrepreneurial endeavors, such as providing good scientists and technicians with an applied research orientation, who can be complementary to the orientation of more focused research institutions.

3.4. Recommendations at the firm level

3.4.1. Portfolio perspective

At the firm level, I identified different types of spin-offs. However, policy makers and academic institutions seem to have a predefined image of a model of venture. They should think in terms of creating a portfolio of spin-off ventures. This is consistent with observations of developed high tech clusters where many sorts of firms, including small ones like SMEs, contribute to the ecology of the cluster (e.g. Saxenian, 1994). Technology innovation and its economic benefits require going beyond the small enterprise, but evidence from developed high tech clusters suggests that SMEs and growth oriented ventures are not exclusive; they each have a role to play in a high tech cluster. As mentioned above, the same is true of service providers. However, policy makers should differentiate policies for SMEs and growth-oriented firms, because they are very different organizations as I have argued in chapter 6.

3.4.2. Importance of seed stage

As the most advanced academic institutions with regard to spinning off ventures were gaining experience, the technology bubble collapsed in late 2000; they discovered the importance of the seed stage of development of ventures and financing. Interestingly, these academic institutions support growth stages of their ventures that increasingly resemble growth stages in developing entrepreneurial clusters, as described, for instance, by Roberts (1991). A good understanding of the seed stage is key to creating policy, especially since, in the absence of strong entrepreneurial community and incubation capabilities in most academic institutions, the transitory or gestation phase is critical in determining whether ventures will persist in their growth orientation (Roberts, 1991).

3.4.3. Filling in the financial gap

With the decline of the financial markets starting in 2000, a financial gap at the seed stage reappeared, particularly in Flanders. Most of the early stage funding sources put in place in the late 1990s have become unwilling to fund early stages. In addition, the size of investment that they had set up to disburse for early stages is now well above valuations of early stage investments. For instance, IMEC is no longer able to spin off ventures that justify valuations of EUR 1 million or more, the minimum investment that the venture capitalists targeted by IMEC consider. Similarly, funds set up by universities in partnership with GIMV and/or banks were designed to provide initial investments of EUR 250,000 to 307,000. They are no longer willing to pay such a price for venture projects spun off without incubation from universities. This financial gap has created an obstacle to academic entrepreneurship which needs to be addressed. This issue is less of a problem in Wallonia, where ULG's fund has focused on small seed funding and UCL is the sole shareholder in its fund, thus having more flexibility in its investment policy. Also, the First Spin-off Program of the Walloon government is a form of seed funding.

I would argue that the seed stage needs some form of subsidy because it is not efficient for investors pursuing a pure economic rationality to fund it. These are small, high-risk investments that require a great deal of monitoring and coaching. The time they require from investors is time away from larger projects with lower risk and clearer potential. In developed entrepreneurial clusters like Boston and Silicon Valley, the seed stage is funded by "friends and family" and business angels who have more than just financial motives and information about the business that normally only insiders have.

In Belgium, "friends and family" are seldom a source of funding and business angels are scarce in high tech sectors because risk aversion is higher and equity culture is lower, especially after the collapse of the financial markets. Also, high income taxes leave little disposable cash, especially for risky investments.

On the other hand, the seed stage is a critical funding stage. In the case of academic spin-off ventures, this stage is also likely to be longer on average than with other ventures because of their innovative nature, which combines market and business risk. Some sort of subsidy, substituting for friends, family and business angels, should be implemented in order to provide an early and patient source of seed funding. It could take the form of a direct subsidy or an indirect one through a tax incentive. The successful model of SBIC in the USA could be considered. [46]

[46] The web site of SBIC is: http://www sba gov/INV/

4. CONCLUDING REMARK

The study of how new ventures were spun off from academic institutions in Belgium in recent years provides interesting insights both at the macro and micro levels. At the macro level, it offers an angle to explore a significant structural and cultural change in Europe: the adjustment of an economy and a political system that is becoming more market oriented under the pressure of global competition and technological change.

At a micro level, this study gives the opportunity to examine some concrete mechanisms through which this evolution materializes. It shows how much such a change involves the adjustment of existing organizations, the replication of foreign organizational models, and the invention of new models of organizations. Besides cultural and political factors, it puts forward the organizational dimension of change and how much a society's ability to adapt relies on its ability to adjust its existing organizations and to produce new organizations that meet new needs. This does not only represent a technical phenomenon, but also a cultural one. Indeed, new organizational forms embody beliefs, values, and norms, so they contribute to cultural change and to the emergence of new institutions.

At a time when the whole world seems to try to do things in a more entrepreneurial way, it is important to understand better how places of traditional industry or emerging countries achieve this and what innovations come out of their endeavor.

[1] Prof. Dr. Nicola Bellini (Scuola Superiore Sant'Anna, Pisa, Italy); Dr. Ed Brown (Department of Trade and Industry, Innovation-Unit/ Northern Informatics/ IdeaGuru group, UK), Prof. Dr. Bart Clarysse (Vlerick Leuven Gent Management School/ University of Gent, Gent, Belgium); Dr. Vincent Duchêne (IWT-Flanders, Brussels, Belgium); Prof. Dr. Georges Haour (Scientific Generics, Cambridge, UK); Prof. Dr. Bernard Surlemont (SME and Entrepreneurship Research Centre at the University of Liège, Liège, Belgium); Dr. Frank Strathmann (GründerRegio, München, Germany); Prof. Dr. Morris Teubal and Mr. Nir Ben-Aharon (the Industrial Development Policy Group at the Jerusalem Institute for Israel Studies, Jerusalem, Israel); Prof. Dr. Wim During and Dr. Aard J. Groen (University of Twente, The Netherlands); Prof. Dr. Hugh Whittaker (ESRC Centre for Business Research – University of Cambridge, Cambridge, UK); Ir. Paul Zeeuwts (IWT-Flanders, Brussels, Belgium)

Appendices

Appendix 1. Acronyms

ASIC	Application Specific Integrated Circuits
CSL	Centre Spatial de Liège
DNH	Denayer Hogeschool
EVCA	European Venture Capital Association
FPM	Faculté Polytechnique de Mons
FIRD	Funds for the Industrialisation of Research Results
FUNDP	Faculté Universitaire Notre-Dame de la Paix
FUSGX	Faculté des Sciences Agronomiques de Gembloux
IBA	Ion Beam Application
IMEC	Institute for Microelectronics
IWT	Institute for Science and Technology
KUL	Katholiek Universiteit Leuven
LUC	Limburg Universiteit Instelling
OECD	Organization of Economic Cooperation and Develop ment
OWS	Organic Waste System
RUG	Rijks Universiteit Gent
SME	Small- and Medium-sized Enterprises
SRIW	Walloon Regional Investment Society
UCL	Université Catholique de Louvan
ULB	Université libre de Bruxelles
ULG	Université de Liège
VIB	Flanders Institute for Biotechnology
VITO	Flemish Institute for Technological Research
VUB	Vrije Universiteit Brussel

Appendix 2.1a. – Interviews in government organizations

Government organizations	**Date of Interview**	**Person(s) Interviewed**
Direction Générale de la Technologie, de la Recherche et de l'Energie (DGTRE)	March 24, 1999	A. Gilin; Director
Erasmus European Business and Innovation Center	March 18, 1999	O. Witmeur; Director
Institute for Science and Technology (IWT)	Ongoing	B. Clarysse; Consultant to IWT

Appendix 2.1b. - Interviews in academic organizations

Academic Organizations	**Date of Interview**	**Person(s) Interviewed**
Centre Spatial de Liége (CSL)	March 12, 1999	N. Legros; manager in charge of technology transfer
Flanders Institute for Biotechnology (VIB)	Feb. 19, 1999	R. Dekeyser; Vice General Director and Technology Transfer Manager
Institute for Microelectronics (IMEC)	March 2, 2000 March 2, 1999 Dec. 14, 1999	C. Deneffe; Head of Business Development Vlaanderen at IMEC P. Raemakers; assistant at Business Development Vlaanderen at IMEC H. Bracquonié; consultant to IMEC on IP issues.
Willems Instituut	March 31, 1999	J. Rauss; President of the Institute
Limburg Universiteit Instelling (LUC)	March 31, 1999	R. Van Ham; Professor
Katholiek Universiteit Leuven (KUL)	June 23, 1999	H. Claes; Manager of LRD
Rijks Universiteit Gent (RUG)	March 9, 1999 Ongoing	A.M. Vandevelde; Member of the Office of the President B. Clarysse; Professor
Université libre de Bruxelles (ULB)	Feb. 28, 2000	T. Legon; member of the industrial liaison office ("Interface")
Université de Liège (ULG)	March 22, 1999 March 22, 1999 Ongoing Ongoing	M. Morant; Director of the industrial liaison office ("Interface") F. Leblanc; in charge of spin-offs at the industrial liaison office B. Surlemont; Professor F. Pirnay; Researcher

Academic Organizations	Date of Interview	Person(s) Interviewed
Université Catholique de Louvan (UCL)	March 1, 1999 March 22, 1999 March 29, 1999 Fall 2001	P. Janssens; Manager at the industrial liaison office. D. Legas; Professor and founder of Iris B. Macq; Professor P. Barré; Researcher
Vrije Universiteit Brussel (VUB)	June 8, 1999	P. Struelens; Staff member of the the industrial liaison office

Appendix 2.1c. - List of Ventures Interviewed or surveyed (*) ranked Chronologically

	Firm	Founded	Academic Institution	Date Interviewed	Person(s) interviewed
1	CropDesign	1998	VIB	09-Feb-99	Herman Van Mellaert, Founders, Patrick Vankeirsbilck, General Manager
2	Elsyca	1997	VUB	26-Feb-99	Patrick Vankeirsbilck, Founders, CEO
3	Polyflow	1984	UCL	01-Mar-99	Marcel Crochet, founder; Mr. Maréchal, VP Sales
4	Easics	1992	KUL	11-Mar-99	Dirck Callaerts, VP Marketing
5	Lasea	1998	ULG	12-Mar-99	Alex Kupiciewicz, founder and CEO
6	Eurogentec	1985	ULG	12-Mar-99	Joseph Martial, founder and board member; André Renard, founder and former VP research
7	Neurotec	1994	UCL	17-Mar-99	Prof. Claude Veraart, technology originator; Mr. Troosters, CEO
8	Iris	1983	UCL	22-Mar-99	Didier Legas, founder and former executive
9	Oligosense	1998	UAI	22-Mar-99	Emmanuel Vanneste, Founder and CEO
10	Telemis	1999	UCL	29-Mar-99	Stephan Kettelaer, founder and CEO
11	ISMC	1995	KUL	06-Apr-99	Peter Van Overschee, Managing Director

	Firm	Founded	Academic Institution	Date Interviewed	Person(s) interviewed
12	Stag	1994	OTHER	15-Apr-99	Mr. Smets; founder and CEO
13	Destin	1993	LUC	16-Apr-99	Prof. Luk De Schepper, technology originator
14	Androme	1989	LUC	19-Apr-99	Raf Van Ham, General Manager
15	Eurogenetics	1984	OTHER	19-Apr-99	Jeff Rauss, technology originator
16	ANSEM	1998	KUL	01-Jun-99	Stefan Gogaert; Managing Director
17	Metris	1995	KUL	01-Jun-99	Bart Van Coppenolle; Managing Director
18	Materialise	1990	KUL	03-Jun-99	Wilfried Van Craen, founder and CEO
19	Eyetronics	1998	KUL	03-Jun-99	Filip Defoort; Managing Director
20	Metis	1998	KUL	08-Jun-99	Alain De Keyser; Luc Van Bokstal, founders and Managing Directors
21	Data Analysis Products	1988	KUL	23-Jun-99	Jos Sas, Managing Director
22	Optidrive	1997	KUL	01-Jul-99	Jan Van Elsacker; Founder & Development Engineer
23	Elias	1992	RUG	01-Jul-99	Richard Robyens; Chairman
24	Hypervision	1990	KUL	08-Jul-99	Dirk Degrooff, Director
25	ICOS	1982	KUL	28-Jul-99	Jos Verjans, CEO
26	Netvision	1995	KUL	03-Aug-99	Stijn Bijnens, founder and CEO
27	IMO	1991	KUL	10-Aug-99	Juul Ivens, Managing Director
28	Krypton	1995	KUL	30-Aug-99	Alex Van den Bosche, founder and CEO
29	Sinvaco	1988	RUG	01-Sep-99	Lieve Decaluwé, General Manager
30	Epas	1992	RUG	10-Sep-99	Mr. Van Meenen, founder and CEO
31	Belsim	1986	ULG	27-Sep-99	Patrick Delava; Sales Engineer
32	Gamma	1983	ULG	28-Sep-99	Odette Collin-Marc, Managing Director
33	Biocode	1989	ULG	28-Sep-99	Jean-Luc Cloux; Managing Director
34	Horpi Systems	1999	ULG	30-Sep-99	Benoit Adam; CEO

	Firm	Founded	Academic Institution	Date Interviewed	Person(s) interviewed
35	Unisensor	1998	ULG	30-Sep-99	Benoit Garnier; Managing Director
36	Metalogic	1991	KUL	09-Oct-99	Christine. Buelens; Managing Director
37	Microbelcaps	1995	ULG	05-Nov-99	Mr. Zgouli, Managing Director
38	Septentrio	2000	IMEC	30-Jan-00	Peter Grognard, CEO
39	Fillfactory (*)	2000	IMEC	25-Feb-00	Questionnaire
40	Coware	1996	IMEC	02-May-00	Karl Van Rompay, Chief Technology Officer
41	Octalis	2000	UCL	01-Sep-00	Jean-Marc Boucqueau; CEO
42	ATC	1983	ULG	25-Feb-00	Jean De Graeve, Director
43	Lambda X (*)	1996	ULB	25-Feb-00	Questionnaire
44	Micromega (*)	1999	ULG	25-Feb-00	Questionnaire
45	Optimal Design (*)	1997	RUG	25-Feb-00	Questionnaire
46	Mithra Pharmaceuticals (*)	1999	ULG	25-Feb-00	Francois Fornieri; General Manager
47	Organic Waste Systems (*)	1988	RUG	25-Feb-00	Questionnaire

Appendix 2.2. – Archival and secondary data

Table 1. **Archival and secondary data on spin-off ventures**

Firm	**Univ.**	**Archival Data**	**Secondary Data**
ATC	ULG	(1)	www.interface-ulg.comBioLiege/ATC/
Algonomics	KUL	www.algonomics.com	
Androme	LUC		
Animal Production Scheduling	ULG	(1)	
Ansem	KUL	(2) Company Brochure www. ansem.com	Het Ingenieursblad nr. 3 – maart 2000;
Artechno sprl	FUSG X		
Avecom	RUG	www.avecom.be/	
Aventis Crop-science	RUG	www.aventis.com/	Science & Technology - Vrijdag 30 maart 2001
Babel Technology	FPM	www.babeltech.com/	
Barco Medix	VUB		http://www.barco.com/corporate/en/pressreleases/show.asp?index=408
Belsim	ULG	(1) Company Brochure; www.belsim.be	
Better3Fruit	KUL	(2) + www.better3fruit.com	
Biocode	ULG	(1) Company Brochure, Product Guide 1999, www.biocode.be	
Biotechtools	ULB	www.ulb.ac.be/rech/spin-off/biotech-tools.html	
BIOTIM	RUG	http://www.jxj.com/suppands/iswa/companies/576.html	
C-Cam Technology	IMEC	http://www.vector-international.be/C-Cam/ccamindx.html	
Cediti SA	UCL	www.cediti.be/	
Cissoid	UCL	http://www-gap.dcs.st-and.ac.uk/~history/Curves/Cissoid.html	
Clavis Image sensor	IMEC		
Coware	IMEC	www.coware.com	

Firm	Univ.	Archival Data	Secondary Data
CREASEL	RUG		
Cropdesign	VIB	www.cropdesign.com	Het Ingenieursblad nr. 3 – maart 2000
Data Analysis Products	KUL	(2) Company Brochure; csimeansreliability.com	
Dekimo	RUG	(1); www.dekimo.com/OverOns.htm	
Destin	LUC	www.destin.luc.ac.be	
Devgen	VIB	www.devgen.com	
Easics	KUL	(2); www.easics.be/	
ELIAS	KUL	(2); www.elias.be/	
Elsyca	VUB	Business plan 1999	Het Ingenieursblad nr. 3 – maart 2000
EPAS	RUG	www.epas.be	
Eurogentech	ULG	(1); www.promocell.be	
Euroscan Instrument	FUND P		
Eyetronics	KUL	(2) Company Brochure; www.eyetronics.com	Het Ingenieursblad nr. 3 – maart 2000;
Fillfactory	IMEC	www.fillfactory.com	
Frontier Design	KUL	(2) - Company brochure; www.frontierd.com	
Gamma	ULG	(1); www.gamma.be	
Horpi Systems	ULG	(1); horpisystems.win.be	
Hypervision	KUL	(2); www.hypervision.be/	
IBA	UCL	www.iba.com	
Icos Vision Systems	KUL	(2) Annual Report 1998; www.icos.be/	
IITM (*)	KUL	(2)	
Ines	ULG	(1)	
Instituut voor stress en werk	KUL	(2); www.isw.be	
Inverto	RUG		
IRIS	UCL	IPO prospectus; http://www.irislink.com	
ISMC NV	KUL	(2) - Company brochure	
JSR Electronics	IMEC		

Firm	Univ.	Archival Data	Secondary Data
Krypton Electronic Engineering	KUL	(2); ; www.krypton.be/	Company Presentation: Seminar on "Spin-offs: van denken naar doen;" November 24, 1999
LamdaX	ULB		
Lasea	ULG	(1) Company Brochure; www.star.be	
LCI-SMARTPEN	IMEC		
LMS	KUL	(2); www.lmsintl com/	
Lucid	KUL	(2); www.luciad.com	
Materialise	KUL	(2); www.materialise.be/ Materialize Vandaag May 98, July 98, Oct. 98, Jan. 99; Magic RP; Magics Communicator; Magics Rapid Tooling; "Next Day" brochure; Sales and personnel figures	
Matrix Europe	IMEC		
MCR	KUL	(2); www.3L.kuleuven.ac.be/managementindex.htm	
MEC international	KUL	(2); www.opikanoba.com	
Mediagenix	VUB	www.mediagenix.com/	
MEMRY Europe	KUL	(2); www.amtbe.com/	
Metalogic	KUL	(2); www.metalogic.be/	
METIS	KUL	(2)	
METRIS	KUL	(2); www.metris.be/	
MicroBelcaps	ULG	(1)	
Micromega Dynamic	ULB		
Neurotec	UCL	(4)	
n-side	UCL		
Numeca NV	VUB		
Octalis	UCL	Brochure from UCL's Lab for Telecommunication	
Oligosense	UIA	www.uia.ac.be/struct/oligosense	Trends December 1998;
Optidrive	KUL	(2); www.optidrive.be/	Het Ingenieursblad nr. 3 – maart 2000;
Optimal Design	ULB		
Organic Waste Systems	RUG	www.jxj.com/suppands/iswa/companies/3137.html	

Firm	Univ.	Archival Data	Secondary Data
Peptisyntha et cie	RUG	www.peptisyntha.com/	
Physiol	ULG	(1)	
Piscimeuse	ULG	(1)	
Policy Research Institute	UIA		
Polyflow	UCL	www.polyflow.be	
Proviron Industries	RUG	www.proviron.com/	
Qmedit	KUL	(2); www.qmedit.com/	
Q-Star	IMEC	www.qstar.be/	
Radim	ULG	(1); www.eurogentec.com	
Réalité virtuelle appliquée	ULG	(1)	
RNA - TEC	KUL	(2); www.rna-tec.com	
Samtech	ULG	(1); www.samcef.com	
Septentrio	IMEC	www.septentrio.com	
Simuflow	ULB		
Sinvaco	RUG	Company Brochure	
Sirus communications	IMEC	www.siriuscomm.com	Trends, May 31, 2001;
Smets Technology Alliance	DNH		
Soltech	IMEC	www.soltech.be	
Spacebel Informatique	ULG	(1); www.spacebel.be	
Star informatic	ULG	(1); www.ines.be	
Synes	KUL	(2); www.synes.com	
Target Compiler Technologies	IMEC	www.retarget.com	
Technologie en Integratie	RUG		
Telelingua	UCL	www.telelingua.com/	
Telemis	UCL	www.telemis.com	
Terracottem	RUG		
Thromb-x	KUL	(2)	www.kuleuven.ac.be/mcm/about.html
Tigenix	KUL	(2); www.tigenix.com	
Ubizen	KUL	(2) (3); www.ubizen.com	
Ultralight Geology and Geophysics	ULG	(1); www.nalagroup.com	
Unibioscreen	ULB		

Firm	Univ.	Archival Data	Secondary Data
Unisensor	ULG	(1); www.unisensor.be	
VACS	KUL	(2); www.vacs.be	
Vartec	RUG		

(1) "The Spin-offs of the University of Liege;" brochure of ULG
(2) KUL Spin-off 1999. Brochure from KUL
(3) Ubizen (formerly Netvision). "A vision on secure e-business" – Company analysis report by stock broker Vermeulen Raemdonck – "Bestuur, management, en supervisie van de venootschap – IPO prospectus – "Netvision, la valeur internet belge" in La Libre Belgique June 12 1999 – "Financial Servics, Banking on Software; in Trends Oct. 1999
(4) Brochure presentating the "Laboratoire de la RehabilitatioNeurale," the lab from which Neurotec was spun off.
Capelle, C. "A real time experimental prototype for enhancement of vision rehabilitation using auditory substitution." IEE Transaction of Biomedical engineering **45**(10).
Veraart, C. "Visual sensation produced by optic nerve stimulation using an implanted self-sizing spiral cuff electrode." Brain Research.

Table 2. **Archival and secondary data on governmental organizations**

Government Organizations	Archival Data	Secondary data
Direction Générale de la Technologie, de la Recherche et de l'Energie (DGTRE)	www.dgtre.be Initiatives 1998. Société spin-offs sur le stand DGTRE	
Erasmus European Business and Innovation Center	http://www.ulb.ac.be/rech/parcs/eebic.html Technopol. Bruxelles-Capital Région Innovante	
Institute for Science and Technology (IWT)	www.iwt.be Vlaams Indicatorenboek. Innovatie en Technologie 1999	
GIMV	www.gimv.be	
City of Leuven	Leuven: Centrum van Kennis en Technologie in Europa (brochure)	

Table 3. - **Archival and secondary data on academic organizations**

Academic Organizations	Archival Data	Secondary data
Centre Spatial de Liége (CSL)		
Flanders Institute for Biotechnology (VIB)	Annual reports www.vib.be/frame.cfm	
Institute for Microelectronics (IMEC)	http://www.imec.be/	

Academic Organizations	Archival Data	Secondary data
Willems Instituut	www.luc.ac.be/	
Limburg Universiteit Instelling (LUC)	www.luc.ac.be/	Denk mee, Doe mee. Fase 1 rapport. Spin-off Innovatie voor Limburg
Katholiek Universiteit Leuven (KUL)	www.kuleuven.ac.be http://www.kuleuven.ac.be/admin/ir	
Rijks Universiteit Gent (RUG)	www.rug.ac.be/ List of spin-off firms De N.V. Baekelands Finds and de Universiteit Gent ter stimuleren can Spin-off Initiatieven	
Université libre de Bruxelles (ULB)	www.ulb.ac.be List of spin-off firms ULB – Interface. La recherché et l'Innovation à votre Service List of spin-offs from ULB	Fondation de l'Entreprise – ULB. Les Enjeux de la Collaboration Industrie – université en Belgique Francophone. M. Osterrieth et B. Smeesters
Université de Liège (ULG)	www.ulg.ac.be http://www.ulg.ac.be/entreprises/valorisation/spin-off_liste.html	
Université Catholique de Louvan (UCL)	www.ucl.ac.be	
Vrije Universiteit Brussel (VUB)	www.vub.ac.be	
Universitaire Instelling Antwerp (UIA)	Het Anwerps Innovatiecentrum (AIC) een andere kijk op valoratie. Dirck Van Dijk. Universiteit Antwerp	

Appendix 2.3. – Secondary Data

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Chiesa, V. and A. Piccaluga (2000). "Exploitation and diffusion of public research: the general framework and the case of academic spin-off companies." R&D Management **30**: 329-340.

Clarysse, B., J. J. Degroof, et al. (2000). Analysis of the typical growth path of technology-based companies in life sciences and information technology, and the role of different sources of innovation financing. Brussels, European Commission, Enterprise Directorate-General.

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Appendix 2.4. – Guide to Interview University Representatives

Interview with Mr. / Mrs.:
Title:
Organization:
Date:
Conducted by:

Address of the Organization and references of the key contacts:

Technology transfer

How large in terms of personnel is the technology transfer unit?
Is there a licensing experience in the staff of the unit?
Cumulative years of experience
Description

If not, how does the university do when it needs to license a technology?

Does the university want to promote licensing?
If yes, since how long has this been the case?
Are scientists receptive to the idea of technology valorization?
What is the revenue of the university in terms of licensing fees?
On how many licenses is this spread over?

FUNDING

Did the [university] create a fund to finance spin-off firms?
If no, does it plan to create one?
If no, to what kind of funding solutions does the university orient its candidates entrepreneurs?
If so, when was it created?
With how much capital?
What is the capital today?
What is the capital invested today?
Did the university partner up with other institutions to create this fund?
If so, with what partners?
Who are the contact persons in these institutions, who are involved with the fund?

Is there a permanent management structure of the fund?
If no, in short how are investment decisions made?
How does the follow up of companies operate?
If yes, how large is it?
How much experience do its members have in financing new ventures?
What is the typical frequency of review of investees?
What is the composition of the board of the fund?
(names of people with affiliation)
How frequently does it meet?
Is the mission of the fund to finance mainly seed stage investments, or does it include funding further stages as well?
If the fund aims at financing early stage(s), does the university get involved in orienting its spin-offs to funding sources specialized in financing further stages?
If yes, what would be typical investors that spin-offs would approach?
Does the fund have a specific investment policy?
If no, it is more ad hoc, depending on opportunities?
How would you summarize this policy?
Is there a target investment size?
Does the fund require the technology to have a demonstrable and growing market potential?
If yes, what is the growth potential threshold?
Does the fund require the technology to be protected or to be able to be potentially protected via patents?
Does the fund consider potential exit solutions?
Does the fund require the presence of management skills from the beginning?
If yes, how are management skills found?
If yes, what are its criteria?
Does the fund require a certain composition of the board of companies?
Does the fund require or encourages the presence of other shareholders besides itself, its financial partners, and the founders?
How would you describe the involvement of the fund in the spin-offs:
hands on, hands off, other
Does the fund get involved in: making strategic decisions, recruitment of leading personnel, organizing mergers, acquisitions, licens-

ing or co-operation agreements, financing the growth of the enterprise.

Appendix 2.5. – Population of Belgian academic spin-off firms as of end of 2000

Table 1. - **Spin-off ventures ranked by alphabetical order**

	Firm	**Research Institution**	**Founding Year**
1	ATC	ULG	1983
2	Algonomics	KUL	1999
3	Androme	LUC	1990
4	Animal Production Scheduling	ULG	1992
5	Ansem	KUL	1998
6	Artechno sprl	FUSGX	1999
7	Avecom	RUG	1995
8	Aventis Cropscience	RUG	1982
9	Babel Technology	FPM	1997
10	Barco Medix	VUB	1997
11	Belsim	ULG	1986
12	Better3Fruit	KUL	2000
13	Biocode	ULG	1989
14	Biotechtools	ULB	1997
15	BIOTIM	RUG	1984
16	C-Cam Technology	IMEC	1995
17	Cediti SA	UCL	1998
18	Cissoid	UCL	2000
19	Clavis Image sensor	IMEC	1996
20	Coware	IMEC	1996
21	CREASEL	RUG	1983
22	Cropdesign	VIB	1998
23	Data Analysis Products	KUL	1988
24	Dekimo	RUG	1988
25	Destin	LUC	1992
26	Devgen	VIB	1997
27	Easics	KUL	1991
28	ELIAS	KUL	1992
29	Elsyca	VUB	1997

	Firm	Research Institution	Founding Year
30	EPAS	RUG	1992
31	Eurogentech	ULG	1985
32	Euroscan Instrument	FUNDP	1991
33	Eyetronics	KUL	1998
34	Fillfactory	IMEC	1999
35	Frontier Design	KUL	1989
36	Gamma	ULG	1983
37	Horpi Systems	ULG	1999
38	Hypervision	KUL	1991
39	IBA	UCL	1986
40	Icos Vision Systems	KUL	1982
41	IITM (*)	KUL	1991
42	Ines	ULG	2000
43	Instituut voor stress en werk	KUL	1998
44	Inverto	RUG	1986
45	IRIS	UCL	1987
46	ISMC NV	KUL	1995
47	JSR Electronics	IMEC	1986
48	Krypton Electronic Engineering	KUL	1989
49	LamdaX	ULB	1996
50	Lasea	ULG	1999
51	LCI-SMARTPEN	IMEC	1992
52	LMS	KUL	1979
53	Lucid	KUL	2000
54	Materialise	KUL	1990
55	Matrix Europe	IMEC	1987
56	MCR	KUL	2000
57	MEC international	KUL	1998
58	Mediagenix	VUB	1992
59	MEMRY Europe	KUL	1989
60	Metalogic	KUL	1991
61	METIS	KUL	1993
62	METRIS	KUL	1995

	Firm	Research Institution	Founding Year
63	MicroBelcaps	ULG	1995
64	Micromega Dynamic	ULB	1999
65	Neurotec	UCL	1994
66	n-side	UCL	2000
67	Numeca NV	VUB	1992
68	Octalis	UCL	2000
69	Oligosense	UIA	1998
70	Optidrive	KUL	1997
71	Optimal Design	ULB	1997
72	Organic Waste Systems	RUG	1988
73	Peptisyntha et cie	RUG	1987
74	Physiol	ULG	1986
75	Piscimeuse	ULG	1983
76	Policy Research Institute	UIA	1994
77	Polyflow	UCL	1988
78	Proviron Industries	RUG	1983
79	Qmedit	KUL	2000
80	Q-Star	IMEC	1999
81	Radim	ULG	1981
82	Réalité virtuelle appli-quée	ULG	1997
83	RNA - TEC	KUL	2000
84	Samtech	ULG	1986
85	Septentrio	IMEC	1999
86	Simuflow	ULB	1999
87	Sinvaco	RUG	1988
88	Sirus communications	IMEC	1996
89	Smets Technology Alli-ance	OTHER	1994
90	Soltech	IMEC	1989
91	Spacebel Informatique	ULG	1988
92	Star informatic	ULG	1983
93	Synes	KUL	1998
94	Target Compiler Tech-nologies	IMEC	1996

	Firm	Research Institution	Founding Year
95	Technologie en Integratie	RUG	1997
96	Telelingua	UCL	2000
97	Telemis	UCL	1999
98	Terracottem	RUG	1989
99	Thromb-x	KUL	1991
100	Tigenix	KUL	2000
101	Ubizen	KUL	1995
102	Ultralight Geology and Geophysics	ULG	1984
103	Unibioscreen	ULB	1999
104	Unisensor	ULG	1998
105	VACS	KUL	2000
106	Vartec	RUG	1994

Table 2. **Source of information for identifying firms**

	Firm	Research Institution	Founding Year	Date	Source
1	ATC	ULG	1983	Q1 – 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
2	Algonomics	KUL	1999	Q3 – 2001	Prof. Clarysse and A. Heimans (RUG) - LRD's web site
3	Androme	LUC	1990	Q1 – 1999	LUC
4	Animal Production Scheduling	ULG	1992	Q1 – 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
5	Ansem	KUL	1998	Q1 – 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
6	Artechno sprl	FUSGX	1999	Q3 2001	Surlemont and Pirnay (1)
7	Avecom	RUG	1995	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
8	Aventis Cropscience	RUG	1982	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
9	Babel Technology	FPM	1997	Q3 2001	Surlemont and Pirnay (1)
10	Barco Medix	VUB	1997	Q3 - 2001	IWT - Prof. Clarysse and A. Heimans (RUG) - VUB

	Firm	Research Institution	Founding Year	Date	Source
11	Belsim	ULG	1986	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
12	Better3Fruit	KUL	2000	Q3 - 2001	Prof. Clarysse and A. Heimans (RUG) - LRD's web site
13	Biocode	ULG	1989	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
14	Biotechtools	ULB	1997	Q4 - 2000	T. Legon (ULB) - A. Gilin (DGTRE)
15	BIOTIM	RUG	1984	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
16	C-Cam Technology	IMEC	1995	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
17	Cediti SA	UCL	1998	Q3 - 2001	Prof. Clarysse and A. Heimans (RUG) - Capart (2001)
18	Cissoid	UCL	2000	Q3 - 2001	Capart (2001)
19	Clavis Image sensor	IMEC	1996	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
20	Coware	IMEC	1996	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
21	CREASEL	RUG	1983		RUG administration - Prof. Clarysse and A. Heimans (RUG)
22	Cropdesign	VIB	1998	Q1 - 1999	VIB
23	Data Analysis Products	KUL	1988	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
24	Dekimo	RUG	1988	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
25	Destin	LUC	1992	Q1 - 1999	LUC
26	Devgen	VIB	1997	Q1 - 1999	VIB
27	Easics	KUL	1991	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
28	ELIAS	KUL	1992	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
29	Elsyca	VUB	1997	Q1 - 1999	VUB
30	EPAS	RUG	1992	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
31	Eurogentech	ULG	1985	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
32	Euroscan Instrument	FUNDP	1991	Q3 2001	Surlemont and Pirnay (1)

	Firm	Research Institution	Founding Year	Date	Source
33	Eyetronics	KUL	1998	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
34	Fillfactory	IMEC	1999	Q1 - 2000	IMEC - C. Deneffe - H. Bracquonié
35	Frontier Design	KUL	1989	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
36	Gamma	ULG	1983	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
37	Horpi Systems	ULG	1999	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
38	Hypervision	KUL	1991	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
39	IBA	UCL	1986	Q1 - 1999	P. Janssens (UCL)
40	Icos Vision Systems	KUL	1982	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
41	IITM (*)	KUL	1991	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
42	Ines	ULG	2000	Q3 - 2001	Prof. Surlemont and F. Pirnay (ULG)
43	Instituut voor stress en werk	KUL	1998	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
44	Inverto	RUG	1986	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
45	IRIS	UCL	1987	Q1 - 1999	P. Janssens (UCL)
46	ISMC NV	KUL	1995	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
47	JSR Electronics	IMEC	1986	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
48	Krypton Electronic Engineering	KUL	1989	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
49	LamdaX	ULB	1996	Q4 - 2000	T. Legon (ULB) - A. Gilin (DGTRE)
50	Lasea	ULG	1999	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
51	LCI-SMARTPEN	IMEC	1992	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
52	LMS	KUL	1979	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site

	Firm	Research Institution	Founding Year	Date	Source
53	Lucid	KUL	2000	Q3 - 2001	Prof. Clarysse and A. Heimans (RUG) - LRD's web site
54	Materialise	KUL	1990	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
55	Matrix Europe	IMEC	1987	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
56	MCR	KUL	2000	Q3 - 2001	Prof. Clarysse and A. Heimans (RUG) - LRD's web site
57	MEC international	KUL	1998	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
58	Mediagenix	VUB	1992	Q3 - 2001	IWT - Prof. Clarysse and A. Heimans (RUG) - VUB
59	MEMRY Europe	KUL	1989	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
60	Metalogic	KUL	1991	Q1 - 1999	KUL (1999) (1) - H Claes (LRD) - IWT - LRD's web site
61	METIS	KUL	1993	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
62	METRIS	KUL	1995	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
63	MicroBelcaps	ULG	1995	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
64	Micromega Dynamic	ULB	1999	Q4 - 2000	T. Legon (ULB) - A. Gilin (DGTRE)
65	Neurotec	UCL	1994	Q1 - 1999	P. Janssens (UCL)
66	n-side	UCL	2000	Q3 - 2001	Capart (2001)
67	Numeca NV	VUB	1992	Q3 - 2001	IWT - Prof. Clarysse and A. Heimans (RUG) - VUB
68	Octalis	UCL	2000	Q3 - 2001	Prof. Macq - Capart (2001)
69	Oligosense	UIA	1998	Q1 - 1999	IWT - Prof. Clarysse and A. Heimans (RUG) - Capart (2001)
70	Optidrive	KUL	1997	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
71	Optimal Design	ULB	1997	Q4 - 2000	T. Legon (ULB) - A. Gilin (DGTRE)
72	Organic Waste Systems	RUG	1988	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
73	Peptisyntha et cie	RUG	1987	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)

	Firm	Research Institution	Founding Year	Date	Source
74	Physiol	ULG	1986	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
75	Piscimeuse	ULG	1983	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
76	Policy Research Institute	UIA	1994	Q3 - 2001	IWT - Prof. Clarysse and A. Heimans (RUG) - Capart (2001)
77	Polyflow	UCL	1988	Q1 - 1999	P. Janssens (UCL)
78	Proviron Industries	RUG	1983	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
79	Qmedit	KUL	2000	Q3 - 2001	Prof. Clarysse and A. Heimans (RUG) - LRD's web site
80	Q-Star	IMEC	1999	Q1 - 2000	IMEC - C. Deneffe - H. Bracquonié
81	Radim	ULG	1981	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
82	Réalité virtuelle appliquee	ULG	1997	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
83	RNA - TEC	KUL	2000	Q3 - 2001	Prof. Clarysse and A. Heimans (RUG) - LRD's web site
84	Samtech	ULG	1986	Q1 - 1999	ULG administration - Prof Surlemont and F. Pirnay (ULG)
85	Septentrio	IMEC	1999	Q1 - 2000	IMEC - C. Deneffe - H. Bracquonié
86	Simuflow	ULB	1999	Q4 - 2000	T. Legon (ULB) - A. Gilin (DGTRE)
87	Sinvaco	RUG	1988	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
88	Sirus communications	IMEC	1996	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
89	Smets Technology Alliance	OTHER	1994	Q1 - 1999	J. Rauss Willems Institute
90	Soltech	IMEC	1989	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
91	Spacebel Informatique	ULG	1988	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
92	Star informatic	ULG	1983	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)

	Firm	Research Institution	Founding Year	Date	Source
93	Synes	KUL	1998	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
94	Target Compiler Technologies	IMEC	1996	Q4 - 1999	IMEC - C. Deneffe - H. Bracquonié
95	Technologie en Integratie	RUG	1997	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
96	Telelingua	UCL	2000	Q3 - 2001	Capart (2001)
97	Telemis	UCL	1999	Q1 - 1999	Prof. Macq - Capart (2001)
98	Terracottem	RUG	1989	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)
99	Thromb-x	KUL	1991	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
100	Tigenix	KUL	2000	Q3 - 2001	Prof. Clarysse and A. Heimans (RUG) - LRD's web site
101	Ubizen	KUL	1995	Q1 - 1999	KUL (1999) (1) - H. Claes (LRD) - IWT - LRD's web site
102	Ultralight Geology and Geophysics	ULG	1984	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
103	Unibioscreen	ULB	1999	Q4 - 2000	T. Legon (ULB) - A. Gilin (DGTRE)
104	Unisensor	ULG	1998	Q1 - 1999	ULG administration - Prof. Surlemont and F. Pirnay (ULG)
105	VACS	KUL	2000	Q3 - 2001	Prof. Clarysse and A. Heimans (RUG) - LRD's web site
106	Vartec	RUG	1994	Q1 - 2000	RUG administration - Prof. Clarysse and A. Heimans (RUG)

Table 3. - **Firms excluded from the population with explanation**

	Firms reported as Spin-offs but removed from the list	**Sources of Identification**	**Reason removed**
1	BETA – CELL	.(4)	.(1)
2	CENERGIE	.(4)	.(1)
3	Dental communications	.(4)	.(1)
4	Expanded Media	.(4)	.(1)
5	Extended Library access solutions	.(4)	.(1)
6	GTS GRAL (Belgium)	.(4)	.(1)
7	Innogenetics	RUG	Not a spin-off firm
8	Interpoint	LRD – KUL	.(7)
9	Microwave Energy Applications Consult	.(4)	.(1)
10	Numerical Mechanics Applications International	.(4)	.(1)
11	OPUS	.(4)	.(1)
12	Prime Membrane Technologies	.(4)	.(1)
13	R.E.D. Laboratories	.(4)	.(1)
14	Skyscan	.(4)	.(1)
15	Smart I.T. Systems	.(4)	.(1)
16	T – Regs	.(4)	.(1)
17	Triconsult	LRD – KUL	.(1)
18	Smartmove	IMEC	Not a spin-off but spin-in
19	TI Consult	.(4)	.(2)
20	Sonecom	.(4)	.(2)
21	Symore	.(4)	.(2)
22	BIEF SA	.(4)	.(2)
23	Diatos	Capart (2001)	.(6)
24	Telelingua Software	Capart (2001)	.(6)
25	Matrix	Capart (2001)	Venture fund investment
26	IBT	Capart (2001)	Not a UCL spin-off firm
27	Sure Consulting and Services	.(4)	.(1)
28	Xylowatt	Capart (2001)	Founded 2001
29	ADE SA	.(4)	.(2)
30	DATA4s	LRD's Web site	.(2)
31	Eurogenetics	Willems institute	.(3)

	Firms reported as Spin-offs but removed from the list	Sources of Identification	Reason removed
32	Adhoc Solutions SA	.(4)	.(2)
33	Mitec SA	.(4)	.(2)
34	ATM Pro sprl	.(4)	.(2)

.(1) No association could be found with a research institution
(2) Not recognized as spin-off by its academic institution
(3) Never transferr technology out of Willems institute - today distribution company
.(4) IWT - Prof. Clarysse and A. Heimans (RUG)
.(5)Consulting activity of a professor
.(6) Strategic partnership with existing firm, not a spin-off
(7) Consulting activity of a professor

Appendix 2.6. – **Spin-off firms not interviewed in the population**

	Firm	Research Institution	Founding Year	Reason why not interviewed
1	ATC	ULG	1983	(2)
2	Algonomics	KUL	1999	(1)
3	Androme	LUC	1990	Interviewed
4	Animal Production Scheduling	ULG	1992	(2)
5	Ansem	KUL	1998	Interviewed
6	Artechno sprl	FUSGX	1999	(1)
7	Avecom	RUG	1995	(2)
8	Aventis Cropscience	RUG	1982	(2)
9	Babel Technology	FPM	1997	(1)
10	Barco Medix	VUB	1997	(2)
11	Belsim	ULG	1986	Interviewed
12	Better3Fruit	KUL	2000	(1)
13	Biocode	ULG	1989	interviewed
14	Biotechtools	ULB	1997	Interviewed (a)
15	BIOTIM	RUG	1984	(2)
16	C-Cam Technology	IMEC	1995	(2)
17	Cediti SA	UCL	1998	(1)
18	Cissoid	UCL	2000	(1)
19	Clavis Image sensor	IMEC	1996	(2)

	Firm	Research Institution	Founding Year	Reason why not interviewed
20	Coware	IMEC	1996	Interviewed
21	CREASEL	RUG	1983	(2)
22	Cropdesign	VIB	1998	Interviewed
23	Data Analysis Products	KUL	1988	Interviewed
24	Dekimo	RUG	1988	(2)
25	Destin	LUC	1992	Interviewed
26	Devgen	VIB	1997	(2)
27	Easics	KUL	1991	Interviewed
28	ELIAS	KUL	1992	Interviewed
29	Elsyca	VUB	1997	Interviewed
30	EPAS	RUG	1992	Interviewed
31	Eurogentech	ULG	1985	Interviewed
32	Euroscan Instrument	FUNDP	1991	(1)
33	Eyetronics	KUL	1998	Interviewed
34	Fillfactory	IMEC	1999	(2)
35	Frontier Design	KUL	1989	Interviewed
36	Gamma	ULG	1983	Interviewed
37	Horpi Systems	ULG	1999	Interviewed
38	Hypervision	KUL	1991	Interviewed
39	IBA	UCL	1986	(2)
40	Icos Vision Systems	KUL	1982	Interviewed
41	IITM (*)	KUL	1991	(2)
42	Ines	ULG	2000	(1)
43	Instituut voor stress en werk	KUL	1998	(2)
44	Inverto	RUG	1986	(2)
45	IRIS	UCL	1987	Interviewed
46	ISMC NV	KUL	1995	Interviewed
47	JSR Electronics	IMEC	1986	(2)
48	Krypton Electronic Engineering	KUL	1989	Interviewed
49	LamdaX	ULB	1996	Questionnaire
50	Lasea	ULG	1999	Interviewed
51	LCI-SMARTPEN	IMEC	1992	(2)
52	LMS	KUL	1979	Interviewed (a)
53	Lucid	KUL	2000	(1)

	Firm	Research Institution	Founding Year	Reason why not interviewed
54	Materialise	KUL	1990	Interviewed
55	Matrix Europe	IMEC	1987	(2)
56	MCR	KUL	2000	(1)
57	MEC international	KUL	1998	(2)
58	Mediagenix	VUB	1992	(1)
59	MEMRY Europe	KUL	1989	(2)
60	Metalogic	KUL	1991	Interviewed
61	METIS	KUL	1993	Interviewed
62	METRIS	KUL	1995	Interviewed
63	MicroBelcaps	ULG	1995	(2)
64	Micromega Dynamic	ULB	1999	Questionnaire
65	Neurotec	UCL	1994	Interviewed
66	n-side	UCL	2000	(1)
67	Numeca NV	VUB	1992	(1)
68	Octalis	UCL	2000	Interviewed
69	Oligosense	UIA	1998	Interviewed
70	Optidrive	KUL	1997	Questionnaire
71	Optimal Design	ULB	1997	Questionnaire
72	Organic Waste Systems	RUG	1988	Questionnaire
73	Peptisyntha et cie	RUG	1987	(2)
74	Physiol	ULG	1986	(2)
75	Piscimeuse	ULG	1983	(2)
76	Policy Research Institute	UIA	1994	(1)
77	Polyflow	UCL	1988	Interviewed
78	Proviron Industries	RUG	1983	(2)
79	Qmedit	KUL	2000	(1)
80	Q-Star	IMEC	1999	(2)
81	Radim	ULG	1981	(2)
82	Réalité virtuelle appliquée	ULG	1997	(2)
83	RNA - TEC	KUL	2000	(1)
84	Samtech	ULG	1986	(2)
85	Septentrio	IMEC	1999	Interviewed
86	Simuflow	ULB	1999	(2)
87	Sinvaco	RUG	1988	Interviewed
88	Sirus communications	IMEC	1996	(2)

	Firm	Research Institution	Founding Year	Reason why not interviewed
89	Smets Technology Alliance	OTHER	1994	Interviewed
90	Soltech	IMEC	1989	(2)
91	Spacebel Informatique	ULG	1988	(2)
92	Star informatic	ULG	1983	(2)
93	Synes	KUL	1998	(2)
94	Target Compiler Technologies	IMEC	1996	(2)
95	Technologie en Integratie	RUG	1997	(2)
96	Telelingua	UCL	2000	(1)
97	Telemis	UCL	1999	Interviewed
98	Terracottem	RUG	1989	(2)
99	Thromb-x	KUL	1991	Interviewed (b)
100	Tigenix	KUL	2000	(1)
101	Ubizen	KUL	1995	Interviewed
102	Ultralight Geology and Geophysics	ULG	1984	(2)
103	Unibioscreen	ULB	1999	(2)
104	Unisensor	ULG	1998	Interviewed
105	VACS	KUL	2000	(1)
106	Vartec	RUG	1994	(2)

(1) Not identified by the time of the end of data collection
(2) Turned down request to be interviewed. Some of these firms accepted to fill in a questionnaire, but never returned it in spite of numerous follow up calls, or returned it only partially filled.

(a) Interviewed but not included in final sample, because interview notes were lost.
(b) Not included in final sample, because it turned out to be a shell company

Appendix 2.7. Interviews GUIDES in ventures

FIRST INTERVIEW GUIDE
(February 1999 to August 1999)

Interview with *[Name of the company]*

Mr. / Mrs. *[name of interviewee]*
of [company name]

Spin-off from [name of research institution]
Date:
Conducted by: *[name of the interviewer]*

- ADDRESS OF THE FIRM AND REFERENCES OF KEY CONTACT(S)
- KEY INFORMATION
  - Founding date:
  - Sector:
  - Number of people:
  - Products
  - Competitors.
  - Clients.
- KEY PLAYERS
- ORIGIN – STORY OF THE FIRM.
- FUNDING
- BUSINESS MODEL
- COLLABORATIONS
- NUMBERS
  - Revenue: Profit Personnel

- MANAGEMENT TEAM AND GOVERNANCE
    - Management team
    - Ownership.
- Board:.

- ENVIRONMENT

- CONCLUSIONS

SECOND INTERVIEW GUIDE IN FIRMS
(November - December 1999)

Interview with *[Name of the company]*

Mr. / Mrs. *[name of interviewee]*
of [company name]

Spin-off from [name of research institution]
Date:
Conducted by: *[name of the interviewer]*

- ADDRESS OF THE FIRM AND REFERENCES OF KEY CONTACT(S)

- BASIC INFORMATION
    - Founding date:
    - Sector / activity.
    - Products /Services:
    - Markets: large institutions, especially in the financial sector.
    - Clients:
    - Revenue
    - R&D expenses:
    - Capital
    - Personnel:

- KEY PLAYERS

- ORIGIN – STORY OF THE FIRM

- ENVIRONMENT
  - Key institutions
- BUSINESS MODEL

  - **FUNDING**

- MANAGEMENT TEAM AND GOVERNANCE
  - Team
  - Board.
  - Ownership
    - Incentive system
    -
- COLLABORATIONS – EXTERNAL CONTACTS
- LOCATION: ADVANTAGES
- WHAT WOULD YOU DO DIFFERENTLY?

<u>THIRD INTERVIEW GUIDE</u>
(December 1999 to December 2000)

Interview with *[Name of the company]*

Mr. / Mrs. *[name of interviewee]*
of [company name]

Spin-off from [name of research institution]
Date:
Conducted by: *[name of the interviewer]*

- ADDRESS OF THE FIRM AND REFERENCES OF KEY CONTACT(S)
- BASIC INFORMATION

- Founding date:
- Capital at founding: BEF ; Capital today:
- Personnel at founding: ; Personnel today: .
- Revenue since founding.
- Percentage revenue from product vs. service:
- Percentage revenue from export:
- % revenue from new products developed in the last 2 years:
- R&D expenses

- KEY PLAYERS

- ORIGIN
- How did the players come together?

    - How did the idea come about?

    - Founding process.

- HISTORY OF THE FIRM - MILESTONES

- Governance
    - Shareholders and their ownership percentage
    - Investor category
        - Founders / management:
        - Personnel:
        - Outside investors:
            - Family and friends
            - Business angels:
            - University:
            - Financial investors:
            - Industrial investors:
            - Public investor:
            - Stock market
    - Board composition
            - Management

        - Non active share-
          holders
        - Non shareholders

-
- FUNDING
    - Outside funding:.
        - Origin of the funds:
            - Personal funds; Public funding / university; Industry,
        - Funding process
        - Types of funds that founders attempted to raise?
            - Have not been raised: others.
    - Subsidies: yes.
  - Employees incentive system – or stock ownership

  - SECTOR / ACTIVITY.
    - Sector :
    - Products /Services:
    - Technology:
    - Markets:.
    - Main clients:.

- FOUNDER(S) / TOP MANAGEMENT TEAM
    - Number of founders at founding:
    - Number of founders today:
    - How many founders left the firm:
    - Education:
    - Business experience at founding:
    - Outside business experience today:.
    - How did the partners come together:.
    - Functional composition of the TMT:
    - Key players beyond the management team
        - Board:
        - Shareholders:

- ENVIRONMENT
  - Key institutions
    -

- Role played by university
- Advantages of being located in the region.
- Technology transfer from university:.
- Outside collaborations / partnerships

BUSINESS MODEL

- Has any outside firm served as model?
- What is the firm's initial business model?
  - What is the current business model?
- What's the main focus at this stage of the business?
- What is the size of the market?
- What are the economics of the business: ?
- Importance of university link to get entry to clients?

- WHAT WOULD YOU DO DIFFERENTLY?
  - CONCLUSIONS

Appendix 2.8. – Questionnaire addressed to firms that turned down interviews

A. Key Figures

1. When was the company founded (dd/mm/yy)? ../../..

2. What was/is the capital, number of employees and revenues at founding and today?

	Capital Currency	Personnel (number)	Revenue Currency
At founding			
Today			

3. Please describe the nominal capital increases in your company over the years?

Year	Amount of capital increase currency

4. *(Check one box for each question)*

	Yes	No
- Did you envisage several rounds of funding in your initial business plan?	☐	☐
- Did the outside investor tie his initial investment to goals?	☐	☐
- Were subsequent rounds of funding tied to the achievement of specific results in prior rounds of funding?	☐	☐

B. About the Founders

1. a) How many founders were there at the time of start-up? ....
   b) How many of the founders left the firm? ....

c) How many of the founders are part of the key shareholders today? ....

d) How many of the founders are part of the key managers today? ....

2. What was the background of the founders at time of founding?

Name	Education (e.g. engineering, management, economics, ...)	Years of academic research experience	Years of business experience	Years of international experience

3. How did the founders come together?

(Check all appropriate boxes)

- ☐ former working experience at the university
- ☐ former working experience in a firm
- ☐ former students
- ☐ friends / family
- ☐ other : ....

4. Is the founding of your company based on :

(Check one box for each question)	Yes	No
- A formal technology transfer from university/ research institute?	☐	☐
- A technology or know how acquired while working at a university / research institute lab?	☐	☐

5. **What was the original idea?**
A company which would eventually be
(Check one box)

- ☐ a company with a main focus on applied research
- ☐ a company with a main activity in consulting
- ☐ a company with main focus on building prototypes
- ☐ a company with main focus on selling products
- ☐ other : ....

What was the main focus during the first years to reach this objective?
(Check one box)

- ☐ applied research
- ☐ consulting
- ☐ building prototypes
- ☐ product sales
- ☐ other : ....

6. **During the founding phase, what was the main goal for the future?**
(Check one box for each statement)

	Not important at all	Not important	Neutral	Important	Very important
To stay small as a company	☐	☐	☐	☐	☐
To stay a majority shareholder	☐	☐	☐	☐	☐
To keep technological excellence	☐	☐	☐	☐	☐
To keep outside investors out	☐	☐	☐	☐	☐
To become a large company	☐	☐	☐	☐	☐

7. **a) Is there a functional management position in the following departments?**

	Yes	No
Manufacturing	☐	☐
Marketing	☐	☐
Sales	☐	☐
Customer service	☐	☐

b) How many employees are working in those departments?

	Number
Manufacturing	....
Marketing	....
Sales	....
Customer service	....

C. Governance

1. **What is the distribution of ownership?**

%	Founders	Private Investors (business angels, companies)	Financial Investors (Venture Capitalists, Banks,...)	Universities	Government based investors	Others
At founding						
Today						

2. **Composition of the board of directors:**

   How many founders, investors, ... are there in the board of directors?

Number	Founders	Investors	Family/ Friends	Industry Representa-tives	Others
At founding					
Today					

D. Activities

1. **Can you describe briefly the main activities of the company?**

   (products/ services/ sector or industry/ market and main clients)

   ....

   ....

   ....

   ....

   ....

E. Environment

1. a) Were some institutions important in the start-up process of the company? Yes ☐ No ☐

b) If so, which one(s)?

(Check all appropiate boxes)

☐ University
☐ Public research organization
☐ Incubation center
☐ Private consulting
☐ Private law firm
☐ Other:..

c) What was the contribution of the most important institution?

(Check one box for each statement)

	Not important at all	Not important	Neutral	Important	Very important
Financial support	☐	☐	☐	☐	☐
Management support	☐	☐	☐	☐	☐
Technology support	☐	☐	☐	☐	☐
Other :	☐	☐	☐	☐	☐

2. Which of the following professional service organizations were important in the start-up and later growth phase of the company?
(Check one box for each statement)

	Not important at all	Not important	Neutral	Important	Very important
Patent attorney	☐	☐	☐	☐	☐
Law firm	☐	☐	☐	☐	☐
Technical consulting organization	☐	☐	☐	☐	☐
Management consulting organization	☐	☐	☐	☐	☐
Specialized recruitment offices	☐	☐	☐	☐	☐
Other:..................	☐	☐	☐	☐	☐

F. Growth process of the company

1. Please indicate to what extent you agree with the following statements.
(Check one box for each statement)

The first years after start-up:

	Completely disagree	Rather disagree	Neutral	Rather agree	Completely agree	Not applicable
a. The early client contacts drastically changed our founding strategy	☐	☐	☐	☐	☐	☐
b. If you could choose between a high revenue project that did not really met your core competencies and a low revenue project that fitted completely in the core business, you would have chosen the smaller project	☐	☐	☐	☐	☐	☐
c. Experience from consulting work made us modify our initial product/ market	☐	☐	☐	☐	☐	☐
d. We, the founders, visited a large number of potential clients without sales as a major objective	☐	☐	☐	☐	☐	☐
e. New insights gained from further research and development completely changed our product/ market idea	☐	☐	☐	☐	☐	☐

f. Consulting mainly served to generate cash, but was not our core business	☐	☐	☐	☐	☐	☐
g. It is better to focus first on a small niche than to target directly the big market	☐	☐	☐	☐	☐	☐
h. Early client contacts redirected our R&D efforts	☐	☐	☐	☐	☐	☐
i. Consulting mainly served as a learning experience	☐	☐	☐	☐	☐	☐
j. It 's more useful to firstly become the leader in a small niche than to directly become a follower in a big market	☐	☐	☐	☐	☐	☐
k. Our R&D efforts had a large impact on our marketing / commercial strategy	☐	☐	☐	☐	☐	☐
l. Publicly funded contract research (European Comission, ...) was the main activity	☐	☐	☐	☐	☐	☐

	Completely disagree	Rather disagree	Neutral	Rather agree	Completely agree	Not applicable
m. As a founder, I thought it was important to market my own products/ services (instead of a product manager)	☐	☐	☐	☐	☐	☐
n. An incentive system for researchers is an important tool to stimulate R&D in your company	☐	☐	☐	☐	☐	☐
o. We only applied to research grants that were strongly related to our core business	☐	☐	☐	☐	☐	☐
p. The help of an expert was important to manage our patent portfolio	☐	☐	☐	☐	☐	☐
q. Prototyping was an important tool to reduce product time to market	☐	☐	☐	☐	☐	☐
r. We found it very important for the future value of our company to build a patent portfolio	☐	☐	☐	☐	☐	☐

2. *(Check the most appropriate box for each statement)*

	Never	Rarely	Sometimes	Always	Not applicable
a. As a founder, did you market your products yourself in the first three years after start-up	☐	☐	☐	☐	☐
b. As a founder do you market your products yourself today	☐	☐	☐	☐	☐

Appendix 4.1. - Summary table of period going from 1980 to 1995

	FLANDERS	WALLONIA

GOVERNMENT POLICIES	• 1980. Federalization. Desire to anchor economy in high tech
	• STI policy.
	  • focused on microelectronics, new materials, and biotechnology
	  • Increase in STI spending, but below European levels
		• 1980. Federalization. Desire to anchor economy in high tech
		• STI policy.
		• Lack of focus
		  • Under investment in research. Half of European levels
		• Failure of entry into biotechnology

	• Creation of new institutions in support of STI policy
	  o 1980. Creation of GIMV, to become the venture capital arm of the government of Flanders.
	  o 1984. Creation of IMEC, microelectronics research center.
	  o 1991. Creation of VITO, Flemish institute for technological research
	  o 1991. Creation of IWT, "one stop shop" coordinating agency for STI policy
	  o 1995. Creation of VIB, Flanders Institute for Biotechnology	

RESEARCH INSTITUTIONS	• Universities consider that technology valorization for commercialization is not part of their mission. Passive support from KUL.	• Universities consider that technology valorization for commercialization is not part of their mission. Small occasional ad hoc financial support from UCL. Ban from

	FLANDERS	**WALLONIA**
	• Research institutions have a strong mandate of technology valorization and transfer. Limited experimentation with spinning off new ventures by IMEC	ULG on spinning-off ventures 1993-1997
FUNDING CONDITIONS	• Venture capital largely from public sources (GIMV) serving to supports "champions" that fit the government's policies. • Short-lived attempt by industrial and financial firms at venture capital activity. • No stock market for young firms.	• Virtually no public or private venture capital. Public investment companies focused on restructuration of declining industries rather than on stimulating high tech sectors • One exception: failed entry into biotechnology • No stock market for young firms.
ACADEMIC SPIN-OFF FIRMS	Most founders set up small ventures as substitute to a job, with the exception of a few founders of biotech firms, who tried to replicate a US model of growth oriented ventures.	Same

Appendix 4.2. - Short Descriptions of Key Flemish Institutions [47]

1. POLICY ORGANIZATIONS

1.1 GIMV [48]

In 1980, the government of Flanders created GIMV, a public investment company. GIMV was initially set up as a traditional government holding company, similar to its Walloon counterpart, SRIW, but, in the 1980s it invested risk capital in most high tech ventures founded in Flanders.[49] Its role as venture capitalist was first institutionalized in 1989 with the creation of the "Take-off Fund," its first venture capital fund. This role increased steadily in the 1990s. In 1994, the Flemish government created the USD 30 million Biotech Fund Flanders and assigned its management to GIMV. Given the scarcity of private venture capital in Flanders and in Belgium, from the 1980s on GIMV became the largest venture capital firm in the country.

1.2 The Institute for Science and Technology (IWT) [50]

In 1991, The Flemish government created IWT, the Institute for Science and Technology. IWT delivers "hard support" in the form of funding and plays a "soft" co-coordinating role. Financial support is provided through the delivery of various types of subsidies to firms: grants for basic industrial research in companies, prototype development of new products, new process development and subsidies for innovation projects in SMEs. "Soft support" is provided notably through the organization of a network of service providers for SMEs (the "SME-Innovation Network"), for which IWT acts as the coordinator, and through the promotion of intellectual property in companies. The ambition of IWT was to become a "one-

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47 Main sources of information: my one interviews (see appendix 2.1); http://www gimv.be/ english; http://www.iwt.be/; http://www.imec.be/ english/; http://www.vito.be/english/; http://www.vib.be/ english/

48 http://www.gimv.be/ english

49 Mietec, ICOS, Innogenetics, Lernout & Hauspie, Plant Genetic System.

50 http://www.iwt.be/

stop-shop" for firms of the technology and innovation policy in Flanders.

Nauwelaers (2001) explains:

> IWT supports and stimulates industrial research and technology transfer in the Flemish industry. All companies established in the Flemish region, and especially SMEs, can request IWT financial assistance in their projects and have IWT services at their disposal. Furthermore, IWT has been assigned a co-ordination mission of all technology transfer and innovation intermediaries in Flanders. (9)

2. RESEARCH INSTITUTIONS

During the 1980s and early 1990s, the Flemish government developed a STI policy focused on three sectors: microelectronics, new materials, and biotechnology. Between 1984 and 1995, it created three specialized research institutions with a strong mandate for research valorization and technology transfer to support this policy: IMEC, VITO, and VIB.

2.1 Inter-university Institute for Microelectornics (IMEC) [51]

In 1984, the Flemish government created IMEC which conducts fundamental research and also has a strong mandate of technology transfer to industry. With IMEC, the Flemish government expected to attract international firms thanks to the creation of a center of research excellence and to enhance the know-how of local firms in microelectronics.

2.2 Flemish Institute for Technological Research (VITO) [52]

VITO was the second specialized research institute created by the Flemish government in 1991, as part of its STI policy. The "Vlaamse Instelling voor Technologisch Onderzoek," or the Flemish

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51 http://www.imec.be/ english/

52 http://www.vito.be/english/

Institute for Technological Research, is devoted to energy, environment, primary and advanced materials. VITO "carries out market-oriented technological research, and develops innovative products and processes." VITO positions itself as a demand-oriented research, with a key mission of knowledge transfer and technological innovation to the benefit of government and industry.

2.3 Flanders Inter-university Institute for Biotechnology [53]

In 1995, the Flemish government created a third specialized research institute, VIB. It combines nine university departments and five associated laboratories and more than 700 researchers and technicians. VIB has three mandates. The first objective is to conduct first class research. The second objective is the transfer of technology by means of license agreements or through spin-offs. The third mission is public relation to familiarize the public with biotechnology and legitimise it in its eyes.

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53 http·//www.vıb be/ englısh/

Appendix 4.3. - Summary of Characteristics of Universities and Research Institutions with Regard to Spinning Off Ventures, 1980-1995

	UNIVERSITIES					Research Institutes	
	KUL	**RUG**	**UCL**	**ULG**	**ULB**	**IMEC**	**VIB**
Policy regarding spin-off ventures	Passive support	No	Generally opposed; Occasional support	Not allowed 1993-97	No	Mandate of technology transfer including spin-off	Not applicable, founded in 1995
Origination of projects	Individual initiatives	Individual initiatives	Individual initiatives	Individual initiatives	Individual initiatives	Mixed, IMEC and individual initiatives	
Technology transfer departments	No (but industrial liaison office)	No	No, but industrial liaison office	No, but industrial liaison office	No, but industrial liaison office	Yes	
IP Capability	No	No	No	No	No	Yes	
Business plan development capability	No	No	No	No	No	No	

	UNIVERSITIES					Research Institutes	
	KUL	RUG	UCL	ULG	ULB	IMEC	VIB
Funding Capability	Minimal, Own funds. EUR 12,500 – 62,500	No	Minimal, Own Funds EUR 12,500 – 62,500	No	No	Yes, Own limited funds and industrial partners (case by case basis)	
Business coaching capability	No	No	No	No	No	No	
Spin-off venture	17	13	4	14	0	5	

Appendix 4.4. - Summary of Government Policies Relevant to Spinning Off New Ventures from Universities and Research Institutions, 1996-2000

	FLANDERS	WALLONIA
R & D Expenditures	• Increase of 10% to 16% yearly increase to reach 2/2% of GRP [54]	• Increase in late 1990s, but in 1999 still below European average of 1 4% of GRP
Regulatory Changes	• 1995 – 1998. Transfer of intellectual property of publicly funded research to universities and research institutions	• 1998. Transfer of intellectual property of publicly funded research to universities and research institutions • 1999 Decree enlarging the mission of the public investment company SRIW from restructuring to the creation of new firms.
Innovation Policy	• 1999. New innovation policy with new focus on spinning off ventures from research institutions Includes: • New expanded role of IWT as "one stop" shop" of the innovation policy • Subsidizing technology departments within universities • Subsidizing of business angel networks	• 1998. First Spin-off program subsidizing researchers with an entrepreneurial project. • 1998. Subsidizing of technology departments within universities. • 1998. Subsidizing of "valuators" in charge of promoting valorizing research to industry. • Wallonia Space Logistics program to stimulate research in space technology and technology transfer
Funding	• Growing role of GIMV. Including: • 1996. Creation of EASDAQ • Creation of VC fund IT Partners • 1997 – 1998. Co-invests in first two spin-off ventures of VIB • 1999. Co-invests in funds of universities of Gent, Antwerp, and Limburg	• 1999. Creation of investment fund FIRD • 1999. Creation of investment fund Start-it

54 GRP: Gross Regional Product

1. Policies of the Flemish government

The main aspects of this STI policy that are relevant to academic spin-off initiatives are:

- The increase in R&D spending.
- The transfer of intellectual property to research institution in 1998.
- The reorientation of the STI policy with a new focus on spinning off new ventures from research institution.
- The multiplication of funding sources for academic spin-off initiatives.

Between 1980 and 1995, the Flemish government had developed a focused STI policy. In this policy, however, technology transfer from academic institutions only marginally included spinning off ventures from research institutions. This policy, which would play a key role in the late 1990s, involved the creation of two dedicated institutions to carry on this policy:

- GIMV (1980), the government's investment company, which played a growing role of venture capitalist, funding "champions" supported by government policies.

- IWT, the Institute for Science and Technology, (1991), the "one stop shop" agency for science and technology providing not only financial subsidies, but also a "soft" co-coordinating role.

There were also three inter-university research centers in sectors that have a strong mandate of commercial exploitation of research and transfer, selected by the government's science, technology, and innovation (STI) policy (Capron, 2000; Nauwelaers, 2001): IMEC, the Institute for Microelectronics, (1984); VITO, the Flemish Institute for Technological Research, (1991) conducting research in energy, environment and materials; and VIB, Flanders Institute for Biotechnology.

1. 1. R & D Expenditures

Table 1 - **Evolution of Budgetary Credits for R & D Policy in Flanders, 1990-2000**

Year	**Total Budgetary credits for R & D in the Flemish Community (Mio EURO)**
1990	255.3
1991	278
1992	265.6
1993	304
1994	317.4
1995	368
1996	429.7
1997	479.6
1998	518.2
1999	575.1
2000	599.8

Source: CFS/Stat ; Data computation: OSTC, 2001. Extracted from Nauwelaers (2001)

A considerable effort had been made to increase spending on STI. The government of Flanders raised its research and technology budget every year in order to reach the objective of 2.2% of the gross regional product, which corresponds to the European average. [55]

1.2. Regulatory Changes

First in 1995 and again in 1998, intellectual property of government-funded research was transferred from the government to research institutions and to a lesser extent to their researchers. Research institutions were given more autonomy in negotiating intellectual property with industrial partners. Conditions under which research institutions could establish spin-off ventures were defined. [1] Similar to the Bayh-Dole Act in 1980, this is credited with increasing research valorization by universities (Owens-Smith et al., 2002).

[55] "Since the middle of the 90s, the Flemish government has committed to a catching-up process for the overall R&D activities and public investments in the region. Since 1993, nominal yearly increases in the governments' budget for STI policy have been very important, exceeding 10% in several years with a peak at 16% in 1995. Between the start and the end of the decades, the credits have more than doubled, in nominal terms." Nauwelaers (2001: 55)

In 1999, a Federal regulation was adopted that made it practically possible for companies to issue stock options. [56]

1.3. Innovation Policy Initiatives

In 1999, the Flemish Parliament adopted an innovation decree, a major in Flemish STI policy. This decree broadened the policy target, as well as the role of the implementing institution IWT, to cover technological innovation as well as science, research, and technological development activities.

Nauwelaers (2001) writes about the innovation decree:

> The decree acknowledges that besides technology, non-technological elements such as: market orientation, financing, intellectual property, management, training, etc. are all crucial elements of the innovation process. Therefore, there is a need, it is stated, for better and deeper co-ordination and collaboration between innovation actors, in the view of developing an efficient and synergetic innovation system in Flanders. Promoting networking and decreasing bureaucratic burden are two horizontal key themes in the new pol-

[56] Prior to that stock options were allowed, but were not practical to issue due to the lack of practical dispositions and uncertainties as to how they would be taxed.

icy...IWT becomes the operator, the "one-stop-shop" and cornerstone of the technology and innovation policy in Flanders. Its primary role in technology policy is to deliver financial means for research with industrial objectives, support enterprises for technology transfer, and foster technology diffusion on the enterprises side, and to deliver applied research funding and specialization grants on the university side...The major innovations introduced by this decree to reach its goals are:

1. New modes of acknowledgement and support for clusters and collective research centres, conceived as "innovation centres"[57].

2. Changes in the direct support system for R&D in enterprises: enlargement of the eligible costs, further specification of selection criteria; specific attention to SMEs; higher support for the collaborative projects; shortening and simplifications of procedures.

[57] These provisions were still pending approval at the time of writing this chapter

3. Support to university interfaces for the valorisation of collaborative projects between universities and enterprises, for the valorisation of university research, and for the creation of spin-off companies. A network of university interfaces is set up too, co-ordinated by IWT.

4. Improvement of the policy planning process: Every four years, the Flemish government has to submit for the approval of the Parliament, an innovation policy plan containing a report on past actions and a definition of future actions and objectives. (56)

We can perceive in this text the enlargement of the policy to aspects of management of innovation rather than strictly support to R&D, as well as references to academic spin-off ventures: "besides technology, non-technological elements such as: market orientation, financing, intellectual property, management, training, etc. are all crucial elements of the innovation process." The text also points to "specific attention to SMEs" and to "support to university interfaces for the valorization of collaborative projects between universities and enterprises, for the valorization of university research, and for the creation of spin-off companies."

There were several specific initiatives within this policy that are relevant to academic spin-off initiatives. In 2000, the Flemish government initiated a EUR 1.3 million program for the funding of "interfaces;" i.e., industrial liaison offices of universities, with the aim of promoting entrepreneurship within universities and the valorization of research results. This program is available for stimulation of co-operation between university and industry, promotion of the creation of spin-off companies, valorization of research results in industry, and dealing with IPR in universities.

In the framework of a European Business Angels program, the Flemish Government supported the setting up of Business Angels networks (BAN) in Flanders. In May 1999, the government agreed on a subsidy for five BAN. The EU finances 50% of the feasibility study and 50% of the pilot phase of these BAN. [58]

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[58] http://www.beban.be/

Finally, in the late 1990s, numerous other initiatives within this policy reflected the overall policy of supporting technology valorization and entrepreneurship. [59]

1.4. Funding Initiatives

Funding initiatives multiplied, especially initiatives consisting of providing early stage funding. Meanwhile, the role of GIMV as the major provider of venture capital continued to grow so that most pubic initiatives involved GIMV .[60] For example:

- In 1996, GIMV participated with IMEC and with other investors in the creation of IT Partners, a EUR 65 million venture capital fund specializing in IT, which became the privileged financial partner of IMEC.
- In 1997 and 1998, it co-invested in the first two academic spin-off ventures of VIB.
- In 1999, it became co-investor in the University of Gent's investment fund, the Baekeland fund.
- In 2000, it co-invested in Antwerp Innovation Centre (AIC), a fund of the University of Antwerp.

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[59] In 1999, the government launched the VIS "Vlaamse Innovatie Samenwerkingsverbanden" (Flemish Co-operation networks for Innovation). It created the "SME-Innovation Network" in 2000; it launched the SME-Technological Innovation Program ("KMO-IWT Network") in 2001 Nauwelaers (2001) provides an exhaustive description of all these policy initiatives.

[60] http://www.gimv.com/

In addition, in 1996, GIMV participated in the creation of EASDAQ, a new pan-European exchange for growth companies modeled after NASDAQ. In 1997, GIMV itself was listed on the Brussels Stock Exchange. In 1998, GIMV positioned itself as a European investment company with Flanders as its base.

2. Policies of the Walloon Government

The main aspects of this STI policy that are relevant to academic spin-off initiatives are:

- the increase in R&D spending,
- the transfer of intellectual property to research institution,
- the reorientation of the STI policy with a new focus on spinning off new ventures from research institutions,
- the multiplication of funding sources for academic spin-off initiatives.

2.1. R & D Expenditures

Table 2 - **Evolution of Budgetary Credits for R & D Policy in Wallonia, 1990-2000**

Year	**Total Budgetary credits for R&D in the Walloon Region (Mio EURO)**	**Total Budgetary credits for STI French Community (Mio EURO)**	**Total**
1990	39.4	166	205.4
1991	45.7	170.8	216.5
1992	56.7	171.5	228.2
1993	66.6	193.5	260.1
1994	72.5	190.1	262.6
1995	66.3	183.6	249.9
1996	67.8	199	266.8
1997	89	197.2	286.2
1998	104	202.8	306.8
1999	133 4	207.4	340.8
2000	132.6	210	342.6

Source: CFS/Stat; Data computation: OSTC, 2001. Extracted from Nauwelaers (2001: 29)

In the late 1990s, the R&D budget in Wallonia noticeably increased. The French Community's own R & D budget also increased significantly during this time. The years 1997, 1998 and 1999 saw a strong rise reflecting the "catching-up" goal of the Walloon R&D policy (Nauwelaers, 2001: 29). However, in spite of these increases, the Walloon R&D budget represented only 1.4% of GNP in 1999, compared to 2.16% in Europe and 2.2% in Flanders (DGDRT, 1999: 4). In addition to the relative under-investment, resources had not been used efficiently because research efforts have suffered from fragmentation (DGDRT, 1999: 4). However, patterns in R&D spending show a turnaround compared to the period prior to 1996.

2.2. Regulatory Changes

Similarly to what happened in Flanders, the Walloon Region decided to transfer the intellectual property of research results for projects carried out with regional funds from the Region to universities. The aim of this move was, obviously, to encourage universities to exploit the results of their research. In order to give the universities the means to exploit this intellectual property, the region initiated two new forms of support to universities. The public Walloon Regional Investment Society (SRIW) had traditionally focused its activity on the restructuring of traditional industries. In 1999, a decree removed the intervention operations from SRIW's objectives. It started, as well as its more local branches, to support new industrial activities through the provision of risk capital (Nauwelaers, 2001: 41). Subsidiaries of SRIW were created in 1999 to specifically take over this latter function. As mentioned above, a Federal law made the issuance of stock-options possible.

2.3. Innovation Policy Initiatives

Of the two Walloon institutional entities, the Walloon Region and the French Community, the Walloon Region handles the R&D policy [61] through its implementation arm, the Directorate General for Technologies, Research and Energy (DGTRE). Wallonia does not have an institution similar to IWT in Flanders. It does not have autonomous research institutions aimed at diffusing technological know-how, similar to the IMEC, VITO, and VIB mentioned above. Wallonia's investment company, SRIW, is also different from GIMV. As mentioned above, until 1999, the focus was on the restructuring of traditional industries. It also differs from GIMV in that it did not have the experience in venture funding nor the network in the venture capital world that GIMV built since the 1980s.

In 1998, the Walloon Region launched a program called First Spin-off in favor of academic spin-off initiatives that was modest in terms of budget. [u] It was, however, significant in that it reflected a new interest among Walloon policy makers, not only in transfer of technology, but in transfer of technology through the creation of academic spin-off ventures. The Region takes in charge the salary

[61] The STI policy is handled in Wallonia by two political bodies: the French Community and the Walloon Region. The French Community mainly finances fundamental research conducted in universities

costs of a researcher for two years to conduct a feasibility study of the valorization of results of research into a commercial venture. Twenty researchers have benefited from this program since 1999. [iii]

The Walloon Region took in charge the costs incurred by the universities for patenting inventions stemming out from these publicly funded research. In addition, it started to support the salary costs of "valuators", located in university interface structures and in higher education institutions, in charge of promoting the valorization of research results in industry. The mission of these persons is to establish contacts between researchers and potential industrial partners, help write business plans and find investors willing to finance the commercial exploitation of research results. They also have the mission to advise university members on IPR aspects. (Nauwelaers, 2001).

In 1998, the Walloon government created "Wallonia Space Logistics" as a partnership between the Walloon Region, the University of Liège, and private investors to valorize expertise of the university and of the "Center Spatial de Liège" (Space Center of Liège) in view of technology transfers. The government funded the project with EUR 25 million. It involves two aspects. First, a research aspects giving further means to the Liège Space Center for undertaking a transfer of scientific knowledge to industrial applications. Second, an economic aspect aiming at exploiting research results into commercial ventures (Nauwelaers, 2001: 37). It involved the building of an incubator.

2.4. Funding Initiatives

As mentioned above, the public Walloon Regional Investment Society (SRIW) had traditionally focused its activity on the restructuring of traditional industries. In 1999, a decree from the Walloon government assigned a new mission to SRIW consisting of supporting new industrial activities through the provision of risk capital. Several subsidiaries were created for this purpose:

- In 1998, SRIW, through its sub-regional public investment company Meusinvest, created a EUR 1 million seed stage fund that invests in academic spin-off ventures in partnership with the Université de Liège (ULG).
- In 1999, FIRD (Fonds pour l'Industrialisation des résultats de la Reserche – Fund for the Industrialization of Research Results) with EUR 12.4 million to support companies wish-

ing to exploit the results of research co-financed by the Walloon Region.

- In 1999, Technowal, to support projects that did not benefit from public subsidies. It invests in start-ups of established technology firms.
- In 1999, a daughter company, Start-it, with EUR 11 million, focuses on mature high tech ventures, taking significant stake in companies, in the range of EUR 250,000 to 620,000, and participating actively in their management. Start-it was co-founded with local institutional investors from the private sector.

In 1999, the government sponsored the creation of business angels networks within the framework of a European program in favor of such networks. [62]

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1 Up until 1995, the intellectual property of publicly funded research belonged to the government. The legal framework of intellectual property rights changed in the late 1990s in favor of research institutions and of researchers. The decree [1] of 22 February 1995 determined that research results, which can lead to valorization (including patents, licenses and other IPR) must be divided between the university or research center and the principal of the contract. Article 103 of the decree of 29 August 1998 determines that IPR from research carried out by university researchers belong to university, without leaving out the

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62 http.//www.waban be/

possibility of negotiating contracts with third parties (and thus dividing IPR between industry and university). A researcher can claim the rights if university fails to exploit them within 3 years after filing the research results The same regulations are used for research projects financed by the two Interuniversity research centers in Flanders: IMEC, VITO and VIB.

ii There are two types of FIRST programs. First Enterprise and FIRST Universities. FIRST-Enterprise aims at fostering the hiring of researchers in enterprises, while working part time in a research laboratory, and at promoting the transfer of knowledge between his research laboratory and the enterprise. FIRST Universities aims at promoting of knowledge from the universities to the industrial world by university researchers, either in the form of doctorate theses jointly supported by the university and a company (FIRST Ph.D), or to support research projects in universities carried out in collaboration with a Walloon enterprise and another research organization located in the EU (FIRST Europe). In 1999, EUR 11 7 million were devoted by the Region to the FIRST Universities program, indicating its modest size (Nauwelaers, 2001: 38).

iii "FIRST Spin-off offers 20 scholarships to researchers each year During the project, they work on the completion of a product, a procedure or a new innovative service concept, they carry out an economic and technical feasibility study, and write a business plan for the creation of a spin-off. The researcher must commit himself to participate in entrepreneurship and management courses during the project (normally taking 2 years, and renewable by 1 or 2 years) At the end of the project, the researcher hands in a report stating the scientific and technical realisations, and indicating the possibilities to start up industrial and commercial activities based on the research. Next to this, the report contains a business plan, financial plan and an estimation of the market The researcher is followed by someone who has experience in the creation and management of companies. Financing covers the remuneration and courses of the researcher, and is fully covered by the Walloon region A lump-sum payment of 5 000 Euro is foreseen for the applying research institute. Conform the decree of 17 December 1997, research results belong to the university However, if the researcher decides to start up a company based on his research at the latest 3 months after the end of the scholarship, the university has to attribute a license to the researcher that: is free during the first 5 years after company start-up, cannot be transferred to third parties without the former approval of university; is exclusive on the condition that exploitation of results becomes effective in a time period that has to be determined by the university and the company. If the company fails to exploit the results before expiration of this period, the license becomes non-exclusive." (Clarysse et al 2001: 85)

Appendix 4.5 - Summary of Initiatives in Favor of Academic Spin-off Ventures by Universities and Research Institutions

	KUL	**RUG**	**IMEC**	**VIB**	**UCL**	**ULG**
Change of policy	1997	1999	1996	Founded 1995	1999	• 1997. Lift ban on spinning off ventures • 1999 Financial and business plan support
Creation of fund	1997. EUR 6 million Partnership with banks	1999. EUR 2.5 million Partnership with banks and GIMV	1996 EUR 65 million Privileged financial partner: IT Partners 2001. Creates seed fund in partnership with banks	1996. EUR 35 million Privileged financial partner: GIMV's Flanders Biotech Fund	1999. EUR 12.5 million Sopartec No financial partners	1997. EUR 6 million Partnership with banks
Technology valorization	• 1998 Hires 2 co-directors of tech transfer unit. One with public sector and industry		• 1996 – 2000. Technology valorization team grows to 20 staff members. Pro-	• 1996 – 2000 Technology valorization team grows to 7 staff members, pro-	• 1996 – 2000 Technology valorization team grows to 6 staff members	• Hires director with industry experience to head industrial liaison

	KUL	RUG	IMEC	VIB	UCL	ULG
	experience • 1999. Starts to put in place IP capability • 1999 – 2001. Hires 5 part time staff members with IP expertise • 1999. Experiments with ways to identify technologies with commercial potential within the university		Pro-active technology opportunity search • 1996 – 2000 Focus on spin-off projects with high potential meeting criteria of venture capital from the outset	active technology opportunity search • 1996 – 2000 Focus on spin-off projects with high potential, meeting criteria of venture capital from the outset	• 1999. Hires director with industry experience • 1999 Creates unit to support spinning off initiatives: Sopartec. • 2000. Creates technology valorization unit within Sopartec • 2000. Initiates strategic partnership with industry	office; • Hires on staff member in industrial liaison office to support spin-off initiatives; Plan to hire one person with IP management expertise
Incubation	2000-2001. Yes, within LRD		Yes, within IMEC	Yes, within VIB	No	No
Network with entrepreneurial community	• 1999. Creates entrepreneurship forum, Leuven Inc. • 1999. Expands science parks and specialization by sector		• 1998. Creates DSP Valley a network of research institutions, established technology firms and start-ups		2000. Initiates network of local spin-off ventures	

	KUL	RUG	IMEC	VIB	UCL	ULG
			• 1999. Joins Leuven Inc			
Total number of spin-off ventures (2000)	31	14	12	2	10	19
Number of spin-off ventures (1996 – 2000)	14	1	7	2	6 (4 in 2000)	5

1. Research institutions in Flanders

1.1 Katholieke Universiteit Leuven (KUL)[63]

The main characteristics that need to be emphasized are the following.

- Up until 1997, KUL had a passive policy towards academic spin-off ventures. It did not oppose individual initiatives of researchers to found academic spin-off ventures. It adopted a proactive policy in 1997.
- 1997. KUL enlarged the mission of LRD to the support of the creation of academic spin-off ventures. LRD started to actively encourage and facilitate the commercialisation of research by the establishment of new ventures.
- 1997. KUL partnered with two major Banks to create a EUR 6 million investment fund: the Gemma-Frisius Fund. The aim of the fund was to make individual investments in the range of EUR 200,000 – 250,000 in new ventures spun-off from the university.

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[63] My main sources of information for this section are my interviews at KUL and with founders of KUL spin-off ventures (see list in Appendix 2 1), B Surlemont and F Pirnay's interview with M. Hinoul and K. Debackere in 1999 and KUL's 1999 publication "KUL Spin-offs," http://www kuleuven.ac.be/admin/lr/niv3pbis/SpinOffs/, Debackere (2000), Clarysse et al (2001)

- 1998. KUL hired a former representative of a Belgian government agency in Washington and in Silicon Valley to become co-director of LRD. His main mission was to gain support from local government and business constituencies and to attract foreign firms in KUL's science parks. Prof. K. Debackere also became co-director and becomes a driving force behind the new orientation of LRD.
- 1998. KUL offered an entrepreneurship course for the first time.
- 1999. KUL, via LRD, put in place an intellectual property capability, started to manage the university's patent portfolio that was until then minimal, and started to encourage researchers to patent the result of their research that has a commercial potential
- In 1999, LRD started to push its candidate entrepreneurs to submit more ambitious projects justifying a starting capital in the range of EUR 200 000 – 372 000.
- 1999. KUL developed a formal technology opportunity search process to identify technologies that had commercial potential.

- In 1999, LRD founded "Leuven Inc.," a forum for the local entrepreneurial community, in partnership with a number of firms and with local entrepreneurs.
- In the late 1990s, KUL also embarked in an expansion policy of its science parks by making plans to create two new ones and specializing them by sector.
- 2001. LRD changed its spin-off strategy: it started to incubate spin-off projects within its own structure with small funding of EUR 30,000 – 60,000, before submitting the projects to the Gemma-Frisius Fund.
- 2001. LRD has five part-time staff members dedicated to supporting various aspects of spin-off projects.
- Number of spin-off ventures before 1996: 19
- Number of spin-off ventures between1996 and 2000: 21
- Appendix 2.5 provides a list of spin-off ventures of KUL.

Of all universities in Belgium, KUL has developed in the late 1990s the first and the most proactive policy in favour of spinning off ventures from the university's labs. KUL's academic spin-off ventures, plus the ventures spun-off from IMEC, which are also located in Leuven, form the first nascent entrepreneurial cluster in Belgium.

1.2. Rijks Universiteit Gent (RUG) [64]

Until 1999, RUG had no policy regarding academic spin-off ventures. In 1999 it partnered with GIMV and two banks to create a EUR 2.5 million investment fund, the Baekeland Fund. The fund made no investment before the end of 2000, perhaps reflecting the lack of supply of valuable entrepreneurial projects. Besides financial support, RUG did not have other forms of infrastructure to support academic spin-off initiatives. (See Appendix 2.5 for a list of ventures founded by individuals affiliated with RUG).

1.3. Smaller universities in Flanders [65]

Even smaller universities that I did not study in detail created investment funds. The Limburg University Centre (LUC) established the EUR 2.5 million Wendelen Fund in 1999 in partnership with two banks. The University of Antwerp established a EUR 3.3 million fund, the Antwerp Innovation Centre (AIC), in 2000 in

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64 My main sources of information for this section are my interview at RUG and with founders of RUG spin-off ventures (see list in Appendix 2 1), Clarysse et al. (2001), http //www.rug.ac.be/index_e.html

65 My main sources of information for this section are my interviews at LUC, with founders of LUC spin-off ventures (see list in Appendix 2 1) and Clarysse et al (2001)

partnership with public and private financial institutions. By 2000, as with the case of the fund of RUG, none of the funds had made investments yet, probably an indication of the difficulty of generating good entrepreneurial projects.

1.4. Inter-university institute for Microelectronics (IMEC) [66]

Created in 1984, IMEC is one of the two inter-university research institutions involved with spinning off new ventures. The main characteristics that need to be emphasized are the following.

- In the mid-1990s, IMEC concluded that it was not equipped to fund and to coach technology start-ups. It wanted to professionalize the management of its spin-off process. Since the performance of the half dozen ventures that it had spun-off before 1996 had been disappointing, IMEC decided to only focus on spin-off projects with high potential that would meet criteria of venture capital firms (("IPO driven" ventures) and would require initial investments of EUR 1 million at the minimum.

[66] My main sources of information for this section are my interviews at IMEC and with founders of IMEC spin-off ventures (see list in appendix 2 1), Clarysse et al (2001), http //www imec be/, http://www it-partners be/, http //www dspvalley com/1 htm

- 1996. IMEC partnered with financial institutions, including GIMV, to set up a EUR 65 million venture capital fund, IT Partners. The fund, run by professional venture capitalists, did not invest exclusively in IMEC's spin-offs, but only had a first right to examine the spin-off projects of IMEC.
- 1996 – 1999. IMEC reinforced its technology valorization unit, which grew to twenty people. It put a new emphasis on patenting and licensing.
- 1998. Forms DSP Valley, a network linking research institutions, established technology firms, and start-up firms.
- 2001. Following rejections of spin-off projects by IT partners, by the end of 2000, IMEC created a seed fund with financial partners to carry spin-off projects to the venture capital stage. [67]
- Number of spin-off ventures prior to 1996: 5
- Number of spin-off ventures between 1996 and 2000: 8
- Appendix 2.5 provides a list of ventures spun-off from IMEC.

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[67] http.//www eetuk com/story/OEG20011022S0028, http //www fabtech.org/site-global/news/2001/10/16 02 shtml

1.5. Flemish Institute for Biotechnology (VIB) [68]

VIB is the second of the two inter-university research institutions involved with spinning off new ventures. It is an inter-university biotech research institute, founded in 1995, by the regional Government of Flanders. The main characteristics that need to be emphasized are the following.

- In 1995, with the creation of VIB, the Flemish government made a substantial commitment to biotech. It provided VIB with annual funding of EUR 25 million.
- VIB has three mandates. The first objective was to conduct first class research. The second objective is the transfer of technology by means of license agreements or through spin-offs. The third mission was public relation to familiarize the public with biotechnology and legitimise it in its eyes.
- Research was conducted in the nine university departments and five associated laboratories. VIB focuses on identifying research findings with commercial potential in its nine university departments and five associated laboratories, on pro-

[68] My main sources of information for this section are my interviews at VIB and with founders of VIB spin-off ventures (see list in Appendix 2.1), Clarysse et al. (2001), http //www vib.be/frame cfm; http.//www gimv.com/

tecting the intellectual property of the research results, and commercialization. In order to do that, VIB had a technology valorization team of seven people with research and industry experience.

- In 2000, VIB had spun-off two ventures: Devgen in 1997 and CropDesign in 1998. Both were ambitious projects raising initial capital of EUR 8.5 million and EUR 4.5 million.
- VIB's privileged financial partner is the public Flanders Biotech Fund managed by GIMV. This fund did not invest exclusively in spin-off ventures of VIB and, when it did, it co-invested with international venture capitalist firms.
- VIB policy towards spinning-off ventures was thus similar to IMEC's, focusing on high potential venture projects meeting criteria of venture capitalists. This policy was probably also determined by particularities of the biotech industry.
- 2000. VIB launched the project of building an incubation center near its existing facilities, which would be operational in 2003.
- Number of ventures spun-off from VIB between 1997 and 2000: 2

1.2. Research Institutions in Wallonia

1.1. Université Catholique de Louvain (UCL) [69]

The main characteristics that need to be emphasized are the following.

- 1998. Ion Beam Application (IBA), a firms spun-off in the mid 1980s from UCL, went successfully public. Following this IPO, the stake of UCL in IBA grew to EUR 30 million according to various sources. This event triggered interest of UCL for technology transfer and for academic spin-off ventures in particular.
- 1998. UCL launched an academic program about managing SMEs
- 1999. the Walloon government's program, First Spin-off, effectively started. It subsidized researchers with an entrepreneurial project. UCL actively encouraged researchers to apply for the subsidy
- 1999. UCL transformed a passive holding company, Sopartec, into an active investment fund (funded primarily with the proceeds of IBA's IPO) investing in spin-off ventures

[69] My main sources of information for this section are my interviews at UCL and with founders of UCL spin-off ventures (see list in Appendix 2 1), Clarysse et al. (2001), Capart (2001), http://www.ucl.ac be/recherche/valorisation html

of UCL. UCL did not partner up with financial institutions. It hired a former executive from a local Pharmaceutical company as head of Sopartec.

- 1999. UCL advertises the opening of a faculty position in entrepreneurship.
- 2000. Sopartec got assigned a third role: the management of intellectual property at UCL by fostering patenting licensing that had not been actively pursued until then.
- 2000. UCL, via Sopartec, initiated "strategic partnerships" with industry that offer synergy, whereby the university lab takes over the research part of the project.
- 2000. UCL planned the project of building an incubation center, which would include an incubator and would be operational in 2003.
- 2000. UCL creates a first faculty position endowed by a company in "management and financing of the technological Innovation."
- 2001. From one staff member in 1999, Sopartec grew to six
- Number of spin-off ventures prior to 1996: 8

- Number of spin-off ventures between 1996 and 2000: 6 (including 4 in 2000).
- Appendix 2.5.provides a list of ventures spun-off from UCL.

1.2. Université de Liège (ULG) [70]

The main characteristics that need to be emphasized are the following.

- 1997. From 1993 to 1997, spinning-off ventures from ULG was not allowed.
- 1998. ULG broadened the mandate of its industry liaison office "Interface" to include technology valorization through the creation of enterprises. It hired Mr. Morant a former executive from industry to oversee Interface and a staff member with experience in marketing to support spin-off initiatives. A plan existed in 1999 to hire a staff member with knowledge in patent law.
- 1998. Creation of a EUR 1 million seed fund, "Spinventure," in collaboration with a local public investment company.
- 1999. Creation of courses in entrepreneurship
- Number of spin-off ventures prior to 1996: 13

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[70] My main sources of information for this section are my interviews at ULG and with founders of ULG spin-off ventures (see list in appendix 2.1); Clarysse et al. (2001); Surlemont and Pirnay (1999); Pirnay (2001); http://www.ulg.ac.be/entreprises/english/index.html

- Number of spin-off ventures between 1996 and 2000: 6.
- Appendix 2.5 provides a list of ventures spun-off from ULG.

1.3. Université Libre de Bruxelles (ULB) [71]

Among the largest universities, ULB is the one that seemed to have taken the least initiatives in favour of technology transfer. The only identifiable initiative is the advertising of the government's First Spin-off program.

[71] My main sources of information for this section are my interviews at ULB and with founders of VULBIB spin-off ventures (see list in Appendix 2.1); http://www.ulb.ac.be/ulb/docs/interface.html

Appendix 6.1. – Analysis of outliers among firms founded prior to 1996 from the point of view of their characteristics at founding

As mentioned above, three other firms were outliers: Eurogenetics, Hypervision and Polyflow. I did not rank one firm, Organic Waste System, because of lack of data.

a) Eurogenetics

Eurogenetics is a biotech firm founded in 1984. It is a spin-off of the Willems Institute, a research institute in biotech established in the 1970s with funds of the European Union's regional development fund. The Institute was set up with a clear mission of technology transfer, which lead to the founding of Eurogenetics. The firm really results from the encounter of the Willems Institute's Director, Professor J. Rauss and Mr. E. Smets, then a manager in charge of European sales at pharmaceutical firm Abbot. Local political connections lead the governor of the province of Limburg where Eurogenetics and the Willems Institute are located to raise EUR 0.75 million from about 30 close acquaintances. Eurogenetics thus started with 30 "business angels." Mr. Smets tried to complement this insufficient funding with revenue from distributing pharmaceutical products of foreign firms in Europe. Distribution was the business he really knew.

Thus, Eurogenetics departs from the SME model in a number of ways. It opens its capital to outside investors and raises an amount significantly superior to SMEs. However, its capital base is still small for a biotech firms, especially, since it will turn out, the initial investors were not ready to invest more and the firm did not develop contacts with venture capital firms. The management is more professional than in SMEs; but, Mr. Smets had no experience in biotech and his experience seemed quite narrow in the domain of sales. There does not seem to have been management and business experience besides him.

Eurogenetics is an interesting example of the experimental dimension of entrepreneurial endeavor, which tried to overcome the SME model. There were really no entrepreneurial competencies around to guide entrepreneurs and their supporters.

b) Hypervision

Hypervision is a spin-off of the Katholieke Universiteit Leuven (KUL) and more specifically of its department of Communication Science. In the 1980s, the department developed a new division of communication technologies to train students in the emerging multimedia technologies. From there it expanded into training and creating multimedia projects for other companies. Similarly to the case of Epas described above, the commercial activity could no longer be handled by the academic department. As a result, Dr. De Groof, the professor in charge of the division of communication technologies, decided to found Hypervision 1991.

Hypervision raised EUR 1.25 from the Dutch electronic giant Phillips and from various local companies active in the media and publishing industries. Phillips' interest was related to its recent launch of the "CD-i." Curiously with such important financial resources and industrial partner, no real management team was put in place. It is difficult to assess retrospectively the growth orientation of the firm at founding, but since then signs have pointed towards a suspicion of the founder against growth. Hypervision seems to have been founded with capital typical of a venture capital-backed firm, but with a human resources infrastructure and business model more typical to traditional SMEs. Hypervision was based on the CD-ROM technology and, as its founder admits, it missed the rise of the Internet. It is a puzzling case. As often with unsuccessful companies, information is hard to obtain.

c) Polyflow

Polyflow is a spin-off of the Université Catholique de Louvain (UCL) founded in 1988 by Professor M. Crochet based on the research of his lab on complex rheology flows. This research developed new viscoelastic models and translated them into software. The success achieved by this research team attracted the interest of industry and by 1988; the lab had sold twenty licenses for the software. This commercial activity was increasingly not compatible with the research activity of the lab, so Crochet and three other researchers founded Polyflow in 1988.

UCL resisted the creation of Polyflow and only reluctantly funded it with EUR 62,500, while the founders invested themselves small amounts. Polyflow continued the commercial activity initiated from within the lab with a founding team composed only of scientists. Polyflow thus departs from the traditional SME model by raising outside funding. However, the size of the funding is similar to SMEs. The growth orientation at founding is not easy to assess; however, signs point towards a low growth orientation. Indeed, in spite of being founded at relatively advanced stage of development with a product and with clients, Polyflow's founders did not include marketing and sales capabilities in the team. Further, founders and other sources report that UCL was suspicious of growth and wanted to limit its financial risk.

The company that I did not rank, Organic Waste System (OWS), was created in 1988 by scientists originally working at the Rijks Universiteit Gent (RUG). OWS' technology converts organic waste into biogas and a stable humus-like product. OWS also offers laboratory testing and consulting services. Because OWS rejected a request to be interviewed and only replied to a questionnaire, the data on this firm is more limited, especially about its founding stage.

Appendix 6.2 – Forms after founding of firms created before 1996

Firm	founding date	academic institution	Capi-tal	Owner-ship	Management	Indication of Growth	Type at foun-ding	Type after foun-ding
Androme	1989	LUC	1	1	1	1	SME	SME
Tri-Consult	1989	KUL	1	1	1	1	SME	SME
IMO	1989	KUL	1	1	1	1	SME	SME
Metalogic	1991	KUL	1	2	1	1	SME	SME
Easics	1992	KUL	2	2	1	1	SME	SME
EPAS	1992	RUG	1	1	1	1	SME	SME
ISMC	1995	KUL	1	1	1	1	SME	SME
Neurotec	1994	UCL	1	1	1	1	SME	SME
Micro-belcaps	1995	ULG	1	1	1	1	SME	SME
Belsim	1986	ULG	1	1	1	1	SME	SME

Firm	founding date	academic institution	Capi-tal	Owner-ship	Management	Indication of Growth	Type at foun-ding	Type after foun-ding
DAP	1988	KUL	1	1	1	1	SME	SME
Gamma	1983	LUG	1	1	1	1	SME	SME
STAG	1994	Other	1	1	1	1	SME	SME
Materialize	1990	KUL	1	1	1	1	SME	SME
Krypton	1995	KUL	1	1	1	1	SME	SME
OWS	1985	RUG	3	2	1	1	SME	SME
Biocode	1989	LUG	2	2			SME	
Destin	1993	LUC-IMEC	2	2	1	2	SME	Outlher
ICOS	1982	KUL	3	3	3	3	SME	Growth-oriented
Iris	1983	UCL	3	3	2	3	SME	Growth-oriented
Frontier De-sign	1979	KUL	3	3		3	SME	Growth-oriented
Netvision	1995	KUL	2	2	2	2	SME	Growth-oriented

Firm	**founding date**	**academic institution**	**Capi-tal**	**Owner-ship**	**Management**	**Indication of Growth**	**Type at foun-ding**	**Type after foun-ding**
Eurogentec	1985	ULG	3	3	2	2	SME	Growth-oriented
Euroge-netics	1984	Othe r	3	2	2		Outlier	Industry sale
Sinvaco	1988	RUG					Outlier	Industry sale
Polyflow	1984	UCL	1	2	1		Outlier	Outlier
Hypervision	1990	KUL	3	2	1		Outlier	Outlier

Appendix 6.3 – Case of a SME founded between 1996 and 2000

Fluidco was founded in 1997 by four researchers from University X. Four researchers from the university started working together in 1993 on two research projects funded by the European Commission. It was within this context that, in 1996, the four colleagues started to discuss the possibility of forming a start-up to commercialize the results of their research in the optimization of fluid dynamics. In 1997, they founded the company. During the incubation period of 1996, the four partners initiated contacts with industry, which encouraged them to go ahead with their project launch. They submitted their project to University X's "R&D Interface," the department in charge of coordination with industry and contract research.

Fluidco was the first spin-off project to come out of University X, and the discussions on its formation were, according to the founders, laborious because University X had no experience in drafting licenses, creating investment agreements, or investing in spin-off firms. Based on my interview with the founders, I understand that both parties had held exaggerated expectations in terms of the share of ownership and of the financial benefits that they thought they were each entitled to. Typical of the fragmentation in Belgium and Europe, University X visited another university, which had some experience spinning off firms, but, according to a founder, it was not helpful. To get help, University X turned to the Administratie Wetenschap en Innovatie (AWI), the Flemish regional administration in charge of technology and innovation. AWI, which had no experience itself in spinning-off firms from research institutions or in technology start-up firms, hired a business consultant to assist University X and the founders craft an agreement.

Fluidco was founded with the minimum legal capital of EUR 62,500, a sum raised from among the founders, three relatives of the founders, the professor who was the head of the founders' lab, and University X. The board was composed of the founders, a lawyer (who was a friend of the founders), and a representative of a supervisory committee of University X. Typical of SMEs, capitalization was minimal and the ownership, as well as the board, was relatively closed. Also typical of the late 1990s, when research institutions started to support spin-off initiatives, their support was limited to a small seed investment, but they offered no coaching.

The representative of University X on the board was supposed to advise the founders, but, according to them, were passive. The founding partners were, however, content with this situation, because they were suspicious of outside interference in their firm. They appeared to be willing to take advice only from their lawyer-friend. They were also opposed to other outside capital, having had to accept, reluctantly, the university as a shareholder.

The four founders were all researchers who possessed no business experience. At founding, only one of the four was on the payroll of the firm, while the three others continued to work at the university lab until the end of the last research contract in late 1999. Only then were they going to join the firm, which represented a major challenge for Fluidco, because it would have to be able to support three more people. The second person on the payroll was a graduate of a community college with a marketing degree and six months of work experience. It was unusual for this type of firm and for founders with such a strong engineering culture to hire someone with a marketing background; however, in this case, the marketing recruit was a very junior person.

The precise nature of the company's product and market was still not well defined. Fluidco was working on two software packages for cathodic protection against corrosion of pipelines, storage tanks, and water treatment plants. The business plan mentioned that such simulation instruments are common in mechanical and aerospace industries, but not in the electro-chemical sector. Fluidco is working on one package for the gas distribution industry and one for the electro-chemical industry. The market focus was very broad and, curiously, did not match the sectors mentioned above, when the founders talked about the product.

Fluidco's founders cited the following firms as their potential clients: Philips (electronics), Siemens (electronics), Bosh (electronics, auto parts), Beckaert (steel cables), and firms in the gas industry in general. Fluidco realized revenues of EUR 2.5 million in 1997 and of EUR 3 million in 1998 and 1999. In 1999, like many academic spin-off firms founded in the late 1990s, Fluidco lived off local and European subsidies, financing research at the firm level. These subsidies served as a kind of de facto seed funding, but they were targeted towards scientific results, not commercial ones.

The business model adopted by Fluidco's founders is clearly one of contract-based work and, more specifically, of consulting. I asked them what other firm they would consider a model for Fluidco. After some thought, they answered that they would consider Leuven Measurement System (LMS) founded in 1979, one of the first academic spin-off firms from the Katholieke Universiteit Leuven (KUL). LMS was a technical consulting firm that had grown organically over the years and was based on a strong engineering culture.

The founders view growth with suspicion. While the professor who headed the department which Fluidco was spun off from, was pushing the founders to shoot for an IPO, they were opposed to such an idea because it would demand opening the firm to others. The naiveté of the professor's position is, in itself, interesting, given the early stage of the firm and its lack of management and business resources. It is probably representative of the atmosphere that prevailed during the late 1990s, marked by the stock market bubble. In contrast, the founders stressed that first and foremost, they wanted to be their "own bosses." They dismissed a prominent Flemish technology start-up that had recently gone public, as "a lot of noise" and as a firm that did not do "real engineering work." Fluidco's model is Leuven Measurement System (LMS), of which a Fluidco founder sayd: "Like us, they [LMS] do software, they are low profile, and, like LMS, we will never become a large firm."

Thus we find in the case of Fluidco the features of a small capital base, a reluctance towards outside capital, a management team that was essentially technical, and a rejection of growth. We also observe that the venture was founded at an early stage with little business skills and a vague business model. The founders did not appear to use their research grants and their consulting as a learning experience to build a business model, which would leverage their expertise, but they seemed to be content with pursuing on a consulting model.

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