CHAPTER 1

VENTURING AND CLUSTERING IN AGRI-FOOD AND HIGH-TECHNOLOGY HOT SPOTS

An introduction

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INTRODUCTION

Innovation and entrepreneurship in the high-technology industries are very much in the news: the active pursuit of breakthroughs in information technology, bio-medical sciences, nanotechnology and genomics, the worshipping of successful entrepreneurs and entrepreneurial firms in business clusters (e.g. Silicon Valley, Cambridge, Leuven – Flanders) and the emergence of user–producer communities (like the global and local Slow Food Movement). In addition to the pioneering efforts by entrepreneurs and firms, policy makers are promoting the formation of techno-industrial clusters and regional communities in which start-up firms, investors, larger companies and various other supportive institutions work together. Various (f)actors have been mentioned in the literature why knowledge clusters and high-tech valleys can (could) become successful. Some researchers have referred to the knowledge base which may spawn key product and process innovations, while others have referred to core companies, so-called flagship firms, or thriving fast-growing ventures propelling a sector or a region. Others again have referred to particular strategic inter-firm partnerships and value chains that promote trust and efficiency in transactions, or an appropriate support framework put in place by government agencies and investors, facilitating knowledge transfer and new business creation. In short, the achievement of a lasting concentration of economic

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activity within a certain geographical area depends on a number of aspects that need to be combined and integrated before a process of increasing returns and sustained development sets off. Below, we discuss the following critical skills and resources for building the roads to research triangles and high-tech valleys: i) a high level of innovative entrepreneurship, providing the inventors and business founders clusters need; ii) the availability of internationally known research centres and effective technology-transfer practices creating the rich knowledge base needed; iii) the dynamic and galvanizing input of venture capital and business networks; and iv) the supportive role of a shared cultural community characterized by collective learning, mutual trust and adjustment; and v) the increasing returns of flourishing local cluster initiatives and collaborative efforts leading to a 'success breeds its own success' dynamic.

THE START OF IT ALL: INNOVATIVE ENTREPRENEURSHIP

Entrepreneurship has something in common with alchemy (i.e. the medieval form of chemistry aimed at changing base metal into gold): both start with (almost) nothing (scrappy materials, good intentions and an ambition to create something new), and whereas the alchemist tries to make gold, the entrepreneur tries to build a company that will generate loads of money and/or fun. In (innovative) entrepreneurship a remarkable transformation takes place from a situation where there is no entrepreneur, no organization and no business opportunity, to one where there is a new man (or woman), a perceived need for a new product, concept or service, and a new venture to exploit this business opportunity. Timmons (1989, p. 1) provides an apt description of the creation and development of a venture and the alchemy of innovation: "Entrepreneurship is the ability to create and build something from practically nothing. It is initiating, doing, achieving and building an enterprise or organization, rather than just watching, analysing or describing one. It is the knack for sensing an opportunity where others see chaos, contradiction and confusion".

When we look at the variety of definitions of entrepreneurship that have been suggested, some of which focus on the extraordinary activities of great individuals and leaders, new venture creation and business entry, entrepreneurial behaviour and innovation, while others even equate it to small-business management and self-employment, we are left with a Babel-like confusion. Various domains and approaches have been distinguished, which in some cases may even contradict each other (Shane 2003). For instance, there are clear differences between the entrepreneur and the small-business owner: the former seeks to extend his business by actively pursuing innovation and growth, while the latter perceives the business as an extension of his/her personality with no major effort in marketing and innovation (Carland et al. 1984). Also, independent entrepreneurship (i.e. self-employment) and intrapreneurship (or corporate entrepreneurship) are not the same. There are, for instance, clear differences in the decision-making processes and the biases and heuristics used by entrepreneurs and managers in large organizations: compared to corporate managers, entrepreneurs will overestimate the probability of being right and over-generalize from a few characteristics or observations (Busenitz

and Barney 1997). In addition, there are various ways to achieve business ownership: one can start up, purchase or inherit a business, or alternatively be promoted by the existing owners of a company (e.g. Cooper and Dunkelberg 1986). Furthermore, venturing has been identified either as a visionary, intuitive and creative process, or as a learning process in which the focus is on the further development of skills and competences (Bhidé 2000): whereas in the former of these definitions the myth of the great idea and the charismatic leader plays a crucial role, in the latter the gradual process of building a company with a dynamic set of capabilities is considered much more important. Another pitfall in entrepreneurship is the Schumpeterian bias, in other words, a strong focus on the innovativeness of entrepreneurial ideas and practices, the creative combination of old and new technologies and the entrepreneur as an extraordinary and revolutionary force (Schumpeter 1976; 2000). As many empirical studies in population ecology literature indicate (e.g. Aldrich 1999; Hannan and Freeman 1989), the 'Schumpeterian' entrepreneur is the exception rather than the rule, and most new firms imitate rather than innovate. As such, most new organizations are simple reproductions of existing ones rather than innovative creations, and only a very few manage to do something that has not been done before. Most entrepreneurs benefit from market imperfections and optimize existing possibilities; according to Kirzner (1997), they have the ability to be alert and spot opportunities that have not yet been seen by others.

In their definition of entrepreneurship, Shane and Venkatamaran (2000, p. 218) emphasize that it is a 'nexus' that involves entrepreneurial individuals seizing lucrative opportunities: "the field involves the study of *sources* of opportunities; the *processes* of discovery, evaluation, and exploitation of opportunities; and the set of *individuals* who discover, evaluate, and exploit them". By actively linking the generation of ideas, concepts and products and the spotting and seizing of opportunities, these 'entrepreneurs' make a positive contribution to the innovativeness, economic activities and dynamics of a country. There is another ingredient we need to address in our discussion of the building blocks of entrepreneurship, and that is the new enterprise that is created by the new entrepreneur to exploit an idea or opportunity commercially and to market an innovation. In entrepreneurship research we should try to investigate the role new ventures play in furthering economic progress: entrepreneurs establish new organizations, non-entrepreneurs do not (Gartner 1989; Low and MacMillan 1988; Low 2001).

Management and organization studies have clearly overlooked the emerging organization (Katz and Gartner 1988; Gartner et al. 1992): there is a definite bias towards established firms and institutions, and the emerging organization only plays a marginal role in the various theories and research activities. With the possible exception of the population ecology school (e.g. Aldrich 1999; Hannan and Freeman 1989), with its emphasis on the vulnerabilities of new organizations (because of their liabilities of newness and adolescence), most organization theories and definitions are based on the assumption that organizations already exist: this is the "taken for granted world of the existing organization" (Gartner et al. 1992, p. 27). Given its overemphasis on these taken-for-granted and legitimate organizations

(either large or small) that are continuously reinventing and reengineering themselves (or ought to do so), one could say that existing management literature sheds little light on what could be called 'pre-organizations and sub-organizations': those emerging organizations that are still in the process of learning and experimenting, interpreting feedback from the marketplace and preparing the groundwork for a solid business, and that have a high propensity to fail. Over the last decade, attention has shifted away from the creative genius of the entrepreneur (the characteristics and functions of the entrepreneur), towards the nature and characteristics of entrepreneurial processes and events – such as opportunity identification, resource mobilization, the creation of new organizations, firm growth and networking (among others: Shane 2003; Baron and Shane 2005; Bhidé 2000; Stevenson et al. 2000; Timmons 1989). In this respect, Gartner (1989, p. 58) in his analysis of the field of entrepreneurship argued that research should focus on what entrepreneurs do instead of what they are.

It is important to emphasize that in the process of identifying and pursuing opportunities, entrepreneurial individuals – either acting on their own or inside an organization – have limited resources at their disposal and face major uncertainties and risks (in terms of demand, competition, supply, prices and the development of skills) (Stevenson et al. 2000; Stevenson and Jarillo 1990). In the initial stages, entrepreneurs often have to do more with less and use what abilities and resources they have at their disposal, which are often the ones that are hidden, overlooked or neglected by others. In other words, most firms set out with a minimum of capital and a maximum of ingenuity and improvization. Aware that attaining their goals and ambitions requires considerably greater resources than the ones to which they currently have access, entrepreneurs have to be creative in how they use and acquire their resources. In this 'bootstrapping' process (Bhidé 1992; Winborg and Landström 2001) starting entrepreneurs can fall back on several tactics, such as working from home, buying used equipment or renting equipment (instead of buying new), generating word-of-mouth marketing, not being paid for shorter/longer periods, deliberately delaying payment to suppliers, exploiting cheap and flexible labour, and turning customers into sales personnel. As Starr and MacMillan (1990) put it, they have to be parsimonious with their assets: buying only what is needed and using the rest without actually owning it, obtaining professional advice through friendship or the promise of future business, raising funds from family, bringing in cash flows before allowing major expenditures. In this phase entrepreneurs are 'hustlers' (Bhidé 1986): they act before they analyse, or act and analyse at the same time. Often the line between research and selling becomes blurred, and entrepreneurs will try to sell their product or service while they are officially looking for advice, information and initial commitment. New entrepreneurs start out with a limited amount of knowledge and pursue modest strategies, and their initial successes depends on their ability to exploit unexpected opportunities. Their success depends on their ability to transform and upscale themselves as they grow in order to benefit from their increased size, allowing them to take on more capital-intensive projects with more predictable outcomes (Bhidé 2000). On the basis of these dynamic skills and modest and parsimonious planning, entrepreneurs learn and become more ambitious. Initially, stakeholders have a low level of commitment, but

as time goes by, they may increase their commitment as the new entrepreneur proves to be a trusted partner.

SETTING THE SCENE: KNOWLEDGE AND SKILLS CREATION AND TRANSFER

The diffusion of scientific and technical knowledge on which hi-tech start-ups are based takes place through university research and teaching, through a sufficient supply of knowledge workers and through structural collaboration and networking within industry, and between industry and academia. Research centres, universities, professional colleges and vocational-training institutions play a key role in the transfer of human capital and knowledge to established companies and to new and small/medium-sized firms. Universities and other educational institutions, spawning out young scientists, engineers, managers, entrepreneurs and other highly skilled workers, provide fresh and qualified inputs to the local labour markets. Intellectual human capital tends to flourish around top-quality research universities with so-called 'star scientists' and prestigious research projects at the scientific and technological frontier play a key role (Zucker et al. 1998). The attraction and retention of outstanding scientific and engineering talent, together with the availability of substantial research funds, and the new knowledge and inventions subsequently generated and produced, stimulate the establishment of an effective technology-transfer policy, prioritizing the licensing of know-how and designs, the founding of new ventures and the initiation of novel collaborative R&D projects with large established companies.

Knowledge transfer involves the development of an idea from a (public or private) laboratory into a commercial product, in this case involving the transfer of people, knowledge, know-how and practices from a university or research establishment to industry and society. To manage the transfer of knowledge effectively, dedicated offices within a university or company may well be expanded or established, or new organizational forms outside the parent (or source) organization may be developed that are designed to move a product from the laboratory to the market place (Roberts 1991). The key mechanisms in technology transfer are co-operative extension and outreach on the one hand, and patenting, licensing and spin-off creation on the other (Postlewait et al. 1993). While the former focus on the development and dissemination of publicly available (non-proprietary) technologies (notably in the domains of agriculture and manufacturing), the latter are aimed at making money from the inventions of public or corporate researchers through the sale of patents, licensing and royalty payments, and equity in spin-off companies. In the former case, there is a strong belief in the free dissemination of knowledge, for instance through publishing, consulting, one-to-one interaction between university and industry scientists, and personnel exchanges and the idea of appropriating and commercializing intellectual property is opposed. In the latter case, on the other hand, private gains from academic research are sought and secrecy requirements to protect proprietary information are met: universities start licensing their intellectual property rights (IPR) in exchange for cash, (future)

sponsored research or equity (i.e. taking shares in new ventures). Knowledge transfer through an Office of Technology Transfer and Licensing is a complex matter that depends on encouraging researchers to participate actively in the commercial exploitation of an organization's intellectual capital, creating proper and transparent incentives, and pooling critical specialized resources to set up effective patenting and licensing agreements and generate successful spin-offs (Debackere and Veugelers 2005).

Any region wanting to be considered a high-tech region will have to prioritize specific fields of science and technology that need to be explored and exploited successfully through the availability of leading research centres and groups. The new knowledge of public or private research laboratories can be commercialized by an external firm licensing or buying the technology or the intellectual design. Alternatively, inventors and idea-developers working at the research institution can commercialize their invention or creative concept themselves through the creation of a new so-called spin-off company, supported or not by their parent organization and/or an investor. To that end, they can enter into a partnership with an incubator to develop their concepts further and start up their own company. Within this spin-off process there are four different roles that can be identified: the inventor, the (often internal) entrepreneur, the source or parent organization and the external investor (in the words of Roberts and Malone (1996): *technology, originator, entrepreneur, source organization and venture investor*). Ideally, these roles are all actively represented, but is also possible that, for example, the internal entrepreneur or the external investor are absent from the commercialization process. To facilitate a spin-off in such a situation the parent organization will have to persuade external entrepreneurs to take a license for the developed technology and to work together with the internal inventor(s). If there is a lack of financial resources in the initial stages, the parent company will have to look for venture capitalists or itself participate financially in the new product. In the start-up of new businesses supported by incubators, similar roles can be identified, the role of entrepreneur/inventor, the incubator as active mentor of the start-up company (for instance by offering housing and coaching), the investment role of the incubator, and the incubator as liaison with professional service providers (specialized law firms, accountants, etc.

Entrepreneurs are better than others (i.e. investors, technology-transfer officials) at identifying and appreciating opportunities, i.e. future states that are desirable and achievable, and at obtaining additional relevant information, because they have prior knowledge and relevant life experience (e.g. through previous jobs, expertise about particular markets, customers, distribution). In other words, whether or not they recognize or perceive an opportunity depends on their own specialized and personal knowledge base. It also means that they will be predisposed to recognizing opportunities in areas with which they are familiar but not in other sectors, even though opportunities may be more promising there. This implies that it is unlikely that two entrepreneurs will identify similar opportunities and that, once an opportunity has been recognized, entrepreneurs and investors may have different interpretations of what the opportunity is. When we apply this to the domain of technology transfer, it becomes clear that it is difficult to centralize opportunity

exploitation; hence the critical early stages of commercializing knowledge (screening, selecting, prototyping) should take place bottom-up and operate close to the scientists, engineers and research groups involved (Debackere and Veugelers 2005). Shane (2000), for instance, identified eight different ventures that exploited a single MIT invention, namely three-dimensional printing (3DP trademark). This patented manufacturing technology was commercialized by entrepreneurs and firms with various industrial backgrounds (e.g. an architectural service agency, chemical manufacturer, photo retail chain). In addition, an entrepreneur's perspective will be influenced by the social networks to which he or she has access, and he or she may possess specific abilities that will affect the way he or she looks for information (e.g. quick and selective) as well as the way he or she sees things (perceptive ability, not-seeing risks).

BOOSTING NEW IDEAS, YOUNG ENTREPRENEURS AND NOVEL FIRMS: THE ROLE OF VENTURE CAPITAL AND ANGEL INVESTING

Because entrepreneurs rarely have the capital to bring their ideas to fruition, they have to rely on outside financiers. To a certain extent, bootstrapping may kick-start an entrepreneur and his/her business. Founders may use their own money to pay for the expenses of setting up and operating the start-up firm. As a means of financing the growth of a company, bootstrapping is often insufficient, and this is where friends, family and business angels (informal investors) providing capital for equity stakes in the fledging company may be of help. At this early stage, banks may be helpful in providing the young and vulnerable company a loan or a mortgage. Banks, however, do not finance growth: they are reluctant to lend to companies that do not have substantial tangible assets (as collateral) and whose futures are highly uncertain. If a company, initially backed by a combination of self-financing, friends, family and business angels, needs more funds to support a major R&D effort or an expensive marketing campaign or financing international expansion, it can approach business angels and venture capitalists.

One possibility is financing through a business angel: an affluent individual (sometimes a 'retired' successful entrepreneur) who enjoys investing in promising new technology ventures and who can afford to take the financial risks involved. To acquire the financial means to enable initial growth, the firm may have to rely on a second round of financing in which clearing banks (through mortgages and loans) and venture capitalists (e.g. external equity) act as investors. The company may be able to reduce the dependency on banks and venture capitalists by self-generated cash flow (through research contracts, consultancy and product sales). In addition to focusing on the past record of the company and its future growth prospects and market, underwriters and venture capitalists select on the basis of the quality of the management team (skills composition), proven technologies, cash flow and cash-out potential. To attract and maintain highly skilled employees, technology firms use employee equity ownership and bonus/profit-sharing schemes. In the consolidation and sustained growth stage, (an)other round(s) of financing by venture capitalists or a bank loans could be used by the new technology-based firm to accelerating its

product development programs and broadening its their distribution channels. In the maturity stage, when an initial public offering (IPO) or sale is expected, the boards of directors are often reshuffled to include outsiders and individuals with expertise missing from top management; also, accounting and control systems and overall performance and transparency have to be upgraded. The founders and venture capitalists often enjoy substantial capital gains from its sale in return for surrendering further equity. In addition to being a costly process demanding significant time of key managers and huge expenses claimed by underwriters, lawyers etc., an IPO is for some ambitious technology firms an interesting possibility to raise further capital (in order to improve the firm's debt–equity ratio, to allow for acquisitions, to meet the need for cash and working capital, and offer an exit for the equity holders).

Another possibility is financing through venture capital, which can be defined as "independently managed, dedicated pools of capital that focus on equity or equity-linked investments in privately held, high-growth companies" (Gompers and Lerner 1999, p. 11). Venture capitalists are a financial intermediary in between a small group of large investors and a broad and diverse group of fledging, high-risk but maybe successful new (or revitalizing) firms. They maintain relationships with a large and diverse group of institutional investors (e.g. pension-fund schemes, university endowments, wealthy families and corporate capital funds) and seek to raise money from them in order to make equity investments with the capital obtained in young high-risk, high-growth companies. Those institutional investors are unwilling and/or do not have the time or the expertise to invest directly in young or restructuring firms. The venture capitalists raise capital not on a continual basis but through collecting and setting up periodic or so-called self-liquidating funds which have a 7-12 year life, and after its termination, the funds have to be returned to their investors (hopefully with a substantial return on investment) and new funds have to be formed. The overriding goal of venture capitalists is to reap capital gains in excess of ten times their original investment in less than 10 years. This will force them to make a reasonably high return on their venture funds and to be very selective about the investments they make and monitor and manage them carefully. Spurred by the incentives provided by the investors (normally a percentage of the capital gains after the return of capital), venture capitalists select the best entrepreneurial ventures, try to maximize the growth of their funds and the financial return from their investment portfolio. While they seek to sell the most successful firms in their portfolios at a high price, they simultaneously face the necessary but painful step of terminating underperforming firms in their portfolios. Their final role is to manage the 'exiting' of these investments: exit possibilities may include a bankruptcy (not a preferred option), a sale of stock through an IPO, through a merger or a trade sale. These subsequent processes of fundraising, investing and exiting, described above, are part of the 'venture capital cycle' (Gompers and Lerner 1999).

In the early phase, financing of the new companies tends to be haphazard and opportunistic. More often than not, start-ups rely on the savings or house of the founder(s), contributions by friends and relatives and/or a bank loan, depending on the need for capital. However, these funds may not be sufficient, and an appeal may

have to be made to private investors, such as informal investors and venture capitalists. Whereas informal investors, also known as business angels, tend to favour start-up companies, venture capitalists invest in fast-growing companies on their way to maturity (i.e. a stock market floatation or a selling-off of the company). In addition to the capital, they contribute expertise with regards to investment and the management of technology companies. Venture capitalists are network brokers *par excellence*: they provide the missing links in the management of new companies. Through new contacts with clients, distributors and new management they provide the young and vulnerable company with a broader techno-economic base and a greater degree of social legitimacy.

Although some entrepreneurs see venture capitalists only as passive financiers of young and ambitious firms, venture capitalists themselves claim that, in addition to the capital they infuse into the company, they add more value to the firm ('smart money'), such as providing new information, references and referrals, and offering other business services (professionalizing the start-up firm's management etc.). Venture capitalists invest in high-risk/high-reward situations of new business being created or existing ones being restructured. Before making the actual investment, they review the proposed business plan of new ventures and make a shortlist of interesting investment possibilities. Serious candidates are thoroughly investigated, both through formal studies of the firm's technology/market strategy and an informal assessment of the management team (i.e. extensive due diligence). Once the decision to invest has been made, venture capitalists negotiate appropriate financial structures, in which funds are frequently disbursed in stages, and often put together through a syndicate of several partners. Venture capitalists take a long-term view towards their portfolio companies and become directly and actively involved in the strategic and operational activities of their firms (often through board representation, and hiring new management and bringing in their business contacts and networks). This process of staged capital infusion, in which each financing round is accompanied by a formal review of the firm's status and progress, provides built-in checks that set targets and milestones for further corporate development and seek to limit opportunistic behaviour by the founders (and also acting as an easy way out of the investment cycle) (Dean and Giglierano 1990). Furthermore the entrepreneur and the managers of the firm are intensively monitored, and with the widespread use of stock grants and options, the overall interest of the growing company as such and its key shareholders is actively promoted. By actively working and investing together in ventures, i.e. the process of syndication, venture capitalists not only make more capital available, but they also spread the financial risk and bring together more expertise and support (Bygrave 1987). Given the diversity and the heterogeneity of the venture-capital community (e.g. corporate and independent venture funds, specialization in the size of deals, stages of financing, syndication partners), co-investing partnerships often provide a clear added value for both the venture capitalist and the entrepreneur.

After receiving seed capital and early-stage funding to develop a new product or prototype, a technology firm will normally require four or five rounds of financing to build sufficient manufacturing capacity, forge effective distribution channels, develop successful follow-on products and engage in global and/or business

expansion. In the start-up phase, the high-tech entrepreneur, having left his/her 'incubating organization' to become self-employed, has to rely on personal savings, assets of friends and relatives and short-term loans. In order to allow for working out basic technology and rounding out the start-up team, on average, a firm needs zero-stage financing of approximately 50-100,000 euro (depending of course on the industry and the type of business). In order to carry out research, test operations and launch new products, a first round of external financing is needed. In the early stages, the company has to finance R&D and market development without being able to sell, or, in other words, it has to cope effectively with the 'burn rate' (i.e. the money a company spends each month exceeding its revenues). If one burns capital to fast, then one is out of business, and when one burns capital too slowly, one runs the risk of falling behind in the competition to innovate, expand and gain market share.

BRINGING IT TO A HIGHER LEVEL: THE IMPORTANCE OF NETWORKING AND COMMUNITY BUILDING

Successful innovation requires a collective effort in bringing together people, ideas and objects that were previously separate, and an effective networking among heterogeneous ties spanning various markets and technologies. Innovators and entrepreneurs put inventions together from what they already know and recombine existing ideas and practices from other industries and innovators (Hargadon 2003). Edison, for instance, owed his success not so much to his ability to build something out of nothing, but rather to the way he managed to exploit his network, borrow the ideas of others, and incorporate and recombine them in his breakthrough innovations. Edison is an example of a technology broker, someone who links otherwise disconnected communities in an attempt to maximize their range of connections. By doing so, a technology broker is in a better position to be the first to see how people, ideas and objects of one world may provide valuable solutions in another. An example of a company acting very much like Edison is the invention factory IDEO, a company that tries to capitalize on the connections it has with many different industries that may not know each other for its commercial innovations (Hargadon and Sutton 1997). As a true (technology) broker, IDEO also clearly benefits from its central position and gaps in the flow of information between subgroups in a larger network, filling these gaps by combining technologies from within and outside its client's industry into new solutions. Because they are connected to a wider variety of industries, knowledge brokers typically have access to a broader range of ideas than firms working in one or a few industries. Technology brokers like IDEO and Edison bring together flows of information at the right moment and design solutions in one area that are potentially valuable to others (Hargadon 1998).

Rather than selecting the best of a number of standard recipes, entrepreneurs gather their ingredients as they go along: they look around their workshop, kitchen or laboratory to see what is available and build their vision on the basis of affordable losses or acceptable risks (Sarasvathy 2001). Depending on their business experience and level of expertise as well as their goals and ambitions, the venturing

activities of nascent entrepreneurs may vary substantially, and predetermine the start-up configuration and subsequent networking activities. While a fresh PhD researcher in his late twenties with only a few key names in his Rolodex may try to commercialize his invention through the research laboratory's incubator or seriously consider setting up an entrepreneurial spin-off, a former senior engineering consultant in his early forties may not need to rely on the active support of his parent organization because he has already built up his own support network. There are obvious as well as subtle differences between these two types of entrepreneurs, with regard to their self-confidence and efficacy as well as in the way others treat them in terms of status and the way their activities are evaluated. Because they lack stable relationships, access to sufficient resources and reputation, young and inexperienced entrepreneurs are prone to a liability of newness or adolescence (Hannan and Freeman 1989). If they are to survive they need to gain access to the resources and information they require and establish the partnerships that will bring them political clout and overall credibility (Elfring and Hulsink 2003; 2007; Hulsink et al. 2004).

Networks are important in the innovation processes of start-ups and small and medium-sized firms, since "innovation does not exist in a vacuum" (Van de Ven 1986, p. 601). On the one hand, the contacts a firm has can provide opportunities for further innovation and growth, and eventually lead to a better performance, while on the other hand they may lead to inertia and stagnation, for instance when the wrong advice is followed or the wrong partner chosen, or when the firm is locked into a leading firm or a sector in decline (De Jong and Hulsink 2005). In the former case the existing social network or new business contact provides opportunities for growth and success, whereas in the latter case the existing network or new business contact turns out to have a constraining or even detrimental impact on the firm's performance. The search for and use of social capital is driven by goal-specificity: it only includes those ties that help a firm attain particular goals. The network of a small firm may range from of a loose collection of ties to a close-knit business group in which the focal organization is strongly embedded.

Networks can be described in terms of i) diversity; ii) strength of relationships; and iii) structural holes (De Jong and Hulsink 2005). *Network diversity* refers to the number of actors in a network, what they do and for what they can be contacted. Highly diverse networks consist of partners with distinct, non-redundant abilities. Various partners may be able to contribute financial capital (e.g. banks, accountants, relatives), physical capital (suppliers) or human capital (educational institutes). In the context of innovation, new customer preferences may be a source of inspiration, but customers can also contribute to the realization of new products by providing feedback on a first concept or by acting as lead users (Von Hippel 1988). The *strength of relationships* refers to the contradiction of strong versus weak ties (Granovetter 1973; 1995). Strong ties are relationships one can rely upon both in good times and in bad times. They tend to bind similar parties in longer-term and intense relationships. Of course, strong ties are not the panacea of good networking. A network consisting only of strong ties may limit a firm's ability to discover information regarding opportunities. Weak ties can be beneficial as well in that they offer new kinds of information, resources etc. *Structural holes* refer to the position of a firm in its network structure. A structural hole is a relationship of non-

redundancy between two contacts. It may imply that the firm is connected to disconnected others, to paraphrase Burt (1992), or that the network partners do not know each other. Structural holes provide information advantages to people who manage to build across cohesive groups, exploiting a position at the edge of two groups. They are extremely important when it comes to seizing and exploiting opportunities for innovation and new businesses.

In the 1980s, large integrated firms with their extensive production systems driven by cost and price leadership concerns found it increasingly difficult to meet the demands for product and process innovation and the flexible manufacturing of high-quality products (Nemetz and Fry 1988). Strategic networks of heterogeneous firms involving ongoing and complex partnerships combine the flexibility of market relationships with the long-term commitment of hierarchical management (Powell 1990). Lorenzoni and Baden Fuller (1995) have looked at the role of the strategic centre of corporations in managing such a network of partners. In strategic networks, the central firms are remarkable in their desire to transfer skills and knowledge and add value to their partners. Typically, they set out to build up their partners' ability and competences and create a sense of common purpose across multiple levels in the value chain and across various sectors. Strategic networks can be seen as a deliberate choice made by management to increase the strategic flexibility and responsiveness of the core companies and to facilitate the development and launching of new products or process innovations, in close collaboration with specialized partners. There are a number of reasons for the emergence of networks in the high-technology sectors, such as a shortening of the product life cycle, the rationalization of R&D and production costs, the need for system integration in converging markets, the concentration on core competencies, and the contracting out of peripheral activities (Bolland and Hofer 1998; Quinn et al. 1997).

High-tech firms follow a kind of spider's web strategy, in that they try to develop and maintain direct and (almost) exclusive relationships with satellite companies from the strategic centre where the core company is located (Hagel III 1996). Strategic investments may have been made by the core company, often through equity stakes in preferred suppliers and spin-off companies, a joint information system and shared knowledge and co-manufacturing between the core company and its satellites. Management literature talks about 'unbundling the corporation' (Hagel III and Singer 2000): the twin activities of design and manufacturing increasingly seem to conflict in today's virtual corporations. Whereas design focuses on responding swiftly to new ideas, nurturing the talents of managers and employees and seizing new business opportunities, manufacturing is mainly about economies of scale and scope. Therefore, it is often better to separate those activities into specialized businesses that have clear advantages over integrated companies. The distinction between key and peripheral functions is made between the core competences that are vital to a firm's creativity, innovativeness and long-term viability, such as R&D, intellectual property and design, and supportive (non-core) functions, which may include manufacturing, often put at arm's length or outsourced, through networks of supportive relationships with contract partners.

In addition to looking at the dynamic capabilities and growth strategies of core firms and the strategic networks in which they are embedded, the role and

involvement of key firms could become even bigger: they could feed industrial districts (Lazerson and Lorenzoni 1999a). The process of globalization and international sourcing has made the larger multinational firms more aware of the competitive advantages of particular regions or districts. Ambitious flagship firms, together with their subcontractors, may create endogenous clusters, if they successfully explore commercial avenues with their partners, and hence diffuse technology and knowledge at the local level. Besides a high R&D intensity, high-technology industries are characterized by a greater than average dependence on skilled, professional and technical labour, especially for the non-routine and innovative activities. In this respect, proximity matters: in order to exchange codified and tacit knowledge, engineers of large firms and specialized suppliers prefer face-to-face communication (on top of electronically mediated communication). In addition to transferring skills and know-how from large to small firms, local training and innovation institutions may also help upgrade the level of capabilities and the knowledge base in a region. Since firms that are located in strong clusters are more likely to innovate and create spill-overs within and between industries, and regional collaboration furthers an endogenous division of labour and offers substantial economies of times, the benefits are clear: "the locational effects save time since the partners share updated knowledge and work on signals rather than complex contracts" (Lorenzoni and Lipparini 1999, p. 335). However, if these industrial districts become too inward-looking and insulated, they may lose their momentum and suffer from inertia. In order to benefit from new technical and market-related information (e.g. new technologies and products, changing customer tastes), local focal firms also need to be well-connected to distant networks. Connections to other industrial districts or direct access to and representation at key input or output markets will provide them with new competitive challenges and generate new strategic partners with open minds and additional capabilities. In that respect, flagship firms act as conductors of their indigenous industrial district and distinct collectors and pollinators of information and skills from elsewhere (Lazerson and Lorenzoni 1999b).

In addition to the factors mentioned above, the availability of 'social capital' also plays an important part in the theory on regional development. Social capital refers to the complex of local institutions and trust relationships between local actors within a region, based on the historically determined local culture (Cohen and Fields 1999). The networks between individuals, companies and institutes within and between which information is being exchanged and resources shared, form the social capital of the region. These networks between relevant actors and institutions have a strong influence on local politics and the economy. The concentration of a certain type of company has advantages for the individual companies. Since companies are located in each other's vicinity, they have access not only to specialized companies and expertise, but also – after a period of time – to an institutional environment that facilitates the transfer from one company to the other. As the companies have worked together before, they share a common past and will understand each other more quickly. The transaction costs of the coordination of economic activities are low: they do not have to face the bureaucracy and rigidity associated with the internalization and (vertical) integration within a company's hierarchy or the

dynamic and chaotic market, where every transaction requires a separate contract and where there are additional costs incurred in monitoring the parties' compliance (Best 1990). The social capital and the (lack or presence of) mutual trust associated with it, may, in short, result in a competitive advantage. The lack or presence of this factor helps to explain the differences in regional productivity and innovativeness.

GOING FOR GLORY: CHANCE, POSITIVE FEEDBACK AND PATH DEPENDENCY

When we look back on the relative successes of, for example, Route 128 and Silicon Valley, we are tempted to see these high-tech districts as the outcome of the vision and strategy of a leading technology university, visionary and driven entrepreneurs, or of core businesses in a region (Saxenian 1994). Nothing could be further from the truth: one cannot plan the rise of successful clusters. Particularly in the early stages, chance and fortunate coincidences have produced, for example in the case of Silicon Valley, a process of co-evolution of technology, market dynamics and institutions, that was to develop further along a path of innovation, depending on the influence of specific local circumstances (Krugman 1991; Kenney and Von Burg 1999). Circumstances that will push the chain of events in a certain direction (thereby more or less excluding any alternatives) include a dominant technology or branch, flagship firms, specific core knowledge institutions, the nature of the demand, and certain institutional arrangements (culture, legislation, contact networks). While these circumstances serve as a more or less successful breeding ground for regional entrepreneurship and cluster activities and for the structuring of the techno-industrial processes along certain trajectories, it is the spark of local initiative that is needed to start the fire of high-tech region formation. An initial combination of local entrepreneurship, chance, 'lucky success' and a positive feedback on business within the region will lead to a self-reinforcing and cumulative location of several high-tech start-ups, their growth into independent knowledge-intensive businesses and the clustering of these core businesses with new companies (such as spin-offs and specialized suppliers), educational institutions and R&D laboratories. It is indeed a remarkable phenomenon that the accumulation of minor events and coincidences, which have a positive combined impact on companies' and institutions' decision on where to locate within a certain region, should gradually lead to the concentration of an industry or branch in a specific region (Krugman 1991). The presence of new companies and dynamic research institutes in itself has an additional appeal for a new generation of companies, professionals and institutions looking for a place to locate. At a certain point in time it is possible that the young and somewhat specialized high-tech cluster will reach a critical mass that will enable it to broaden its technological base or expand into new sectors.

When we talk about research and technology 'hot spots', we are dealing with internationally acclaimed regions with a high level of R&D and knowledge creation (a substantial proportion of sales revenues on R&D) and advanced technological capabilities of its main actors (employing a high proportion of scientists, engineers and technicians). Techno-industrial districts are dynamic configurations of actors,

conditions and activities: they emerge, rise and fall, and their success may not be everlasting: they may vary between 'hot spots' (i.e. regional clusters of high-growth firms competing in the same industry but as a group outperforming others) and 'black holes' and 'blind spots' (Pouder and St. John 1996). In that way, Silicon Valley grew out of Santa Clara County's 'Heart of Delight', known for its cultivation of delicious fruits and vegetables, and the promising Speech and Language Valley in Ypres (Flanders, Belgium) (after serious fraud and mismanagement practices by the flagship firm L&H, and its subsequent collapse shortly after the technology bubble burst) became a blind spot again (De Witte et al. 2001). Bresnahan et al. (2001) made it clear that in analysing the success factors of techno-industrial valleys a distinction should be drawn between the conditions that have a positive effect on the emergence, creation and the early growth of a cluster, and the conditions for the next stage of the cluster's development sustaining and consolidating the widening and deepening of the cluster. In order to refine the group of fledging techno-industrial districts, it is useful to make a distinction between endogenous and home-grown expansion and exogenous externally induced growth on the one hand, and the diversity and heterogeneity of the knowledge infrastructure on the other. The process of economic growth stems from two modes with regard to the creation of new ventures (small, specialized, niche-oriented) and the expansion of existing firms (internal venturing and alliances with small and large firms): the entrepreneurial and the corporate mode (Miller and Côté 1987).

A cluster is a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities; Porter (2000, p. 15) defines clusters as "geographic concentrations of interconnected companies, specialised providers, firms in related industries, and associated institutions (universities, standards agencies, trade associations) in a particular field that compete but also co-operate". There are two key elements in Porter's concept: 'geographic', which specifies the embeddedness of economic activities within regional production systems, and 'interconnected', which refers to firms and supportive institutions working together in sharing information, providing capital and facilitating the transfer of critical assets and joint promotion. Interdependent companies and supportive institutions are linked by co-location, commonalities and complementarities: they work side-by-side in the same geographical area and at the same time compete with each other in some areas (such as design and process innovation) and work together in others (joint export promotion). These links among companies and between firms and supportive institutions are vertical (buying and selling in chains), horizontal (complementary products and services), social (a proximate group of interlinked companies) and spatial (confined to geographic areas) in nature. One cannot equate a cluster with a single industry or region, because that would leave out the social networking and technological and geographic proximity of firms and their associate institutions and the crucial interconnections with other industries that strongly affect competitiveness. So clusters have a sector (a particular techno-industrial domain), a region (a geographic place) and a social component (a shared community and identity). Martin and Sunley (2003) have criticized Porter's cluster concept as simply brand and place marketing for a region or an industry; instead they prefer a

less elusive concept such as local production systems. In discussing this fashionable 'cluster' concept we touch upon a sensitive nerve, namely the public relations, cultivation and socialization involved in building the brand of a particular techno-industrial district. A big part in the effort of raising awareness of a region's socio-economic and technical strengths and the collective marketing of an industrial district is played by brokers and intermediaries who set up dialogues between all the economic and political actors involved, promote all kind of collective services for local firms (e.g. financial advice, marketing and design services) and establish links with relevant research facilities.

STRUCTURE OF THE BOOK

Innovation and entrepreneurship in the high-technology industries is in the spotlight not only of academics working in the domains of business and/or regional and technology studies, but also of journalists, captains of industry and policy makers. Newspapers, magazines, policy documents and conferences dedicate ample space and time to the breakthroughs and commercial spill-overs and spin-offs in the bio-medical and food sciences, the worshipping of ambitious entrepreneurs and dynamic flagship firms, the creation of dynamic agri-food and health clusters, and the development of research and technology poles. Also, American and European policy makers seek to link innovation, entrepreneurship and clustering in the engineering and life sciences to economic growth, competitiveness and regional development. In addition to the pioneering efforts by entrepreneurs and firms, policy makers are promoting the formation of techno-industrial clusters and regional communities in which start-up firms, investors, larger companies and various other supportive institutions work closely together. In this book we address the particular activities of innovators, entrepreneurs, large firms, investors and governments in the formation and expansion of regional networks in the agri-food, bio-medical and engineering sciences. Relevant issues in this respect are the emergence of new ventures and dynamic firms, the particular role played by venture capital and large corporations in commercializing innovations, the transfer and mobility of people, ideas and assets, the creation of user–producer communities and promoting and financing innovations and start-up firms, their internal collaboration and their outcomes, and public–private partnerships between public research establishments, large firms and other stakeholders.

The first part of this book provides an analysis of the development of a selective number of high-tech clusters. It compares various leading research and technology clusters, such as the North Carolina Research Triangle Park (NC RTP), Silicon Valley in Northern California and Route 128 in and around Boston in the United States, the high-tech cluster country Israel, and the Leuven – Flanders region in Belgium. The development of NC RTP is a perfect example of the interaction between business, academia and industry, leading to a well-known successful triangle.

In Chapter 2, John Harding describes and critically evaluates the success factors. NC RTP was founded in 1959 and is now the largest research park in the United

States. Since it is recognized that about half of the initiatives to create such a park fail, the success of NC RTP is indeed remarkable, and it also shows that translating and/or transplanting the concept to other regions is not easy. Hardin argues that regions should fulfil at least six prerequisites in order to be able to establish the right ecological system for a successful high-tech cluster: i) an existing base of R&D and high-tech activity; ii) a number of research universities, medical schools or engineering institutes; iii) a good transportation infrastructure; iv) a network of infrastructure and business services; v) a medium- and large-sized metropolitan area; and vi) a number of visionary and effective leaders. These requirements were certainly met in a series of ICT clusters that developed in the U.S. over the past century.

In Chapter 3, Wim Hulsink, Dick Manuel and Harry Bouwman carry out a critical analysis of the development of clustering of information and communication technology (ICT) companies. It all started in the Boston region, the so-called Route 128 area, with its large concentration of highly qualified colleges, universities and research institutes. MIT and Harvard University, together with their spin-off firms and R&D affiliations, are/were among the global pioneers in modern academic entrepreneurship and high-cluster development. This cluster served as a role model for Stanford University in initiating and stimulating the (further) development of Silicon Valley as a dynamic techno-industrial community in the Bay area on the West Coast. This chapter begins by analysing the pioneering role of MIT and the Route 128/Boston region, and goes on to show how this initiative was quickly taken over by Silicon Valley, which quickly developed established itself as the internationally known scientific and techno-industrial hot spot. The authors show that the continuous success of Silicon Valley is based on several waves of innovation that enabled the valley to restructure itself rapidly and successfully through the evolution of novel industries based on new emerging information and communication technologies. They describe the emergence of four generations of companies over the past fifty years, in alignment with the developments in the ICT business: from integrated circuits, computer technology, PC's and databases to the internet and the internet intermediates (e.g. Google). The notion that success breeds success certainly applies to Silicon Valley, a region that keeps reinventing itself on the basis of new break-through technologies.

Several countries all over the world have adopted policies to encourage innovation and entrepreneurship as a national priority. However, change processes are complex in nature, and there is no general recipe available. Having said that, attempts are being made to develop models for initiating and developing new ventures. In Chapter 4, Uzi de Haan suggests a multilevel economic-growth model and illustrates this model for the Israeli high-tech sector. The success of this sector makes it an interesting case study for economic growth based on innovation and entrepreneurship. Crucial in this multilevel model is the recognition of five capital factors as necessary for economic growth: knowledge capital, financial capital, human and social capital and entrepreneurial capital. These factors appear to be of crucial importance at various organizational levels (firm/regional/national/ industrial). The multivariable and multilevel characteristic of the model creates multiple indirect relations. It has the potential to bridge the gap between academic

research and policy making. It gives a better understanding of the factors involved and the underlying interactions that are important for economic growth. The model may provide policy makers with a framework for the changes required to support economic growth. This first part of the book ends with an intriguing story about the dynamic technology region in Belgium, called the 'Knowledge Pearl Leuven'. Martin Hinoul describes and explains why the region of Leuven has developed into a very successful knowledge creation and commercialization region that serves as a good example for the European knowledge economy. Here again, it is the key combination of a high-quality research centres, a dynamic entrepreneurial culture with a number of people that serve as role models, and research capital and venture capital. Specific organizations were put in place to stimulate the transfer of knowledge further. The Catholic University of Leuven's Research and Development organization plays (has played) an important role in the establishment of contract research, the management of university's intellectual property and the creation of high-tech spin-off companies. Moreover, a state of the art infrastructure was built, including incubators and research parks.

The second part of this book, which consists of three chapters, focuses on the importance of innovation, entrepreneurship and knowledge transfer. The horticultural industry of The Netherlands is a good example of an important economic sector that is successful as a result of ongoing innovations.

In their chapter, Hans Dons and Raoul Bino show that the unique position of this sector is based on the industrial entrepreneurship of breeders, producers and traders. The country's entire chain of vegetable and ornamental produce has reached a high level of efficiency, logistics and quality control. Another important factor is the research environment that has led to the generation of a high level of fundamental knowledge in plant sciences, in particular plant breeding. The sector was also very successful in transferring and commercializing this knowledge. The authors show that, to enable such an implementation of new knowledge via innovations and applications, an effective and efficient interaction between the various partners is essential. Recent examples of public–private partnerships as described in this chapter are good illustrations of this approach. Despite the many examples of the successful transfer of knowledge, there is a widespread belief that industry and society at large have failed to take full advantage of the scientific capacities and technological developments generated by the publicly funded research infrastructure.

In Chapter 7, Jordi Molas-Gallart and Damien Mc Donnell discuss an interesting approach developed by the Defence Diversification Agency (DDA) to promote the wider exploitation and further development of the capabilities existing in the UK defence research establishments. They present a new type of infrastructure that links the various actors of an innovation system. DDA sees its technology broker function as that of a facilitator identifying different types of needs across a broad client base, rather than that of a commercial intermediary. In this way, the organization responds to the need to bridge different communities and organizational forms, operating in different contexts and with different cultures and practices.

Chapter 8 shows the impact of a government programme to stimulate innovation and entrepreneurship in the life-sciences industry. Between 2000 and 2004 the

Dutch Ministry of Economic Affairs launched an 'Action Plan Life Sciences', including the BioPartner program. The objectives of this program were to contribute to a more entrepreneurial culture at the Dutch academia and to assist in the generation of 75 new dedicated life-sciences companies. Haifen Hu and Ward Mosmuller were very much involved in the execution of this BioPartner program, and they describe how the Dutch approach has worked out. Their chapter reports and evaluates the results of the program and additionally gives an overview of the position of the Dutch life-sciences sector by the end of 2004.

The third part of this book, Chapters 9 to 12, focuses on a number of very specific developments in the agri-food clusters and communities of Europe.

In Chapter 9, Christina Brasili and Roberto Fanfani report on interesting research concerning the development of Industrial Districts (IDs) in Italy. IDs are localized concentrations of inter-industrial relationships between firms, families and institutions. Using this concept of IDs, the authors describe the characteristics of the Italian food industry and its structural changes between 1981 and 2001. The IDs are considered one of the main factors of the successful and rapid development of Italy after the Second World War. The structural analysis described in this chapter reveals high levels of concentration and specialization. The agri-food districts in Italy are characterized by typical and high-quality products, derived by natural and historical traditions. Started as real niche markets, they have expanded and are becoming a structural part of the food demand, while food safety and product quality together with distinctiveness make these products unique on the international markets.

Another example of an interesting food cluster, introduced and discussed by Magnus Lagnevik in Chapter 10, is the Öresund Region, covering the eastern part of Denmark and the South of Sweden. It is regarded as one of the fastest-developing food clusters in Europe, and the resources for the Öresund food cluster are formed by a combination of multinationals, small innovative companies, support organizations, professional research institutions and academic centres. Interestingly, the Öresund University is a voluntary agreement between several universities and institutes at both sides of the Öresund Sound. An extensive network has been established at the interface with the food industry, with stakeholders from various parts of the value chain. This has led to an increase in the interest for food innovations and has provided new competences and knowledge for the renewal of the food industry in this region.

Chapter 11 focuses on the emergence of the Slow Food movement. Slow Food has developed from a small movement in the Langhe area of Piedmont into an international movement for the enjoyment of 'good, clean and fair food'. The intention of the Slow Food movement is to develop an alternative to the industrializing food sector, by building on natural resources and the culture and social capital present in old local associations. Hielke van der Meulen not only describes the fascinating development of this movement, but also takes a critical look at a number of major 'business dilemmas': How to develop local food networks in order to compete with global bulk-food producers; the contradiction between a local gastronomy cluster and the international ambition of the movement and the dilemma between the commercial attitude of private entrepreneurs and sponsors and the pursuit of social goals. In the final chapter of this part of the book, Wim

Vanhaverbeke, Jan Larosse and Wouter Winnen give an introduction to the Flemish food industry of Belgium, using the important West-Flemish frozen-vegetable industry as an example of cluster analysis. They show the added value of using data about relationships between customers and suppliers in cluster analysis. Moreover, they develop a new cluster analysis methodology for co-operation and cluster formation in a niche market. The competitive advantage of the local frozen-vegetable cluster is the result of a close interaction between producers and all other actors within the local socio-economic environment. The vitality of such a cluster is based on a blend of co-operation (in purchasing, learning, R&D) and competition (in sales). The study shows that monitoring in detail developments in the business chain between suppliers and consumers is a source of strategic intelligence for new initiatives in cluster policy.

In the final two chapters of this book, recent developments in innovations and business activities in the eastern part of The Netherlands and more specifically in the Food Valley are discussed. In the previous chapters of this book several examples have been given about economically successful regions within Europe. Since a number of years, the European Commission strongly stimulates the innovation performance of such regions. Also, within a small country like The Netherlands, the government recognizes the economic potential of its various regions and supports the professional education, technology transfer, entrepreneurship and knowledge networks. In Chapter 13, Peter Tindemans focuses on one of the hot spots for innovation, the East of The Netherlands. By focusing on conditions and actors rather than indicators, he critically evaluates the concept of the Triangle East Netherlands (EN). The Triangle EN consists of three distinct 'Valleys', local concentrations of knowledge and innovative networks, concentrated around a university, that seek to join forces and initiate collaborative research projects: Food Valley at Wageningen, Health Valley at Nijmegen and Arnhem, and Technology Valley at the Twente region. By comparing the Triangle EN with other established knowledge and innovation regions, it is clear that a 'one size fits all' policy for the development of such hot spots will not work. One of the valleys that form part of the Triangle EN is Food Valley. This is a relatively small geographical area, with Wageningen University and Research Centre as the main knowledge provider, surrounded by several food research institutes and most of The Netherlands' major food companies. In Chapter 14, Charles Crombach, Joep Koene and Wim Heijman evaluate the development of Food Valley from the first initiative towards a fully developed and actively operating network. Although Food Valley has not nearly reached the level of Silicon Valley yet, qualifying it as a mini-Silicon Valley with great potential certainly does make sense. As such Food Valley Netherlands is another nice example to illustrate the building of roads to Research Triangles and High-tech Valleys, the title and subject of this book.

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