

**NETWORKS IN ENTREPRENEURSHIP:
THE CASE OF HIGH-TECHNOLOGY FIRMS
TOM ELFRING & WILLEM HULSINK**

ERIM REPORT SERIES <i>RESEARCH IN MANAGEMENT</i>	
ERIM Report Series reference number	ERS-2001-28-STR
Publication	May 2001
Number of pages	36
Email address corresponding author	t.elfring@fbk.eur.nl
Address	Erasmus Research Institute of Management (ERIM) Rotterdam School of Management / Faculteit Bedrijfskunde Erasmus Universiteit Rotterdam P.O. Box 1738 3000 DR Rotterdam, The Netherlands Phone: + 31 10 408 1182 Fax: + 31 10 408 9640 Email: info@erim.eur.nl Internet: www.erim.eur.nl

Bibliographic data and classifications of all the ERIM reports are also available on the ERIM website:
www.erim.eur.nl

ERASMUS RESEARCH INSTITUTE OF MANAGEMENT

REPORT SERIES RESEARCH IN MANAGEMENT

BIBLIOGRAPHIC DATA AND CLASSIFICATIONS		
Abstract	The value of networks as integral part of the explanation of entrepreneurial success is widely acknowledged. However, the network perspective lacks specification of the various dimensions of a network and their impact on the early development of a venture. We make a distinction between a Schumpeterian start-up pursuing a radical innovation and a Kirznerian venture on basis of an incremental innovation. This distinction is introduced as a contingency in the way networks contribute to the ability of the entrepreneur to discover opportunities, to get resources, and to gain legitimacy. In this explorative study three cases on high technology firms in The Netherlands provide empirical material to develop a number of propositions on the network effect on the survival or performance of start-ups.	
Library of Congress Classification (LCC)	5001-6182	Business
	5546-5548.6	Office Organization and Management
	HD 62.5	New business enterprises. Starting a new business, Entrepreneurship
Journal of Economic Literature (JEL)	M	Business Administration and Business Economics
	L 20	Firm Objectives, Organization and Behavior: general
	M 13	Entrepreneurship
European Business Schools Library Group (EBSLG)	85 A	Business General
	270 A	Strategic Management
	100 G	Organizational Growth
	85 B	Small Business Management, Entrepreneurship
Gemeenschappelijke Onderwerpsontsluiting (GOO)		
Classification GOO	85.00	Bedrijfskunde, Organisatiekunde: algemeen
	85.10	Strategisch beleid
	85.00	Bedrijfskunde, organisatiekunde: algemeen
	83.82	Midden- en Kleinbedrijf
Keywords GOO	Bedrijfskunde / Bedrijfseconomie	
	Strategisch management, organisatievernieuwing	
	Ondernemerschap, Startende Ondernemingen, High Technology Netwerken, cases Nederland	
Free keywords	start-up firms, networks, high-tech entrepreneurship, discovering opportunities, entrepreneurial processes.	
Other information		

Networks in Entrepreneurship: The Case of High-technology Firms

Tom Elfring & Willem Hulsink

**Erasmus University Rotterdam
Faculty of Business Administration/Rotterdam School of Management
Department of Strategic Management and Business Environment
PO Box 1738, 3000 DR Rotterdam, The Netherlands
Tel. +31 10 4082618
Fax. +31 10 4089013
e-mail: t.elfring@fbk.eur.nl & w.hulsink@fbk.eur.nl
and first author also affiliated at Wageningen University (NL)**

Paper submitted to

Small Business Economics

Rotterdam, February 2001

Networks in Entrepreneurship: The Case of High Technology Firms

Abstract

The value of networks as integral part of the explanation of entrepreneurial success is widely acknowledged. However, the network perspective lacks specification of the various dimensions of a network and their impact on the early development of a venture. We make a distinction between a Schumpeterian start-up pursuing a radical innovation and a Kirznerian venture on basis of an incremental innovation. This distinction is introduced as a contingency in the way networks contribute to the ability of the entrepreneur to discover opportunities, to get resources, and to gain legitimacy. In this explorative study three cases on high technology firms in The Netherlands provide empirical material to develop a number of propositions on the network effect on the survival or performance of start-ups.

1 Introduction

In the network perspective the crucial role of external ties is emphasized to understand the start and development of an entrepreneurial venture. In a number of studies (Birley, 1985; Aldrich & Zimmer, 1986; Johannisson, 1987) the contribution of a network to the development of a start-up has been examined. The network of an entrepreneur plays an important role in the search for new opportunities and the quest for resources. In the case of innovative ventures, the network is helpful to improve performance and gain legitimacy (Van de Ven, 1993; Baum et al., 2000; Cooke & Wills, 1999). It is also argued that access to resources is one of the main roles of a network, as the limited amount of resources is a main bottleneck for entrepreneurial ventures. The overall notion is that a more developed network, in terms of the number of ties and the quality of the ties, is more beneficial to a start-up than a less developed network.

Although the value of networks as integral part of the explanation of entrepreneurial success is widely acknowledged, there remains a number of unresolved issues. For example, the network perspective lacks to be specific about the context and the timing of the role of network relations (Bloodgood et al., 1995). And there is little specification of the various dimensions of a network and their impact on the early development of a venture (Steier & Greenwood, 2000). In addition, there are conflicting results; for example, 'both strong and weak ties are argued to be positively related to performance' (Rowley et al., 2000: 369) and for family start-ups the internal network appears to be more important than the external network (Littunen, 2000). Also in the social capital literature strong ties are not only positively related to performance, but in some cases they are believed to be detrimental to performance (Gargiulo & Benassi, 1999).

Recently, some contingencies have been introduced to the particular role of certain network relations in the early development of a venture. Birley (1985) acknowledged the different contribution of informal contacts and formal ties in early corporate evolution. Rowley et alia (2000) introduced the industry context as a contingency. They showed that in a highly dynamic environment weak ties are positive related to the performance of firms, while in a stable environment strong ties appeared to be positively related to performance. In this study another contingency is introduced, namely the type of innovation of an entrepreneurial venture. We argue that there exist distinct configurations of entrepreneurs and their supportive networks with different processes of sensing opportunities, acquiring resources and obtaining legitimacy. Two types of entrepreneurial modes are put forward: a Schumpeterian start-up pursuing a radical innovation and a Kirznerian venture on basis of an incremental innovation are distinguished (Cheah, 1990). Furthermore we examine the requirements on the network of these two types. This distinction between a Schumpeterian and a Kirznerian entrepreneurial modes will be introduced as a contingency in the way networks contribute to the performance of start-ups. The early growth of start-ups is affected by the perception of opportunities, the ability to get access to resources and the ability to gain legitimacy. These three variables are important for the survival of start-ups and networks have an effect on the way entrepreneurs deal with them.

In short, the leading research question for our paper is the following: How do networks affect the ability of entrepreneurs, in Schumpeterian versus Kirznerian start-ups, to discover opportunities, to get resources and to gain legitimacy. By introducing these contingencies we address the challenge posed by Leenders & Gabbey (1999: 485): ‘The search for contingency factors can be guided by the following question: which social structure is beneficial/detrimental for whom, which goals (..)’. Our focus is on the network strategies high technology start-up firms pursue (or have pursued) to ensure growth and find support and recognition by significant others. Before discussing the particular role of networks in the early growth of high-technology firms, we first discuss some perspectives in entrepreneurship theory in general, and on the networking entrepreneur in particular.

Three case studies of ICT and biotechnology companies from the Netherlands are discussed. In this explorative study the cases provide empirical material from which we develop some propositions concerning networking effect on the success of high-tech start-ups. One of the three case companies is successful, one went bankrupt and failed, and the performance of the third one is still unclear but it manages to survive. All of them faced a number of hurdles which needed to be taken in order to survive. Some of the impediments were merely of a technological nature (e.g. hampering product development), others included the financial-organisational bottlenecks that threaten the start-up firm's early growth (e.g. lack of capital, customers and business partners). In addition, the companies faced the difficulty of gaining cognitive and/or socio-political legitimacy. We review how particular network relations and strategies have been helpful to overcome these hurdles.

2 Towards a theory on the networking entrepreneur

2.1 Emergence of networking in entrepreneurship theory

The field of entrepreneurship involves the study of sources of opportunities and enterprising individuals who discover, evaluate, and exploit them (Shane & Venkataraman, 2000). Three components of entrepreneurship theory can be distinguished: the characteristics of the entrepreneur, the opportunities, and resources to exploit opportunities. Each of them has been examined extensively in disciplinary fields as psychology and economics. For example, in the personal traits perspective the issue is whether particular psychological characteristics of individuals make them prone to behave and succeed as entrepreneurs (Brockhaus & Horwitz, 1985). However, this approach has had difficulties to find strong empirical evidence. One of the problems is the selection bias (Aldrich & Zimmer, 1986; Amit et al., 1993). Each of the disciplinary perspectives have its limitations to explain entrepreneurship. In addition, the environment has been treated too much as an externality in entrepreneurship theories (Van de Ven, 1993). The way a start-up is embedded in their environment is seen as a factor which may help or constrain the entrepreneur. The network consists of resource providers, government agencies, potential clients, and other stakeholders. They should be incorporated into the way we conceptualize entrepreneurship.

In this study we view the networking approach as a way to provide a linkage between the components of a theory on entrepreneurship. This linkage may improve our understanding of entrepreneurship as it opens the possibility to view entrepreneurship as a dynamic process (Aldrich & Zimmer, 1986). Networks, first of all, facilitate and constrain the entrepreneur to find lucrative opportunities. Secondly, entrepreneurs draw on their network to pursue opportunities as they provide access to resources. Thirdly, networking is helpful when the emerging firm of the entrepreneur requires legitimacy. Thus the network approach appreciates the embeddedness of start-ups within the economic and social environment and we distinguish three distinct contributions of networks to the ability of entrepreneurs to seize opportunities. The three are: the ability to discover opportunities, the ability to secure resources, and the ability to gain legitimacy. These three roles of networks in entrepreneurship (Birley, 1985; Aldrich & Zimmer, 1986; Larson & Starr, 1993; Van de Ven, 1993) will be shortly discussed (see figure 1).

- figure 1 about here -

Opportunities

In the search for opportunities networks play a central role. In one of the first studies on this role, Birley (1985) carefully documented how often entrepreneurs seek advice and feedback on the core ideas of their business plan, when they turn to friends and family for local issues, and when they use formal ties to look for financial support. The start-up was seen as an iterative process in which the number of informal and formal ties affected the success of the entrepreneur to find a lucrative opportunity. The environment and the opportunities it contains are diverse and uncertain. The network of an entrepreneur is a source of information to locate and evaluate opportunities. The perception of opportunities by individuals is imperfect as they are limited by bounded rationality and cognitive biases, therefore the network must be included as it influences the perception of opportunities (Aldrich & Zimmer, 1986). The search for information constitutes a substantial part of the activities of an entrepreneur starting a venture. It is not only purposeful search for particular data on markets, but also the search for information to monitor, evaluate, test, and confirm the development of a venture (Nohria, 1992).

Networks and in particular the weak ties in the network provide access to information about a diverse set of topics, ranging from potential markets for goods and services, innovations and promising new business practices. In the network literature a distinction is made between weak and strong ties. Strong ties are built on a history of past dealings and in these relationships a degree of trust can play a role (Aldrich & Zimmer, 1986). Weak ties refer to a diverse group of persons with whom one has some business connection. Strong ties are associated with close friends, while weak ties can be connected to acquaintances (Granovetter, 1973). Weak ties tend to be formed by people who work in different contexts, and therefore these people may have access to different sources of information, resources and opportunities. Weak ties are considered to lead to a more varied set of information and resources than the strong ties can (Bloodgood et al., 1995) and consequently weak ties enhance the ability of entrepreneurs to

spot opportunities. Weak ties may raise the alertness of entrepreneurs and therefore the network of weak ties of an entrepreneur may set into motion a chain of events, started by spotting of an opportunity and leading to a new business start-up.

Resources

Providing access to resources is another contribution of networks to the venturing process. Networks and in particular strong ties are important in getting the required resources to exploit the spotted opportunities. Network members representing strong ties are more motivated to help the entrepreneur than the network members with whom the entrepreneur has weak ties. Potential entrepreneurs assess their ability to get hold of the required resources at relatively low cost on the basis of their strong ties. Thus a network with sufficient strong ties raises the chances that a potential entrepreneur will act as it reduces the perception of uncertainty about the returns of investing in certain opportunities.

Entrepreneurs rarely possess all the resources required to seize an opportunity. One of the crucial tasks of an entrepreneur is to assemble the resources that are needed. This is quite a difficult task as in the initial stages of a start-up the financial resources are limited and given the uncertainty about the growth of the venture it is not very clear how many resources are required. One of the key survival strategies is 'asset parsimony' (Bhide, 1994; Hambrick & MacMillan, 1984). The required resources need to be secured at minimum cost. Paying the market price for resource, such as labor, materials, advice and commitment is often too expensive. Social transactions play a critical role in the acquisition of venture resources. These resources can be acquired far below the market price, the entrepreneurs and also intrapreneurs employ social assets such as friendship, trust, and obligation (Starr & MacMillan, 1990). It is interesting to note that both independent start-ups and intrapreneurs use similar cooptation strategies for taking advantage of underutilized resources of 'friends', such as begging, borrowing, scavenging and amplifying (Starr & MacMillan, 1990, p. 84)

Personal and business networks at the start of a venture develop over time. Through trial-and-error and coordination both parties evaluate the feasibility and fit of potential resources to the start-ups needs. In particular, some of the weak ties develop incrementally and become more structured as communication and coordination intensifies (Larson and Starr, 1993). As a result some weak ties become strong ties. Strong ties can become trust-based relations with mutual commitment and interdependence. Such strong ties are associated with the exchange of high-quality information and tacit knowledge (Rowley et al., 2000).

Legitimacy

The third contribution of a network to the success of a start-up is the way it opens possibilities to gain legitimacy. Gaining legitimacy is imperative in starting something innovative (DiMaggio, 1992). Stinchcombe (1965: 148-150) has introduced the notion of the *liability of newness*, or simply stated, young organisations face higher risks of failure than old ones. Established organisations have a set of institutionalised roles and tasks, stable customer ties, experienced constituents, a surplus of capital and creativity (slack), and a shared normative framework at their disposal, which all contribute to an effective provision of goods and services and their ultimate survival. New firms and novel organisational forms, on the other hand, are more likely to fail just because they still have to develop and acquire those prerequisites. The reasons for higher mortality rates for new (types of) organisations include the creation and learning of new roles (without role models), the development of new links with users and clients, the promotion of trustworthy relations among (relative) strangers, and the high risks and socio-economic costs of generating new markets (Stinchcombe, 1965). Faced with the aforementioned 'liability of newness', a new venture has to organize institutional support and legitimacy. This appears to be in particular the case for relatively radical innovations. Novel ways to combine resources or to enter new markets create conditions of high uncertainty. This uncertainty rises as the new venture breaks with established norms or the industry ways of doing business. In such a case of Schumpeterian entrepreneurship it is crucial to gain legitimacy in order to proceed.

Although often referred to as key to organisational evolution, a proper definition and use of the concept legitimacy in theoretical and empirical organisational research is hard to find. Pfeffer and Salancik (1978; 194) have made the point that legitimacy is intangible and non-proprietary; it is 'conferred status and, therefore, always controlled by those outside the organisation.' Suchman (1995: 574) has defined legitimacy in a broad sense as 'a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions.' Aldrich and Fiol (1994) make a distinction between cognitive and socio-political legitimacy. Understanding the nature of the new venture is referred to as cognitive legitimacy. It has to do with the spread of knowledge about the new business concept. The second, related, type of legitimacy is labeled socio-political legitimacy and refers to the extent key stakeholders accept the new venture as appropriate and conforming to accepted rules and standards.

Achieving sociopolitical legitimacy is in particular difficult when the new venture is very novel and challenges the existing industry boundaries. In those cases changes in the institutional framework are often required. Entrepreneurial ventures, which require changes in institutional regulations in order to accommodate its development have a strong incentive to organize legitimacy. In the study by Aldrich and Fiol (1994) a number of strategies on the part of the founding entrepreneurs are discussed to overcome existing legitimacy barriers. Concerning cognitive legitimacy network actors, such as, competitors, distributors and universities, should be mobilized to create partnerships in order to achieve a wider understanding of the new concepts. Organizing sociopolitical legitimacy asks for collective action, negotiations with other industrial constituents and joint marketing and lobbying efforts.

2.2 New contingent networking approaches

Increasingly the simple causality between the size and diversity of the network and venture success is challenged. In certain circumstances the need for information, resource openings and

links to legitimate parties is overwhelming. This situation may in particular arise for new technology-based firms (Nohria, 1992) as complexity and uncertainty in these ventures is high. In these cases priority has to be given to certain ties. The efficiency of the network becomes an issue in the debate on the contribution of the network to the performance of the start-up. More generally, Burt (1992) argues that an efficient network, one with a minimal number of redundant ties, improves the performance of start-ups. The entrepreneur should try to get access to different clusters and minimize the number of ties to each cluster. Thereby the danger of network overload is reduced (Steier & Greenwood, 2000).

A related debate concerns the beneficial or detrimental effects of a dense network with trust and strong ties versus a sparse network with few redundancies and weak ties on the performance of entrepreneurial ventures. In a network with strong ties the exchange of information and tacit knowledge may strengthen the position of the focal firm. Firms in such a network benefit from these ties as they are helpful for joint problem solving, learning and coordination (Coleman, 1988). Within a relatively closed network there is a lot of flexibility to explore new relationships and opportunities. The benefits of such a dense and trust-based network is referred to as 'Coleman rents' (Kogut, 2000). Besides the obvious benefits of shared norms, trust and collective monitoring, there is increasing evidence that closure in such networks may also hamper the development of some firms. In the literature on social capital, a recent article with the illustrative title 'The dark side of social capital' (Gargiulo & Benassi, 1999) showed that a dense and trust-based network may have some liabilities as well. For example, the ability to access new information from other clusters may be hampered as there is a strong focus on the existing network. Firms which need networks for its explorative capabilities should not be locked into a 'Coleman' network. They can benefit much more from the structural holes in a 'Burtian' network. A Burtian network contains many weak ties and firms in such a network are in a good position to explore the environment for new innovations and unique information. The benefits of such a network accrue to the firm with such network and have recently been labelled by Kogut (2000) as 'Burtian rents'.

Recently, the contingency argument has been introduced to put the networks in which entrepreneurs are embedded and in which they participate into perspective. What companies require from their contacts and contracts varies across firms (e.g. the goals and the needs they have and the stage of development they are in), across sectors and across time; in the words of Rowley et al. (2000: 383): 'both strong and weak ties are beneficial to firms but under different conditions - for different purposes and at different times'. For instance, it has been proposed that in the initial or even nascent stage, family and other strong ties play an important role, while later on formal contractual relations become more dominant (Birley 1985; Bloodgood et al., 1995). In addition, in the study by Rowley and associates (2000) the industry context was introduced as a contingency. They showed that in a highly dynamic environment weak ties are positive related to the performance of firms, while in a stable environment strong ties appeared to be positively related to performance. In this study another contingency is introduced, namely the type of innovation of an entrepreneurial venture.

In a recent empirical study (Rowley et al., 2000) these different roles of certain network configurations were reconciled by introducing the industry context as a contingency: different degrees of environmental uncertainty and varying rates of innovation impose different requirements upon firms what they want from their (future) networks. Rowley et alia (2000) showed that in a highly dynamic environment of the semi-conductor industry weak ties were positively related to the performance of firms, while in the steel industry strong ties appeared to be positively related to performance.

In this study we want to introduce the type of innovation, radical versus incremental, as another contingency. A radical innovation in the Schumpeterian way requires a different role of the network than a start-up introducing an incremental innovation. The research question is how the relations and structure of the network contributes to the ability of start-up to access information and mobilize resource and legitimacy. We expect that the network contribution differs for the type of innovation. This distinction is in particular relevant for high-tech start-ups. These start-ups face large information requirements as the new technology is often not yet proven and the

market potential is also unknown. The network support they need varies. We expect that there is a substantial difference whether the start-up is pursuing a radical innovation rather than an incremental innovation.

3. High-tech start-ups and early growth

New technology-based firms often have ambitious growth targets of achieving substantial sales, obtaining crucial patents or preparing for a stock market listing within 5-10 years after their formation. They are characterised by R&D efforts, experimentation, and a high percentage of highly-educated employees with university or postgraduate degrees, working in corporate laboratories and in new product development units (Martin 1994; Bolland & Hofer 1998). These new technology-based firms are often established by college-educated engineers and scientists with prior business experience, who focus on the production and commercialisation of new technological knowledge and innovations. University spin-offs and new technology-based firms try to keep or establish a link between the science and business communities by carrying out joint research and relying upon licensing agreements and various alliances to commercialise their new technologies and products.

New high technology firms face a number of hurdles on their path towards commercial success. In order to reach a relatively secure position in a market segment or production network, the high-technology start-up firm needs to acquire the resources, skills, and find internal and external partners. High technology start-up firms face the difficult task of exploiting its initial innovation before it is challenged by stronger and more experienced rivals while simultaneously establishing the technological capability for a continuing stream of follow-up innovations. Some of the bottlenecks young firms have to overcome are related to the scientific and technological uncertainties which may hamper product development, regulatory approval and market launching. Also the lack of financial and organisational resources may threaten the start-up firm's survival and constrain its growth, such as a lack of capital and professional management, and the

difficulty of finding leading-edge customers and attracting international strategic partners. High tech firms are often based on novel technologies and an innovative business model. There is an absence of objective information and evidence about the new activity. As a result these high tech firms lack legitimacy. Founding entrepreneurs have to develop strategies to gain legitimacy

The early growth of high-tech start-ups may be characterised by search and discovery to establish a fit between the technological possibilities and the demands of particular niche markets. During this process it is difficult to earn money and the financial requirements can be partly explained by this period of minimal earnings. High-tech ventures often require more capital and hence the role of the venture capitalist is bigger. In addition, the venture capitalist not only provides capital, but also advise and counseling, and in some cases they bring in complementary capabilities, such as managerial experience. This experience is needed to deal with the high uncertainties in some of these emerging high tech markets. Another way to manage this uncertainty is teams instead of a single entrepreneur. Team-based ventures appear to be relatively successful in the first stages (Roberts, 1991). The high-tech focus of the founder needs to be complemented by management knowledge.

A distinction can be made between radical and incremental innovations. Radical innovations disrupt the existing economic conditions and requires a change in the business context, instigated by a visionary and persuasive entrepreneur (Schumpeter, 1934). Incremental innovations on the other hand are far less disruptive and are brought to market and exploited by alert entrepreneurs (Kirzner, 1973). 'Schumpeterian' entrepreneurship promotes dis-equilibrium, new combinations disrupt the existing conditions (Cheah, 1990). Some entrepreneurial start-ups cause radical innovations and change the rules of the game in an industry. In contrast, 'Kirznerian' entrepreneurship is a process towards equilibrium: 'Entrepreneurial discovery is seen as gradually but systematically pushing back the boundaries of sheer ignorance, in this way increasing mutual awareness among market participants and thus, driving prices, output and input quantities, toward the values consistent with equilibrium' (Kirzner, 1997, p. 62). In the Kirznerian conception of entrepreneurship the alert entrepreneur discovers the existence of

profitable discrepancies, gaps, and mismatches in knowledge and information the others have not yet perceived and exploited (Cheah, 1990). These differences are expected to have an impact on the role of the network in the development of a venture (see figure 2). The case material will be used to formulate a number of propositions, for future testing, on how particular networks affect the ability of entrepreneurs to discover opportunities, to get resources and to gain legitimacy.

- figure 2 about here -

4 Cases of high tech start-ups

4.1 Methodology

This research is explorative and the object is not to test particular hypotheses but to contribute to theory building in the field of high-tech entrepreneurship and network development. Because of the inductive nature of the research the selection of the cases was not a random process, but based on theoretical sampling (Eisenhardt 1989). The main selection criterium was representation of firms from high-tech industries and start-ups with a traceable life course, with data and details available about their formation, their product/service offerings, the personal traits of the entrepreneur(s) involved, and their competitive and institutional environment. In our case studies we focus on three (former) high-tech start-ups from the Netherlands: two ICT-companies (the Wageningen-based Noldus and the Amsterdam-based Digicash) and one biotechnology company (Pharming from Leyden). The collection of data was conducted through interviews and discussions with founders and senior managers (two per company), other interviews with the firm's key people and company reports in newspapers and trade journals, and analysis of company briefings and industry data. These multiple data sources were used to be able to check the validity of the data. The next step was to describe the characteristics of the

three high-tech start-ups, their founders, and their early growth trajectory. In the following section we compare and analyse the three case studies more systematically.

4.2 Noldus

Noldus main products are standard software packages, such as *The Observer*, *EthoVision* and *UltraVox*, which enable the collection and analysis of data of human and animal behavior. The company's mission states that these products help scientists, engineers and practitioners to study the behavioral processes, to automate measurements, to improve the quality of their data, and to increase their productivity. In addition to the standard software packages they offer integrated data acquisition and data analysis systems, including PCs and audiovisual equipment. Furthermore, they also deliver custom software development, training and consulting services. Applications to study human and animal behavior can be found in a large number of disciplines, such as neuroscience, pharmacology, ethology, veterinary sciences, ergonomics, industrial engineering, and sports research, which are found in many companies, government agencies and universities. Noldus has over 1500 clients in over 65 countries. The main office is in Wageningen, and Noldus has subsidiaries in Sterling, USA and Freiburg, Germany. In the ten years of its operations it has grown from a one person -entrepreneur - company to a high-tech firm of around 40 employees and sales of about 5 mNLG. Important clients are Bayer, Glaxo, and Organon from the pharmaceutical industry; Microsoft, Oracle, and SAP from the software industry; Ericsson and Deutsche Telekom from the telecommunication industry; DaimlerChrysler and Volvo from the car industry; Lockheed Martin and NASA from the aerospace industry.

The company was started by Lucas Noldus shortly after he obtained his PhD from Wageningen University in 1989. The first product was a software package based on the software development during his PhD research project on the behavior of wasps. Already during the final phases of the research, the interest of other researchers of animal behavior into the software was substantial and provided a first indication of the market for such software. In the last stages of his PhD, Lucas Noldus started to develop, in his spare time, a more general software

application called The Observer. The University was supportive, in the sense that they agreed that he could use the University facilities outside office hours to work on his new software package. In that case the University would not claim any intellectual property rights or royalties. The University, however, was his first client after he started his firm. Mr Noldus started his firm in an incubator building. Although he did not use some of the additional services for advice of start-up companies in these type of buildings, Mr Noldus benefited from the discussion with entrepreneurs from other start-up companies in that building. Incubator buildings facilitate the learning from fellow entrepreneurs. The investments in product development and distribution in the first years were funded internally and externally. Senter (national technology promotion agency) provided some technical subsidies and internally he reinvested as much as possible in the development of new software. His parsimonious policy for example went as far as allocating only a minimal salary to himself, all he could save went into product development. When he needed advice or information on a particular aspect of running his business he tried to avoid expensive consultants. He rather turned to his developed network of Wageningen contacts to ask how they solved that issue.

Most of the marketing efforts of Noldus are devoted in attending to conferences of relevant research fields and getting in contact with researchers, engineers, and practitioners who can use the software products to study behavioral processes. Marketing is networking and once the contact is established the unique characteristics of the product are helpful in getting it sold. Most of the markets are niche markets in the sense that Noldus is the first in that particular field or the competitors are one or more steps behind. The marketing strategy can also be characterized as a stepping stone approach. From the strong position in the pharmaceutical industry they got in contact with researchers in the psychology and neuroscience field. Visiting conferences in the latter disciplines gave them leads to new customers. An example of a recent client, Volvo, will illustrate the dynamics. This client is using the Noldus software in the ergonomics group. Ergonomics is an important discipline in the design of cars. The seating and position of the instruments and the way drivers react to that can be analyzed using Noldus software. They got in touch with the ergonomics people from Volvo at an ergonomics conference, and the Noldus

people attended the ergonomics conference on basis of suggestions of ergonomics researchers they met at an psychology conference.

Growth driven by this stepping stone strategy has been substantial. However, it is a rather labor-intensive marketing strategy and consequently it will be difficult to grow very fast. In fact, the ambition of Mr Noldus is balanced growth, he is clearly aware of the dangers of very fast growth. Growth is also constrained by his strategy to finance new product development and new distribution channels by internal means. As a result he does not need venture capitalists to finance growth of the company. This conservative growth strategy has resulted in a stable growth path, with annual growth figures between 15 and 50 percent in the last 7 years, a reasonable profit margin and a healthy balance sheet.

4.3 Pharming

Pharming is one of the leading players in the field of genetic manipulation, cloning and successfully transferring genetic material from one life-form to another. This biotechnology company is a listed medium-sized company with a workforce of approximately 150 people and annual revenues of 13 mEuro (1999). After the Ministry of Economic Affairs had granted the RijksUniversiteit Leyden (RUL) an R&D subsidy of approximately 1.5 mEuro to investigate the possible production of biopharmaceutical proteins by transgenic cattle in 1988, the idea for an academic spin-off came up. As a consequence, the biotechnology company GenPharm (the forerunner of Pharming) was founded. The company was co-founded by Professor De Boer, a biology professor at the RUL, who had previously worked at Genentech (the American biotechnology pioneer) and Mr. Postma, an industrial liaison officer at the RUL. The ties between the start-up company and the university were close from the beginning. GenPharm located its corporate premises at the University's Science Park and the RUL participated in the company's stock. Due to a general lack of venture capital and trust in biotechnology in the Netherlands at the end of the 1980s, the founders came up with the suggestion for a two-tier structure in which the Dutch/European subsidiary would be part of the larger American holding

company GenPharm International (GPI), in which Genencore (affiliated with Genentech) and Chimera Biotech had major stakes.

Initially GenPharm worked closely with the government's agricultural laboratory IVO-DLO, generating Herman, the first transgenic bull in the world, and the breeding of cows (Herman's offspring) with human genes for the treatment of *mastitis* (a cow disease). For that purpose the firm had set up further R&D and farm operations at various places in the Netherlands. In 1990, after a secret research contract had been signed with Nutricia/Numico, a Dutch nutrition company and the American health company Bristol-Meyers-Squibb (BMS), GenPharm's involvement in producing biomedical protein in the milk of transgenic cattle shifted toward serving the larger public with 'humanised' babyfood in particular and clinical nutrition for patients (e.g. intestinal infection and blood poisoning). In the early 1990s, concerns about and protests against the cloning of bull Herman and experimenting with its transgenic off-spring result in pressures from animal rights activists on the Minister to ban the allegedly un-ethical activities of Pharming. Due to ongoing political and financial support from the Ministry of Agriculture and due to a massive awareness campaign, instigated and organised by GenPharm, in which various associations of *captive* patients were mobilised, Parliament decided that there was no reason to prohibit the experiments with bull Herman. Since the industry association NIABA had only recently been created, the spread of information about transgenic technologies and raising the public knowledge of biotechnology about its benefits to society had to be carried out by the few companies themselves. Furthermore, in 1992, the Ministry of Agriculture granted GenPharm another subsidy (approximately 1 mEuro) to continue its research.

Although very often in the spotlight, the company was struggling and the American shareholders put GenPharm under increasing pressure. In 1993, a new CEO was appointed to streamline the firm's activities and, due to an internal conflict, co-founder Professor De Boer left GenPharm. Two years later, GenPharm was divested from GPI through a sort of management buy-out and received new investments from Dutch investors and the American Red Cross. The company renamed itself Pharming NV. In the same year, Pharming acquired FinnGene Ltd, a small and

specialised Finnish biotechnology company, a producer of EPO and human lactoferin). FinnGene became fully integrated into the Dutch biotechnology company and was renamed Pharming Oy. In 1996 Pharming set up a small laboratories and breeding farm in Belgium for the development, manufacturing, distribution and sales of products for rare diseases.

The year 1998 was key in the corporate evolution of Pharming with expanding moves and impediments happening almost simultaneously. Pharming set up a subsidiary in the USA (Rockville, Maryland), close to its contract research partner, the American Red Cross, and furthermore signed an agreement with the Genzyme Corporation to develop and commercialise the enzyme human alpha-glycosides for treatment of Pompe's disease (a lethal hereditary muscular disease). In the same year, Pharming became a public company, when it was listed on the Pan-European Stock Exchange EASDAQ (a year later it became also listed at the Amsterdam Stock Exchange). In 1998, however, Pharming was also forced, due a final ban of the Dutch Ministry of Agriculture on animal cloning, to relocate its dairy farm operations in the Netherlands and transfer them to Finland, Belgium and the USA.

Over time, Pharming has transformed itself from a technology-driven into a (more) market and product-driven company. Its objective has been to find niche markets for unmet medical needs (e.g. the rare Pompe's disease) and to expand the sales and marketing efforts of its proprietary treatments. Pharming has developed an science and technology base by carrying out in-house and contract research activities. Over the years, the company has built up a world-wide patent position, consisting of about 10 patents filed in Europe and in the USA which churn out a steady stream of royalties. Pharming is still very much dependent on subsidies and contract research, without any products on the market place yet. In order to speed up R&D and the testing and production of drugs and also leverage its intellectual property portfolio, Pharming is increasingly working together with new academic groups (e.g. FinnGene), companies (e.g. Genzymen) and other institutions (e.g. the American Red Cross). Early 2001, after approval from the American Food and Drug Administration (FDA), Pharming may soon have its first marketable product. Pompase, the firm's therapy against Pompe's disease, has now thoroughly been tested and the

company is hoping that its treatment of Pompe's disease will be granted an Orphan Drug status (i.e. a sheltered commercial position for some years). Pharming is now preparing the launch of this enzyme, in collaboration with its non-exclusive partner Genzyme.

4.4 Digicash

As expressed in its mission statement and throughout its corporate activities from 1990 to 1999, Digicash has sought to offer *solutions for security and privacy*. The firm's primary activity was to develop and commercialise safe and anonymous payment technology products for small money transfers over the Internet. In April 1990, Digicash was set up as a spin-off of the CWI, the Centre for Research in Mathematics and Computer Science of the University of Amsterdam. The founder of the company Dr. David Chaum, then head of the Cryptography Group at CWI, is a world-leading expert in the field of cryptography. Initially, most of Digicash' products and applications were based on his patents in public key cryptography. The main reason to establish a company was the plan by the Dutch Government to develop a road pricing system. Initially, Digicash started off with family capital of 2.5 mNLG for setting up the company; the company did not have any backing from informal investors and/or venture capitalists. As it did not immediately have any tangible products to sell, the start-up firm had to rely upon the revenues generated by consultancy projects and contract research. Digicash participated in a number of technology promotion projects sponsored by the Dutch government and the European Commission. In 1995, Digicash was acknowledged as a successful high-technology start-up in Europe and a potential winner in a business area thus far dominated by American companies (e.g. Microsoft, SUN, Oracle): the company was awarded the European Information Society Technologies' (IST) prize by the European Union for its outstanding contribution to technology and innovation.

The further development of Digicash was very much technology-driven and inspired by the firm's participation in several technology promotion programmes. Especially, the first five years of the company were very much project-oriented, characterised by a kind of self-management

being relatively chaotic and ill-structured. Digicash's ultimate goal was to bring secure and safe electronic cash into the main stream and to bind some larger clients to its (proprietary) technology (it managed to issue a number of licenses to banks all over the world to experiment with and use its e-cash technology). Besides in the financial services sector, the company had also found business partners and clients from other industries (e.g. automatic road toll collection and manufacturing/distribution of cryptographic devices). Although relying very much on public funding and sales being very marginal, the situation for Digicash looked promising in the mid-1990s: it employed about 50 people, was making a little profit, and it had embarked upon an internationalisation strategy by establishing small subsidiaries in the USA and Australia.

In the early 1990s, the market for small-scale payments was still relatively open and fragmented, offering potential for new entrants, including Mondex, Cybercash, and Digicash. In the mid-1990s, however, things were changing and large competitors moved into Digicash's domain: big banks started experimenting with chipcards, Microsoft and others pushed for electronic money as an add-on to Internet browsers, and MasterCard and VISA, together with a number of software companies, were working hard on the joint promotion of which would later become the Secure Electronic Transaction (SET) standard. Also in its home base, Digicash was left in the cold. When the Dutch banks were working hard on designing a system for allowing on-line payments (centred around their co-operative clearing house Interpay), they had approached Digicash to participate in the project. Unfortunately, Digicash asked too much money for its involvement and the banks eventually adopted the SET standard, which by 1997 had become the *de facto* global standard.

In order to break into the US market and tap from the most recent technological and commercial knowledge in electronic commerce, Digicash decided to move its headquarters and research laboratory to Silicon Valley. The decision to move the company's headquarters to the heart of the Internet-revolution was strongly promoted by a group of American and Dutch venture capitalists, who announced in April/May 1997 a major investment (between 10 and 15 m\$) in the still pioneering company. For the first time, after having relied on subsidies and

retained earnings (consultancy fees, patent/license royalties) to finance its expansion, Digicash strengthened its capital base through venture capital. One of the investors' demands was that management needed to be replaced, because major business experience was lacking. Founder Chaum stepped down as president and CEO of Digicash (as largest shareholder, he stayed on as member of the Supervisory Board), and took up the post of Chief Technology Officer. Mr. Nash, a senior executive, who was previously at Amdahl and VISA, was hired as the new CEO.

Although nominated for the Dutch Broos van Erp prize for successfully promoting innovative ICT technologies and applications, Digicash' future looked bleak in September 1998: its Dutch subsidiary ran into financial difficulties (and as a consequence staff had to be scaled to 6 employees), and the company lost its toehold in the US as the only bank testing its system, the Mark Twain bank in Missouri, abruptly closed the 3-year trial with anonymous electronic cash. A month later, their European offices were already closed and the Digicash holding company, with a debt of 4 m\$, had to ask for a Chapter 11 filing, and eventually went bankrupt. Finally, a suitor was found to buy Digicash' intellectual assets. The Seattle-based company, e-Cash Technologies, in August 1999 announced the acquisition of the firm's technologies, including the patented blind signature encryption scheme.

5 Analysis of cases

5.1 Noldus

Noldus fits to the notion of Kirznerian entrepreneurship. Search for a successful product has been limited. The department of entomology of the University was the first client and this lead user provided sufficient feed back to enter the market with a well- defined product. The niche in the market was discovered by an alert entrepreneur. The degree of uncertainty and the level of ambiguity concerning the purpose and strategy of the venture was limited. The means to

accomplish the development of the software package and to sell this package to the targeted group of clients was, however, highly uncertain. In the initial period of the venture trial and error is an important mode for learning about the development and planning of new products and markets. In the initial stage the emphasis was on exploitation, sell this successful software package to as many new clients as possible and develop software for different application as efficient as possible.

The network of the Wageningen University has been used purposefully, for example to get qualified employees and to get hold of resources at relatively low costs. The dense network in Wageningen with many strong ties was helpful for this particular purpose. However, the marketing of the product posed a different problem. Getting in contact with diverse users as DaimlerChrysler, Bayer, Oracle, Ericsson required the exploration of a network of weak ties. Contacts in a conference on ergonomics were used to get access to the car industry and the car industry provided leads again to firms in other industries.

There has been only a slight legitimacy problem. The founder of Noldus once remarked that: 'I never told my first corporate clients that the software was developed on basis of observations of wasps, that might have damaged the credibility of the software'. Achieving legitimacy has not been a major hurdle for Noldus. Sociopolitical legitimacy was not a problem, largely because the standard software industry is well established. However, the type of software developed by Noldus was new and achieving cognitive legitimacy was important in order to convince clients to buy the software, to become a reliable partner for suppliers and other parties and to become an attractive employer. Noldus was able to describe his software package in rather broad terms, the collection and analysis of data on human and animal behavior, encompassing existing knowledge. In addition, his collaboration with some research fields and the close ties with the University has helped him to achieve cognitive legitimacy.

5.2 Pharming

Although the company has done pretty well with having spotted potentially attractive opportunities in the treatment of rare medical disorders (e.g. the orphan drug Pompace) and acquired the resources needed in order to survive and grow (e.g. key patents, new people in R&D and management, financing, business partners), sales are still negligible and its long-term financial situation is still vulnerable. Probably, Pharming is the most famous biotechnology company in the Netherlands, but sadly enough not because of its patent or product portfolio or market valuation (Easdaq and AEX), but simply because of all the (inter)national mediahype and controversy around Bull Herman. Most people did not know for what purpose the firm carries out its cloning experiments or do not endorse them morally. In its Schumpeterian strategy of being the lone ranger in a developing industry, Pharming could in its initial stages not rely upon an established trade association, which could inform the general public about biotechnology and hold seminars to explain the activities of Pharming and its competitors. Pharming's early search for business opportunities showed a high degree of opportunism, only later to be replaced by more stable ties with strategic partners (American Red Cross, Genzyme).

In terms of acquiring key resources, research money, knowledge and regulatory permission were key to Pharming's growth. It was able to play off the various stakeholders against each other. To farmers and the Ministry of Agriculture, Pharming justified transgenic manipulation, because this would eventually allow for a treatment of the cow disease *mastitis*. In a later stage, Pharming found an ideal partner willing to stand up against the animal liberation front lobby and defend its biotechnological experiments by aligning itself with groups representing patients suffering from all kinds of hereditary diseases. Just because of the outside pressures and their constant need by the public for new information, Pharming's communications policy was not always coherent over time. On a couple of occasions key information was manipulated, in which the truth became economised or hidden. Also Pharming's inexperienced communications department and its subsequent hiring of an aggressive and professional PR firm to do the political lobbying for them led to a lack of consistency over time.

The company's goals and activities became very controversial with a selective spread of knowledge, depending on the various interests of the group of internal and external stakeholders. The founders could draw upon their strong and dense network in the R&D constituency of the emerging biotechnology industry; for the further development of their company weak ties with marketing and PR/lobbying professionals would have been beneficial. It was only later that the company discovered the strength of those weak and more diverse ties. The firm could furthermore rely upon its strong ties with the university, offering its prestigious spin-off premises at its newly created technology park, and upon its American Genentech partners, working closely with them (tacit knowledge).

Despite recognition in the academic community and among the constituents in the agri-business and health care domain, Pharming's cognitive and socio-political legitimacy was controversial. This required, besides the aforementioned intensive information and education programmes, the instigation of aggressive lobbying campaigns towards regulatory authorities and pressure groups. Especially during the D-days for obtaining another round of allocating testing subsidies and during political decision making on allowing animal testing and cloning, Pharming found itself isolated. As a relatively young company Pharming was still building up a credible reputation and furthermore lacked a network with strong and close ties (e.g. through a widely recognized industry association, and international partners), and loose and diverse ties that would contribute to an understanding of its cause (e.g. alignment with both patient organisations and the animal rights organisations). After cloning had been banned and it had moved its farm operations to other countries, Pharming worked towards establishing close ties with recognized organisations (e.g. partnering with the American RedCross and international market leader Genzyme) and accomodating the various pressure groups by participating strongly in a society-wide cloning debate.

5.3 Digicash

In the early and mid-1990s, when a number of trials with on-line payments were carried out, expectations of these new financial systems were high. At that time people were fearful of using credit cards to pay over the Internet: this was the opportunity for new business Digicash and others start-ups spotted. Over the years with the proliferation of the Internet and electronic commerce, however, this fear seems to have subsided and most consumers prefer to use credit cards for arranging secure transactions (or still relying upon traditional means of payments, e.g. cash or cheques after delivery in Western Europe). Compared to the potential of revolutionary Digicash-like systems, consumers instead preferred an evolutionary change towards adjusting the already established credit card system for secure on-line payments on the basis of the widely accepted SET-standard. As an insurgent into the market for facilitating financial transactions, Digicash could not cope with the 'gradual conservatism' of the credit card companies and the banking community, effectively exploiting the large installed base of credit cards and the inertia of consumers in general and credit card holders in particular. As a small company, Digicash did not have major partners in either the financial community and/or in the software world.

Over the years, Digicash has increasingly focused on software and de-emphasised its efforts on smart cards: as such it shifted from a Kirznerian to a Schumpeterian mode. Like its electronic cash technologies, Digicash' applications for secure electronic voting and road pricing were welcomed by policy makers as interesting technical solutions to socio-economic problems, but actual procurement of its technologies was negligible. As a consequence of its structural dependence on grants and technology subsidies in the Dutch and European setting, Digicash became very sceptical about government support. In its formation stage, the high-tech start-up relied upon the close ties with its source organisation, the CWI Lab, by hiring a number of researchers and locating the firm at the University's science park. Just because it continued to rely upon dense ties with similar R&D partners and working with them in numerous government-sponsored projects, Digicash could not develop into a market-driven and product-based organisational structure. Despite its high involvement in those pilots and sharing tacit knowledge in technology consortia, Digicash' activities continued to focus primarily on innovation and exploration without raising revenues from selling products and licenses. The

company did not have the weak and diverse ties needed to tap into other businesses (e.g. banking and software) and the larger American software and credit card companies, actively involved in setting the SET-standard. Digicash's cognitive legitimacy was very much targeted towards its R&D network of contractors and partners, with limited attention to the large business users and the general audience.

The market for micro-payments is still something of a non-starter, or formulated in the words of Aldrich and Fiol (1994): it is an industry in creation where fools like Digicash and other pioneers in on-line payment systems rushed in and ran into trouble. The problem for the struggling Digicash was whether there really is/was a market for micro-payment solutions in which the company sought to specialise (i.e. electronic cash at a low cost that was anonymous and secure): the legitimacy of the industry and the start-up firms active in that market was low/moderate. Although the cognitive legitimacy of its activities was reasonable with more or less everyone customer agreeing on the need for safe and anonymous payment systems for (future) Internet transactions (shopkeepers were more sceptical), Digicash' socio-political legitimacy was low: the firm itself did not put a lot of effort in making itself known in the market place and or in the policy arena. Instead of working with key business partners and support from governments on an international dominant standard, the company was still doing one experiment after another. As a Schumpeterian start-up working on a proprietary standard for micropayments, Digicash could not allow to be left aside by the key players in the domestic and international arena (credit card companies and software companies). Unfortunately the firm had not developed either close or weak ties with them, and eventually found itself marginalised as a beautiful loser in the new Internet-based economy.

- table 1 about here -

6 Concluding remarks

One of the arguments in the paper is that the more start-ups are able to discover and exploit opportunities the higher the performance of a start-up. Particular network relations are beneficial or detrimental to the discovery and exploitation of opportunities. The effect depends on the type of innovation (Schumpeterian/radical versus Kirznerian/incremental) and the purpose of the network effect (discovering opportunities, securing resources, and gaining legitimacy). Concerning the discovery of opportunities the cases provide material to illustrate how weak ties were helpful to discover opportunities. The 'stepping stone' marketing approach of Noldus clearly shows how new relations at one conference lead to other networks linked to other industries and particular niches. At the same time the failing Digicash entrepreneurs were unable to spot lucrative opportunities for its novel technology. To some extent this may be explained by their lack of diverse and weak ties. They appeared to be working very much within a dense network with strong ties focussed on technological developments. Thus the contingency of type of innovation seems to have no differentiating impact on the way network ties promote the discovery of opportunities, in both cases weak ties are the driver.

Proposition 1

Weak ties promote the discovery of opportunities in both Schumpeterian and Kirznerian start-ups.

Concerning the securing of resources, the second issue for start-ups, strong ties appear to be beneficial in both the Schumpeterian and the Kirznerian situation. However, the causal mechanisms are different. In the Kirznerian situation of incremental innovations the emphasis is on exploitation and efficiency. Here strong ties are used to get a good deal and pay less than the market price. Networks are used to support a strategy of 'asset parsimony'. Different processes to benefit from strong ties can be observed in the Schumpeterian case. The Digicash and Pharming case show that strong ties are used to explore new research trajectories in close collaboration with partners. Exchange of information and tacit knowledge is important and can only be accomplished in trust-based relationships.

Proposition 2

Strong ties promote the ability to acquire resources at low costs in Kirznerian start-ups.

Proposition 3

Strong ties promote the acquisition of resources from partners by exchange of tacit knowledge in Schumpeterian start-ups.

Association with research institutes with high reputation, such as Universities, is helpful in obtaining cognitive legitimacy, i.e. the spread of the knowledge base and the broad acceptance of the new firm. This has been the case for both the Schumpeterian and Kirznerian cases. However, there is a difference between the Noldus case on the one hand and the Pharming and Digicash cases on the other hand. In the Noldus case it is a new product for a new market niche, but it is also software, which is part an established industry. Thus the demands on the network to improve awareness and trusted knowledge about it is rather limited. For the Schumpeterian cases the required diversity of strong ties is much bigger, as in both cases real new activities, which build on a number of different industries have to become understood.

Proposition 4

Strong ties promote the ability to gain cognitive legitimacy through association in both Kirznerian and Schumpeterian start-ups.

As shown in the Digicash case where the company found itself closely tied up within the R&D community, the company was unable to break out and reach for market- and product-oriented applications. Furthermore the company was absent in the national and international regulatory arenas, where the crucial decision was taken to support the joint SET-standard, supported by two large software and credit card consortia. Also Pharming relied strongly upon its strong ties with the research community and its health care and agri-business constituents. Moral concerns from animal liberation groups and activists and regulatory hurdles were clearly underestimated,

eventually leading to a ban on its cloning activities. As both cases illustrate, strong ties had a perverse effect on the ability to gain socio-political legitimacy. Obviously, if those two companies had developed a more diverse set of weak ties with different stakeholder groups, they would have acted differently, more sensitive to societal and institutional concerns.

Proposition 5

Strong ties are detrimental to the ability to gain socio-political legitimacy.

Proposition 6

Weak ties may promote the chances to gain socio-political legitimacy.

The argument of this paper has relied upon two entrepreneurial - Kirznerian and Schumpeterian - modes, which are opposed to each other. One could also argue that those two modes complement each other or succeed each other subsequently, all depending on the life cycle of the products, companies, and industry. In this study we have found evidence of this the rotational symmetry of Kirznerian and Schumpeterian modes (Cheah 1990), in the evolution of Digicash. Initially the firm sought to explore and exploit niche cryptographic applications, later to be followed by an ambitious entry into breakthrough micro-payments. More research is needed in which stages of their corporate life course pursue different kind of innovations.

For Schumpeterian start-ups network requirements in terms of diversity of weak and strong ties are crucial for survival and future growth. Redundancies have to be avoided and priorities have to be given to particular ties to avoid network overload. One strategy, as exemplified by Pharming and Digicash, and also suggested in the literature (Steier and Greenwood, 2000; Cable and Shane, 1997), is to get access to a new sub-network by linkage to a venture capitalist. The added value of the network of a venture capitalist is more important to the performance of start-ups than the provision of capital itself. Although in a later stage, both Pharming and Digicash benefited from the input of extra resources (finance, human capital, management expertise), the seizing of new market opportunities (e.g. focus on orphan drugs,

relocation to Silicon Valley), and more cognitive and socio-political legitimacy, thanks to the commitment of venture capitalists. Of course an increase of the start-up's dependence is the downside of such a far-reaching alignment.

The added value of the network of the venture capitalist has to be visible and credible: picking the wrong venture capitalist (i.e. one with a limited and irrelevant network to the requirements of the start-up), may be counterproductive. In fact, the Digicash case showed that the parties taking care of the first round of financing did not add much in terms of the firm's network diversity and did eventually not much to save it from bankruptcy. As shown in the case of the Schumpeterian start-up Pharming, however, a group of venture capitalists, provided access to a relevant set of diverse networks and ultimately guided the company through further growth and stabilisation. Obviously ties with some stakeholders are more important than others and to find out more about the specific contribution of venture capitalists to the growth and development of networks of entrepreneurs and start-ups is input for another research.

References

- Aldrich, H.E. and C. Zimmer, 1986, 'Entrepreneurship through social networks', in: D. Sexton and J. Kasarda (eds), *The art and science of entrepreneurship*, Cambridge, MA.: Ballinger,
- Aldrich, H.E. and C.M. Fiol, 1994, 'Fools rush in? The institutional context of industry creation', *Academy of Management Review* **19**: 645-670.
- Amit, R., L. Glosten and E. Muller, 1993, 'Challenges to theory development in entrepreneurship research', *Journal of Management Studies* **30**: 815-834.
- Baum, J.A.C., T. Calabrese and B.S. Silverman, 2000, 'Don't go it alone: alliance network composition and startups' performance in Canadian biotechnology', *Strategic Management Journal* **21**: 267-294.

- Bhide, A., 1994, 'How Entrepreneurs Craft Strategies that Work', *Harvard Business Review*, March-April, 150-163.
- Birley, S., 1985, 'The role of networks in the entrepreneurial process', *Journal of Business Venturing* **1**: 107-117.
- Bloodgood, J.M., H.J. Sapienza and A. Carsrud, 1995, 'The dynamics of new business start-ups: person, context, and process', in: J.A. Katz and R.H. Brockhaus (eds), *Advances in entrepreneurship, firm emergence, and growth*, Greenwich (CN): JAI Press.
- Bolland, E.J. and C.W. Hofer, 1998, *Future firms. How America's high technology companies work*, Oxford: Oxford University Press.
- Brockhaus, R.H. and P.S. Horwitz, 1986, 'The psychology of the entrepreneur', in: D. Sexton and J. Kasarda (eds), *The art and science of entrepreneurship*, Cambridge, MA: Ballinger.
- Burt, R.S., 1992, *Structural holes: The social structure of competition*, Cambridge, MA: Harvard University Press.
- Cable, D.M. and S. Shane, 1997, 'A Prisoner's Dilemma Approach to Entrepreneur-Venture Capitalist Relationships', *Academy of Management Review* **22**: 142-176.
- Cheah, H.B., 1990, 'Schumpeterian and Austrian entrepreneurship: unity within duality', *Journal of Business Venturing* **5**: 341-347.
- Coleman, J.S., 1988, 'Social capital in the creation of human capital', *American Journal of Sociology* **94**: 95-120.
- Cooke, P. and D. Wills, 1999, 'Small firms, social capital and the enhancement of business performance through innovative programmes', *Small Business Economics* **13**: 219-234.
- DiMaggio P., 1992, 'Nadel's paradox revisited: relational and cultural aspects of organizational structures', in: N. Nohria and R.G. Eccles (eds), *Networks and organizations. Structure, form, and action*, Cambridge (MA): HBS Press.
- Eisenhardt, K.M., 1989, 'Building theories from case study research', *Academy of Management Review*, **14**: 532-550.

- Gargiulo, M. and M. Benassi, 1999, 'The dark side of social capital', in: R.Th.A.J. Leenders and S.M. Gabbey (eds), *Corporate social capital and liability*, Boston: Kluwer Academic Publishers.
- Granovetter, M.,1973, 'The strength of weak ties', *American Journal of Sociology* **91**: 481-510.
- Hambrick, D. and I.C. MacMillan, 1984, 'Asset parsimony - Managing assets to manage profits', *Sloan Management Review*, Winter, pp. 67-74.
- Johannisson, B., 1987, 'Beyond process and structure: social exchange networks', *International Studies of Management and Organization* **17**: 3-23.
- Kirzner, I.M., 1973, *Competition and entrepreneurship*, Chicago: University of Chicago Press.
- Kirzner, I.M., 1997, 'Entrepreneurial discovery and the competitive market process: An Austrian approach', *Journal of Economic Literature* **19**: 60-85.
- Kogut, B., 2000, 'The network as knowledge: generative rules and the emergence of structure', *Strategic Management Journal* **21**: 405-425.
- Larson, A. and J.A. Starr, 1993, 'A network model of organization formation', *Entrepreneurship: Theory and Practice* **18**: 5-15.
- Leenders, R.Th.A.J. & S.M. Gabbey (eds), 1999, *Corporate social capital and liability*, Kluwer Academic Publishers, Boston.
- Littunen, H., 2000, 'Networks and local environmental characteristics in the survival of new firms', *Small Business Economics* **15**: 59-71.
- Martin, M.J.C., 1994, *Managing innovation and entrepreneurship in technology-based firms*, New York: John Wiley & Sons.
- Nohria, N., 1992, 'Is a network perspective a useful way of studying organizations?' in: N. Nohria and R.G. Eccles (eds), *Networks and Organizations; Structure, Form, and Action*, Cambridge MA: Harvard Business School Press.
- Pfeffer, J. and G.R. Salancik, 1978, *The external control of organizations. A resource dependence perspective*, New York: Harper & Row.

- Roberts, E.B., 1991, *Entrepreneurs in high technology. Lessons from MIT and beyond*, New York: Oxford University Press.
- Rowley, T., D. Behrens and D. Krackhardt, 2000, 'Redundant governance structures: An analysis of structural and relational embeddedness in the steel and semiconductor industries', *Strategic Management Journal* **21**: 369-386.
- Schumpeter, J.A., 1934, *The theory of economic development*, Cambridge, MA: Harvard University Press,.
- Shane, S. and S. Venkataraman, 2000, 'The promise of entrepreneurship as a field of research', *Academy of Management Review* **25**: 217-226.
- Starr, A.S. and I.C. MacMillan, 1990, 'Resource cooptation via social contracting: resource acquisition strategies for new resources', *Strategic Management Journal* **11**: 79-92.
- Steier, L. & R. Greenwood, 2000, 'Entrepreneurship and the evolution of angel financial networks', *Organization Studies* **21**: 163-192.
- Stinchcombe, A.L., 1965, 'Social structure and organisations', in: J.G. March (ed), *Handbook of Organizations*, Chicago: Rand McNally & Company.
- Suchman, M.C., 1995, 'Managing legitimacy: strategic and institutional approaches', *Academy of Management Review* **20**: 571-610.
- Van de Ven, A.H., 1993, 'The development of an infrastructure for entrepreneurship', *Journal of Business Venturing* **8**: 211-230.

figure 1: Research framework

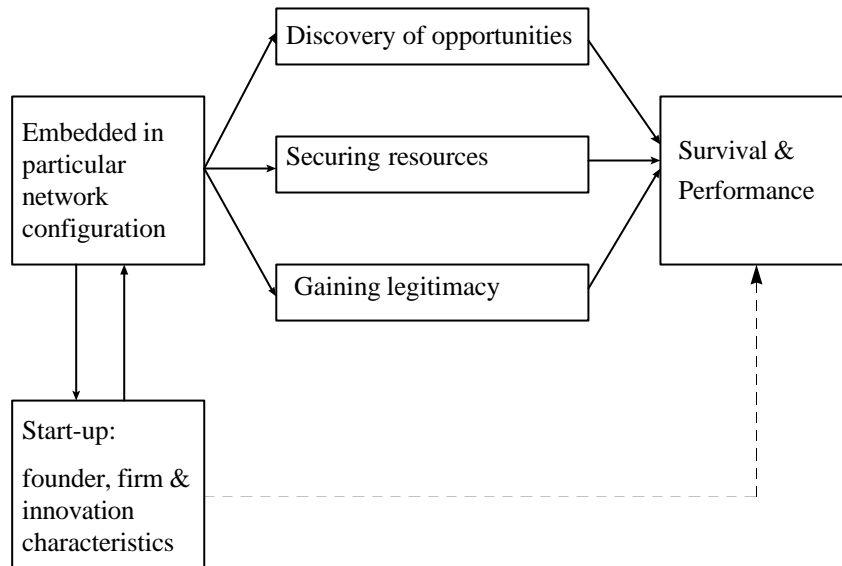


figure 2: Entrepreneurial modes

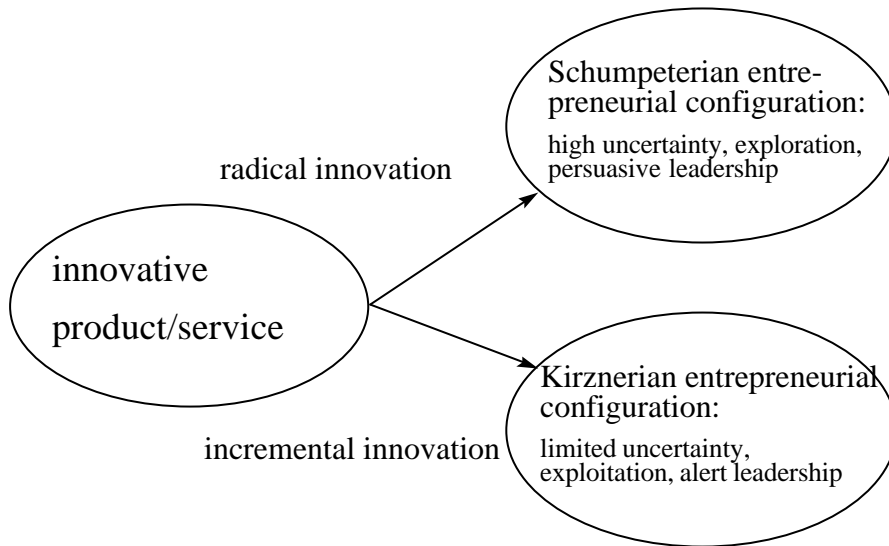


table 1: Comparison of high-tech start-ups and their networking activities

	Noldus	Pharming	Digicash
Type of innovation	Kirznerian	Schumpeterian	first Kirznerian, then Schumpeterian
Seizing opportunities	weak ties (stepping stone marketing)	strong & weak ties: RUL & 2 ministries, new customer groups	weak ties (project-to-project)
Securing resources	strong ties (asset parsimony)	strong ties: exchange of tacit knowledge	strong ties: exchange of tacit knowledge
Gaining legitimacy			
• cognitive	- strong ties (association with university)	- strong ties: leading R&D labs & partners	- strong ties (CWI + A'dam science park)
• socio-political	- not relevant	- strong ties: detrimental effects	- strong ties: detrimental effects

Publications in the Report Series Research* in Management

ERIM Research Program: "Strategic Renewal and the Dynamics of Firms, Networks and Industries"

2001

Organisational Path-Dependence and Institutional Environment: The Case of East Asia's Chinese Family Business Groups

Michael Carney & Eric Gedajlovic

ERS-2001-07-STR

Institutional Change and Firm Adaptation: Toward a Typology of Southeast Asian Corporate Forms

Michael Carney & Eric Gedajlovic

ERS-2001-08-STR

Ownership Structure, Investment Behavior and Firm Performance in Japanese Manufacturing Industries

Eric R. Gedajlovic, Toru Yoshikawa & Motomi Hashimoto

ERS-2001-09-STR

Setting up a Business in the Netherlands: Who starts, Who gives up, Who is still trying?

Marco van Gelderen, Niels Bosma & Roy Thurik

ERS-2001-15-STR

Networks in Entrepreneurship: The Case of High-Technology Firms

Tom Elfring & Willem Hulsink

ERS-2001-28-STR

2000

Start-Up Capital: Differences Between Male and Female Entrepreneurs, 'Does Gender Matter?'

Ingrid Verheul & Roy Thurik

ERS-2000-07-STR

Strategies, Uncertainty and Performance of Small Business Startups

Marco van Gelderen, Michael Frese & Roy Thurik

ERS-2000-18-STR

Creation of Managerial Capabilities through Managerial Knowledge Integration: a Competence-Based Perspective

Frans A.J. van den Bosch & Raymond van Wijk

ERS-2000-19-STR

Transition Processes towards Internal Networks: Differential Paces of Change and Effects on Knowledge Flows at Rabobank Group

Raymond A. van Wijk & Frans A.J. van den Bosch

ERS-2000-22-STR

Creating the N-Form Corporation as a Managerial Competence

Raymond van Wijk & Frans A.J. van den Bosch

ERS-2000-24-STR

* A complete overview of the ERIM Report Series Research in Management:
<http://www.ers.erim.eur.nl>

ERIM Research Programs:

LIS Business Processes, Logistics and Information Systems

ORG Organizing for Performance

MKT Decision Making in Marketing Management

F&A Financial Decision Making and Accounting

STR Strategic Renewal and the Dynamics of Firms, Networks and Industries

Competition and Market Dynamics on the Russian Deposits Market
Piet-Hein Admiraal & Martin A. Carree
ERS-2000-25-STR

Interest and Hazard Rates of Russian Saving Banks
Martin A. Carree
ERS-2000-26-STR

The Evolution of the Russian Saving Bank Sector during the Transition Era
Martin A. Carree
ERS-2000-27-STR

New Entrants versus Incumbents in the Emerging On-Line Financial Services Complex
Manuel Hensmans, Frans A.J. van den Bosch & Henk W. Volberda
ERS-2000-41-STR

What's New about the New Economy? Sources of Growth in the Managed and Entrepreneurial Economies
David B. Audretsch and A. Roy Thurik
ERS-2000-45-STR