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Abstract

There are two conflicting patterns of network development of founding entrepreneurs that emerge from existing literature. One of them evolves from an identity-based network dominated by strong ties into an intentionally managed network rich in weak ties. The other involves the opposite, with weak ties dominating in the emergence phase and some of them developing into strong ties, the latter of which are characteristic of the early growth phase. The empirical part of this study focused on the development of the networks of 32 IT start-ups in The Netherlands, which we constructed on the basis of secondary data sources and in-depth interviews with the founders. We found three distinct patterns of network development. The conflicting patterns from the literature fitted two of our patterns and we were able to reconcile them by showing how initial founding conditions and post-founding entrepreneurial processes influence tie-formation processes. We propose that the simultaneous effect of these tie-formation processes leads to particular development patterns of weak and strong ties over time, highlighting the importance of investigating network processes.

Keywords: start-up firms, networks, entrepreneurial processes, IT industry, spin-off, incubator

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Introduction

The importance of social networks for the founding and growth of entrepreneurial firms is acknowledged in a growing body of literature (Brass et al. 2004; Greve and Salaff 2003; Hite and Hesterly 2001). Although social networks have many dimensions, the mix of weak and strong ties is at the core of the debate about network benefits (Uzzi 1997; Lechner et al. 2006; Jack 2005; Batjargal 2003). Network ties enhance the ability of entrepreneurs in key entrepreneurial processes, such as spotting opportunities (Ardichvilli et al. 2003), acquiring resources (Batjargal 2003) and gaining legitimacy (Aldrich and Fiol 1994). Network literature has detected a strong tendency to form ties to similar people (McPherson et al. 2001). This tendency applies to entrepreneurs as well (Kim and Aldrich 2005) and it favours the formation of a dense network of strong ties. Although such a network configuration has its merits, in particular situations it is associated with the 'dark sides' of social capital (Garguilo and Benassi 1999). Developing innovative solutions requires a high proportion of weak ties and a

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diverse network rich in structural holes (Rowley et al. 2000; Ruef 2002). What drives entrepreneurs to establish and deepen some relationships and not others, and how do they manage their mix of weak and strong ties?

Personal networks develop over time and the contribution of the various network ties to the venture formation process changes (Larson and Starr 1993; Greve and Salaff 2003; Maurer and Ebers 2006). We are interested to see how these relationships change over time and for what reasons. Although studies that adopt a more dynamic approach to this issue are limited in number (Hoang and Antoncic 2003), they produce contradictory results. Hite and Hesterly (2001) argue that an entrepreneur's personal network evolves from an identity-based network dominated by strong ties into an intentionally managed one that is rich in weak ties. Similar findings (Johannisson 2000; Lechner et al. 2006) support that pattern of network development, and others have stressed the importance of strong ties at emergence (Bruederl and Preisendorfer 1998; Batjargal 2003; Jack 2005). Some scholars (Greve and Salaff 2003; Steier and Greenwood 2000), however, argue that the amount of weak ties is relatively high in the emergence phase. Our ambition is to explain these conflicting findings on network development and explain them in order to develop some general patterns of network development.

Research into the antecedents of network development still faces substantial challenges (Brass et al. 2004). In particular, knowledge about the relative importance of initial founding conditions (Marquis 2003) and post-founding entrepreneurial processes (Stuart and Sorenson 2005) on network development is limited. We propose two initial founding conditions to enhance our understanding of the antecedents of network development. First, with regard to initial network condition, Hite and Hesterly (2001: 283) conclude that 'not all emerging firms are equally endowed in terms of initial network connections and these differences matter'. Since variations in the set of initial network ties may have consequences for the further development (Greve and Salaff 2003), we address that issue by examining cases that vary according to whether the entrepreneur is an industry insider or outsider, i.e. whether they have connections to central players in the industry. We distinguish the following categories:

(1) *independent start-ups.* This category includes companies that are founded by entrepreneurs who are relative outsiders to the industry.

(2) *spin-offs.* This category consists of start-ups that are based on ideas and knowledge from insiders; the founders were employees in an established firm or research institute within the industry.

(3) *incubator-driven companies.* This category is created, founded and built *within* an incubator and consists of founders who are 'indirect' insiders in that they profit from the incubator's network ties in the industry.

The second initial founding condition is the type of innovation introduced by the start-up. We distinguish incremental and radical innovations. Radical innovations are associated with exploration and competence destruction, while incremental innovations are far less disruptive and have to do with exploitation and competence-enhancing measures (Anderson and Tushman 1990). Start-ups pursuing incremental innovations require a different set of network ties to develop and prosper than a start-up engaged in a radical innovation (Ruef 2002; Rowley et al. 2000).

In addition to looking at initial founding conditions, we also explore how post-founding entrepreneurial processes influence tie formation and hence the mix of weak and strong ties. To varying degrees, entrepreneurs face the challenge of having to spot opportunities, acquire resources and gain legitimacy and, as these entrepreneurial processes require different mixes of weak and strong ties, the overall optimal mix will differ. By distinguishing these entrepreneurial tasks, we address Jack's (2005: 1254) call 'to consider the actual function and utility of network ties' and that of Hoang and Antoncic (2003:179) to 'increase the precision of tie content measures'.

This paper seeks to address these challenges on the basis of 32 case studies in a dynamic and innovation-rich industry. In this explorative study, we examine how entrepreneurs shape their network of strong and weak ties. We intend to establish a number of distinctive development patterns and examine whether the patterns suggested by Hite and Hesterly (2001) and Steier and Greenwood (2000) may fit into one of them. The case studies all involve new Dutch firms dealing with information and communication technologies (IT industry). We constructed the networks through secondary data sources and interviews with the start-ups' founders. With regard to the development of the founders' ego-networks, we focused on the mix of weak and strong ties. A core contribution of our study is that we reconcile conflicting patterns of network development in the literature by examining the way initial founding conditions and post-founding entrepreneurial processes affect tie-formation processes.

Networks and Entrepreneurial Processes

Network Development and Venture Formation Process

Hite and Hesterly (2001) argue convincingly that an entrepreneur's personal network evolves from an identity-based network, dominated by strong ties, towards an intentionally managed one rich in weak ties. They propose that, in the emerging phase, start-ups rely primarily on strong ties, because those ties will usually provide resources. Later, in the early growth stage, entrepreneurs will expand their network to include weak ties. In the early growth phase, it is necessary to develop a more diverse network that is rich in weak ties, to gain information on new business leads. Others (Greve and Salaff 2003; Steier and Greenwood 2000), however, argue that the mix of strong and weak ties develops in a different way. Unlike Hite and Hesterly (2001), these authors have observed a relatively high share of weak ties in the emergence phase. They argue that a network that is rich in weak ties in the emergence phase enhances the search for new information concerning the development of an entrepreneur's business plan.

Strength of ties is defined by Granovetter (1995) as the intensity and diversity of relationships, i.e. the difference between strong and weak ties, on the basis of four criteria: the frequency of contact, the emotional intensity of the relationship, the degree of intimacy, and reciprocal commitments between the actors involved. While weak ties provide access to novel industry information and new business contacts, strong tries are relationships that can be relied on in both good times and bad times. Strong ties tend to bind similar people in longer-term and intense relationships. These relations will promote the development of trust, the transfer of fine-grained information and tacit knowledge, and joint problem solving (Uzzi 1996; Krackhardt 1992).

Strong ties have shortcomings as well. There is the risk of *overembeddedness*, i.e. of stifling economic performance (Uzzi 1996). Close ties within and among business communities are vulnerable to exogenous shocks and may insulate such communities from information that exists beyond their network. There is the danger of being blind to new developments or of being 'locked-in' (Johannisson 2000). Weak ties refer to a diverse set of persons working in different contexts with whom one has some business connection and infrequent or irregular contact. These loose and non-affective contacts increase diversity and may provide access to various sources of new information and offer opportunities to meet new people (Granovetter 1995; Burt 1992).

In short, both strong and weak ties are useful and contribute to the emergence and growth of firms, although they are beneficial in different ways and at different stages of a company's development (Elfring and Hulsink 2003). Therefore, the ideal entrepreneurial network includes a particular mix of strong and weak relationships (Uzzi 1997). To understand how this mix and its associated benefits to the entrepreneurial venture change over time, we need to show how initial founding conditions and post-founding entrepreneurial processes affect tie formation, which leads to changes in the mix of weak and strong ties.

Network Benefits and Tie-formation Processes

How do the initial founding conditions and post-founding entrepreneurial processes affect the mix of weak and strong ties? One aspect of the initial founding condition is the initial network condition, and previous studies have indicated that different network requirements apply to the three distinguished start-ups, i.e. independent, spin-off and incubatee firms. Independent start-ups need to get connected to players in the field of the IT industry. As outsiders, their strong ties will most likely not provide them with direct access; they will try to form ties through the friends of their strong relationships (Jack 2005). In addition, they may visit events in the industry as one of the ways to connect to weak ties in order to search for information and leads to the inner circles of the IT industry. Concerning spin-offs, it is likely that they rely mainly on their strong ties to parent organizations to obtain information on opportunities, acquire resources and gain legitimacy. Finally, incubatees have a strong tie to an incubator and they intend to use that strong tie. However, the role of incubators is not only to provide advice and resources, they act also as brokers to relevant players in the field. Thus, the incubatee will be introduced to new relationships, which are initially weak ties but may soon develop into strong ties.

The type of innovation is the basis for the second initial founding condition. Start-ups pursuing an incremental innovation can rely much more on their strong ties than start-ups involved in radical innovations (Elfring and Hulsink 2003). Radical innovations are often based on new combinations of diverse knowledge domains, and a diverse network of weak ties enables entrepreneurs to search for information (Hansen 1999).

Post-founding entrepreneurial processes influence the optimal mix of weak and strong ties. Entrepreneurs vary in the extent that they need to focus on one or more of the three entrepreneurial processes, i.e. seeking opportunities, acquiring resources and gaining legitimacy. For example, some start-ups are accepted in the field because of the reputation of the founder, and consequently they do not need to establish network ties conveying legitimacy, while others who are not in that position will benefit from such ties. Furthermore, each of the three entrepreneurial processes requires a different mix of weak and strong ties to be most beneficial for the start-up. Previous work on this issue shows the importance of prior knowledge (Shane 2000) and novel information (Fiet 1996) that can be found through weak ties. Entrepreneurs rarely possess all the resources they need to seize an opportunity (Garnsey 1998). In the emergence phase, entrepreneurs depend on their strong ties (Bruederl and Preisendoerfer 1998), often for a 'friend's favour' (Starr and MacMillan 1990). Later on — in the early growth phase — start-ups increasingly gain access to resources through normal market transactions and we expect there will be a shift towards weak ties. The third entrepreneurial process that benefits from network ties is the potential to gain legitimacy. Innovative ventures have to organize institutional support and legitimacy (Aldrich and Fiol 1994). Having weak and strong ties to central players in the field will help these start-ups to overcome this legitimacy barrier. To our knowledge, none of these studies have taken the network benefits of all three entrepreneurial challenges into account simultaneously. We expect that, by examining all three different types of network benefits systematically, we will be able to improve our understanding of the development of the mix of strong and weak ties.

How do entrepreneurs shape their network to satisfy their particular needs? A central issue is that how they search and select alters with whom they can form a tie, how they select some weak ties to develop into strong ones, and finally which ties they drop. Thus, we distinguish three tie-formation processes, i.e. adding ties, upgrading ties and dropping ties. Entrepreneurs will turn to similar alters as long as these provide the necessary information. When these are not able to provide the information and resources, entrepreneurs have to look beyond their strong ties and turn to the friends of their strong ties to obtain what they need (Jack 2005). Some weak ties will be upgraded to strong ties, and the issue is what the selection mechanisms to invest in particular weak ties are and how that transition of fragile weak ties to more robust strong ties is realized. Moreover, dropping ties is also of interest. The difference between the potential benefits and the realized benefits will play an important role in deciding either to upgrade or to drop the tie (Hite 2005; Jack 2005; Kim and Aldrich 2005); usually, weak ties are dropped. Entrepreneurs search and select ties to align the mix of weak and strong ties to the changing needs of a venture over time. The research question is, how do initial founding conditions and post-founding entrepreneurial processes influence tie-formation processes and to what extent the simultaneous effect of the three tie-formation processes will lead to changes in the mix of weak and strong ties?

Research Design

This study focuses on emerging IT companies, which we define as companies with a minimum of two employees that offer IT products or services and were founded between 1990 and 2000. All start-ups are from the information technology industry in The Netherlands, including information and communication technologies (hardware and software), and firms using these technologies to produce or distribute 'cultural' content. In most developed economies, the IT industry is a dynamic sector where new technologies can quickly make existing ones obsolete and their application creates or revolutionizes markets and demand. The IT industry may be seen as representative of technology-based ventures or high-tech industries (Lee et al. 2001). Our research focuses on the entrepreneur and his or her network of relationships. Our sample of young IT companies includes 32 start-up firms and 31 entrepreneurs (one serial entrepreneur who founded a second company after he sold his first start-up), and their ties to relevant investors, business partners, customers, other entrepreneurs, etc. To enhance validity, we collected data from multiple sources. We constructed the networks of the start-ups by interviewing the founders of the 32 companies and by gathering secondary data, such as articles in newspapers and trade journals, company reports and internet visits. Our research was explorative in nature and rooted in Eisenhardt's (1989) interpretative methodology, which allows theory and data to interact. Her comparative case approach allowed us make a systematic comparison of start-ups founded by relative outsiders versus insiders, and start-ups pursuing radical versus incremental innovations.

Case and Data Collection

In selecting the various cases, we applied the theoretical sampling logic as discussed by Eisenhardt (1989) to gather a number of cases (see Appendix 1 for key information on selected cases) for each of the six categories (see Table 1), using two dimensions, relative outsiders versus insiders and degree of innovation, to determine the six categories. Thirty-two start-ups were selected non-randomly from the databases of the Business Information Centre (BIC) at Erasmus University Rotterdam, EIM, and Dutch ICT-trade magazines (*Automatiserings Gids*, *Computable*, *Emerce*). Basically, we had three populations of start-ups: independent start-ups, spin-offs and incubatees. On the basis of secondary data and discussions with industry specialists, we looked for an even distribution between start-ups pursuing an incremental versus a radical innovation. In the selection of cases, we also looked for a geographical distribution across The Netherlands to avoid a bias in favour of start-ups from the major cities. Furthermore, we wanted to have a balance between the parents of spin-offs from large private firms and public research institutes. We also looked for a balance between private-sector and

Table 1.
Case Start-ups Classified by Initial Network Conditions and Type of Innovation

	Independent	Spin-off	Incubatee
Incremental innovation	Co-makers Keekaboo Metrixlab Planet Internet Ring Rits Telecom Vision Web Vocognition	Profuse Proloq Wellance Xpertbuyer	Careerfever Factory Zoo Hot Orange Information Innovation Punt Edu
Radical innovation	Annie Connect Euronet InterXion Nedstat Xoip	Bitmagic Carp Technologies HuQ Speech Technologies Oratrix Tornado Insider Tridion	Bibit Gopher Publishing Siennax Tryllian

public-sector incubators. After conducting the interviews, we realized that some of the cases needed to be reassigned to a different category. The final classification is presented in Table 1.

The interviews were semi-structured and, on average, lasted between 60 and 90 minutes. The interviews were conducted by one of the researchers (who each conducted about half of the total number of interviews), with the industry specialist present at all times. The interviews concentrated on the development of the entrepreneurial network. We used four name generators to obtain information about changes in the mix of weak and strong ties over time and about the content and type of advantages these ties provided to the founders. As we were interested in the development of ties over time, we chose the name-generator approach which, compared to the position generator, had the advantage of allowing us to track changes over time (Burt 2002). A disadvantage of the name generator is the potential under-representation of weak ties, as people tend to forget weak ties more easily (Lin 2001). We used two methods to reduce the risk of under-representation of weak ties. Firstly, in line with Pettigrew (1987), the initial questions focused on the type of business and on the context of networking. From there on, the questions focused on the names of the ties, allowing us to develop start-up storylines, combining the networking with the development of these new firms. Secondly, to help founders search their memory for (weak) ties that had been useful to them, we used four name generators instead of just one. We went back to where the original idea for a start-up came from, in particular to the persons that played a role in the opportunity recognition process. With regard to resource acquisition, we asked questions concerning the role of ties in obtaining the initial capital, and hiring key employees. Similarly, questions were asked about the role of specific ties with regard to gaining legitimacy. This tactic is similar to the one suggested by Van de Ven and Engleman (2004) to chart major events, such as breakthroughs in the three entrepreneurial challenges, in the development of start-ups, and we used those events to generate the names of ties. We then discussed the history of these ties, both weak and strong, and the way they developed over time.

To round off the interviews, we asked the entrepreneurs to name the four people that had been the most important in the emergence and growth of their firm. A name generator that relies on four relationships is more or less in line with leading experts in the field who suggested generating a list of alters from three to five (Burt 1992: 123; Lin 2001: 88). Although this was partly done to summarize the importance of the relationships mentioned earlier, in some cases people were mentioned that had not been mentioned previously. As a result, we are confident that we got a fairly accurate impression of the networking activities over time and of the mix of weak and strong ties that evolved. The in-depth interviews were taped and transcripts were made.

Data Description and Analysis

The framework, research questions and constructs we defined in advance served as a lens to focus our attention during data collection, description and analysis. To show how we reduced the data and arrived at three distinct patterns of network development we follow a number of steps similar to the ones suggested by Eisenhardt (1989). In the first step, the analysis focused on understanding the network development of each of the individual start-ups. This 'within-case' analysis was based on the interview transcripts, publicly available company profiles, and discussions with industry specialists. The cases were sent to the entrepreneurs to ensure that the case descriptions contained a fair representation (a data matrix for summaries on each case is available from the authors on request). By applying and aligning different perspectives and methods to collect data, and hence combining thick description with accuracy, we improved the reliability and validity of the data by triangulation (Jick 1979).

In the second step, we compared the network development of the start-ups in each of the six categories to detect general patterns, in a process Eisenhardt (1989) calls a cross-case comparison (see Table 2 for summary of results). In the next step, we compared these patterns and showed how tie-formation processes result in changes in the mix of weak and strong ties (see Table 3 for summary of analysis). Finally, in a workshop, we discussed this cross-case comparison and preliminary findings with the participating start-up firms, thereby further securing the reliability and validity of the data. Our efforts to demonstrate the reliability and validity of the data allow us to use the retrospective accounts of the cases on network development (Miller et al. 1997).

Results

Independent Start-ups

Independent start-ups are relative outsiders to the IT community. They benefit from some of the strong ties, such as friends and relatives or relationships from previous work environments. However, strong ties appear to be relatively unimportant in terms of the pursuit of opportunities. The dominant networking activity is the exploration of weak ties. Most of the founders in this category identify opportunities through their weak ties. Experienced (e.g. Nedstat) and inexperienced (e.g. Planet Internet) founders invested a substantial amount of time meeting new people, going to conferences and participating in new types of networking activities.

In most cases, the new companies' business model changed during the emergence phase. The changes were often inspired by discussions with acquaintances, such as people the entrepreneurs had met recently or persons they were referred to by relatively 'distant' friends. The networking could be described as a frantic search for people who could provide information on new opportunities and on the feasibility of the business plan. Uncertainty regarding the tasks and strategy was high, and the start-ups were continuously looking for people who could provide information concerning the feasibility of their business model. The rate of new weak ties added to a network appears to be high, although, on the other hand, these ties are dropped as soon as the entrepreneurs realize that they are unable to provide new insights. At the same time, some of the weak ties developed into strong ties during the start-up phase. The role of strong ties (often close friends and family relationships), although they were limited in number, was to provide 'trusted' feedback on the various stages of the business plan. These strong ties were often outsiders to the IT community, while the weak ties were mostly insiders.

During the opportunity discovery process, some of the weak ties developed into trusted ties, some of which appeared to play an important role in the process of securing resources. For example, at Metrixlab, a tie from a First Tuesday meeting became a board member and provided the company with access to capital and technology. Similarly, the founder of Co-makers developed a strong tie from an MBA class, who brought him into contact with valuable knowledge sources. However, despite the role played by these 'new' strong ties, the older strong ties, people the entrepreneurs knew from previous activities, but also family, appear to be more important in terms of gaining access to the required resources. Start-ups engaged in radical innovations use a mix of weak and strong ties in the resource-acquisition process. Some of these strong ties have been newly developed and they play a role in finding and selecting new weak ties.

For start-ups engaged in radical innovations, the discovery of opportunities and resource acquisition to a large extent takes place simultaneously, because of continuous changes in the business plan. Thus, the search for new information on opportunities continues to be important for a longer period than in the case of incremental innovations, and the role of weak ties in the emergence and early growth phase is more pronounced.

With regard to gaining legitimacy, the network benefits can be described as a mix of strong and weak ties. It was interesting to see that almost all of the entrepreneurs pursuing radical innovations were aware of the importance of legitimacy. However, not all of them were actively searching for persons or organizations to be associated with in order to gain legitimacy. Some of them, in particular those pursuing incremental innovations, used existing strong ties, such as family (e.g. Co-makers), former colleagues from previous work environments (e.g. Vision Web) and friends (e.g. Ring) to gain legitimacy. Start-ups involved in radical innovations relied only occasionally on existing strong ties (such as Annie Connect). Most of them benefited from recently developed strong ties with a reputation in the field; the launching customer of Nedstat, a property developer for InterXion and a well-known financial backer of Xoip all conveyed legitimacy. The growing involvement of these ties with the start-up was partly the result of intensive discussions concerning the feasibility of the business plan and the need to tell a consistent story about the benefits of the start-up's new product to its customers.

Spin-off Entrepreneurs

The spin-offs in our sample were kick-started and headed off to a fast early growth due to the in-depth industry knowledge of the founding entrepreneurs. However, in a number of the cases, the contacts and resources of the parent organization proved to be a mixed blessing: while the entrepreneurs had a number of ongoing commitments (contracts, patents/licences) and strong ties (a clear industry affiliation), they were relatively weak in developing new weak ties, and as a consequence they were unable to break away from the comfort provided by the existing networks.

With regard to the discovery of opportunities, spin-offs clearly fall back on the parent organization and on their previous skills and colleagues for ideas and projects they want to pursue. Start-ups pursuing incremental innovations benefited most from the help provided by strong ties in the emergence phase in discovering and assessing the potential of particular business opportunities. Although strong ties proved to be dominant, weak ties played a role as well. Xpertbuyer, for instance, found it relatively easy to use its weak ties to look for new information on its business plan, as it was embedded in a network of 'old friends' who provided the company with references and feedback on leads and new ties. This process of looking for weak ties with the help of strong ties was of minor importance to this type of spin-offs. It appeared to be crucially important to spin-offs pursuing a radical innovation, who started out with a mix of weak and strong ties, with the interaction between strong ties and weak ties increasing the efficiency of their search for new information on the basis of weak ties. Instead of them having to conduct a frantic search using a large number of weak ties, their search was to a certain extent focused because of trusted information provided by strong ties in the field. Thus, spin-offs based on radical innovations benefited from the interaction between strong and weak ties by improving the efficiency of the search for information through weak ties.

Most of the spin-off entrepreneurs remain close to their parent organization and become a kind of subcontractor or specialized supplier to their former employer. In most cases, existing strong ties that have been built up during work at the parent organization are sufficient to satisfy the need for resources of start-ups with modest growth ambitions. The more ambitious spin-offs, often pursuing a radical innovation, continue their search for new information on potential resources by developing new relationships (e.g. Tornado Insider, Bitmagic and Tridion), which means relying more heavily on the development of weak ties. The resource-acquisition process, in the case of radical innovations, partly overlaps with the discovery of the opportunities process, as the business plan develops in the course of the emergence and early growth phases. Start-ups that are involved in radical innovations have to break away from their parent organization and attempt to add new and more heterogeneous contacts to their network.

The dominant logic of establishing legitimacy in the market by spin-offs pursuing incremental innovations is based largely on the strong existing connection with the parent company. These spin-offs also extended the strong tie network by actively promoting their achievements in new environments. Spin-offs that were involved in developing radical innovations hardly used their connection to the parent company at all to establish legitimacy in the marketplace. They employed a number of tactics to establish themselves, such as trying to qualify for financing or subsidy schemes, participating in business plan competitions and actively seeking publicity, or joining all kinds of technology networks and/or regional associations and affiliating themselves with VIPs. Some of these contacts developed into strong ties that played a role in gaining legitimacy.

Incubatees

It proved to be more difficult to put incubatees and their networking behaviour into perspective. First of all, the incubator organizations with whom our incubatees were affiliated were all new and inexperienced (e.g. Twinning was established in 1998; Gorilla Park, Small Business Link and Newconomy in 1999), and in the process of establishing a name for themselves. In a number of cases, incubator and incubatee evolved together, helping each other wherever and whenever they could (Hot Orange); in other cases, resources, services and facilities were offered much to the surprise of future 'incubatees' (e.g. Tryllian, Information Innovation) and they accepted it opportunistically. The supply of services, resources, facilities and contacts varied not only between the various incubators, but also within the investment portfolios of individual incubators: for instance, one Twinning company benefited only marginally from an early investment, while another firm received an office space, a whole set of specialized services and two major co-investments.

The incubatees pursuing an incremental innovation relied mainly on a small number of strong ties, or they were well connected in the field and could move ahead more or less without incubator support. Start-ups based on a radical innovation relied mostly on their own network consisting of a mix of weak and strong ties, the incubator being but one of those ties, helpful in defining the nature of the business opportunity. Some weak ties develop into strong ties.

With regard to resource acquisition, most of the incubatees benefited from the services and facilities offered by and through the incubators. As a strong tie, the incubators provided access to a range of new weak ties, such as law firms, consultancies, accountants and investors. Some incubatees wondered whether the new contacts actually contributed to their success. Some of the incubatees pursuing a radical innovation faced network challenges similar to those facing

Table 2. Findings for Six Categories: Role of Weak and Strong Ties to Transfer Three Types of Content

		Independent	Spin-off	Incubatee
Incremental innovation	*Opportunities*	Weak ties dominant in emergence phase in search for information. Some develop into strong ties. Some weak ties are dropped.	Strong ties dominant in emergence phase. In early growth, opportunity recognition only limited role.	Strong ties dominant in emergence phase. In early growth, opportunity recognition only limited role.
	Resources	Mix of weak and strong ties. Existing strong ties such as friends and family important. Limited role for 'new' strong ties.	Strong ties most important, but weak ties also play role in early growth phase.	Strong ties, largely from past experience and also incubator, play role in combination with growing importance of weak ties.
	Legitimacy	Existing strong ties played limited role.	Existing strong ties important to gain legitimacy.	Existing strong ties and incubator of limited importance.
Radical innovation	*Opportunities*	Weak ties dominant in emergence phase in frantic search for information. Some develop into strong ties and give feedback and guidance on business plan development. Many weak ties are dropped.	Mix of weak and strong ties important in both emergence and early growth phase. Weak ties important: some whose business plan changes over time; also some weak develop into strong; others are dropped.	Mix of weak and strong ties in emergence phase, largely independent of ties provided by incubator. Some weak ties develop into strong ties; others are dropped.
	Resources	Interaction between weak and new strong ties. Gradually these new strong ties play role in finding and selecting weak ties providing resources, thereby a bit more focus in search.	Mix of weak and strong ties. Interaction makes search through weak ties more efficient as strong ties provide feedback on finding and selecting weak ties. Focused search.	Mix of weak and strong ties. Incubator is just one of the ties in the network. Newly developed strong ties are helpful in making search through weak ties more efficient and focused.
	Legitimacy	Weak ties and some strong at emergence, but in early growth recently developed strong ties crucial to convey legitimacy.	At emergence, weak ties play role; also strong ones. Some develop into strong ties; they are of value in early growth.	Strong ties, of which incubator is one, at emergence; later also newly developed strong ties.

Source: See text.

independent start-ups. The role of the incubator was small, often representing only one or two (strong) ties out of a large set of weak and strong ties that had to be developed. These strong ties (which were sometimes newly developed) proved to play an important role in the search for information through weak ties, helping incubatees select useful weak links. In addition, the selection of some of these weak ties to be developed into strong ties was made easier because of the feedback provided by the strong tie.

The relatively unknown incubatees could also benefit from the reputation and brand name of their well-known incubator, which gave them quicker access to banks, investors and other service providers. However, not all the incubators had established a name for themselves. The issue of legitimacy and the role of incubators was not considered very crucial by start-ups involved in incremental innovations. Their existing strong ties were more important in obtaining market recognition. With regard to start-ups pursuing radical innovations, a strong link to an incubator, mostly to one particular person within the incubator organization, proved helpful in gaining legitimacy. However, incubators represented one tie within a larger set that played a role in achieving a position in the field.

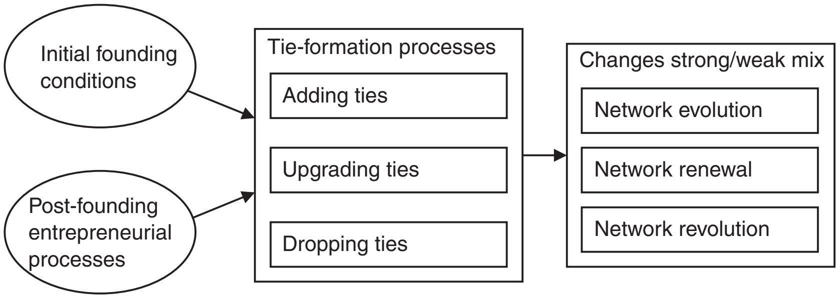
Discussion and Concluding Remarks

In this study, we have explored how entrepreneurs shape their surrounding networks. One of the results is the recognition of three distinct patterns of network development. These different patterns allow us to reconcile some conflicting findings in previous studies. We have demonstrated that each pattern is the result of a particular set of initial founding conditions and post-founding entrepreneurial processes. We were able to show that these antecedents influence tie-formation processes, and the simultaneous effects of these processes lead to a particular development of the mix of weak and strong ties over time.

Our findings spell out three distinctive patterns of network development. The first one is *network evolution*, a pattern that is observed mainly among industry insiders, such as spin-offs and incubatees pursuing incremental innovations. It involves a development from a network dominated by strong ties towards a network with a growing share of weak ties. Strong ties, including family ties and previous professional relationships, are important in the emergence phase, in that they provide access to resources and offer trusted feedback. As a venture moves into its early growth phase, a growing number of weak ties will be added. Because most start-ups have the ambition to expand into new markets, they need these weak ties in their search for private information on business opportunities. This pattern of network evolution confirms the results reported by Hite and Hesterly (2001), Jack (2005) and Lechner et al. (2006). We expand on the findings presented in these studies by limiting the extent to which that pattern can be generalized and show that it is the result of specific sets of initial founding conditions and post-founding entrepreneurial processes.

With this first pattern, the initial founding conditions involve entrepreneurs who are insiders in their industry and who are engaged in incremental innovations. They have strong ties in their relevant field and can usually rely on strong

Figure 1. Conceptual Model of Antecedents of Tie-formation Processes and Effects on Mix of Weak and Strong Ties



ties to obtain what they need. Start-ups involved in incremental innovations have a limited need for new information, which means there is little incentive for them to add new weak ties. They focus on exploitation rather than on exploration, and are busy building their firm. Consequently, they concentrate on one of the three post-founding entrepreneurial processes, which is acquiring resources. The other two post-founding entrepreneurial processes, spotting opportunities and gaining legitimacy, are less important in the emergence phase. In general, resources are obtained through strong ties, which explain the dominance of strong ties in the emergence phase. In the early growth phase, the process of discovering new opportunities may become more relevant when entrepreneurs want to expand beyond their original plan, at which point more weak ties are added.

The second pattern is one of *network renewal,* which is associated with insiders like spin-offs and incubatees pursuing radical innovations. Here, weak and strong ties are both important in the emergence phase, without either of them playing a dominant role. Weak ties are important in the search for new information concerning the further development of the business plan. Strong ties provide legitimacy and trusted feedback, as well as offering a certain degree of focus in the search for weak ties that may provide new information. As a venture moves into its early growth stage, some weak ties are dropped when they fail to provide the expected complementary resources. On the other hand, some weak ties prove useful in a number of ways, and as such they develop into strong ties. In particular, the pivotal role of legitimacy, in combination with the other network benefits, creates multiplex ties, which play a key role in managing start-up networks. This pattern of network renewal fits the network development described by Steier and Greenwood (2000). This study moves beyond Steier and Greenwood (2000), suggesting a generalization of the pattern they identified in a single case-study, to the general pattern of network renewal associated with a particular set of initial founding conditions and post-founding entrepreneurial processes.

With this pattern, the initial founding conditions involve entrepreneurs who are insiders in the industry and who are engaged in radical innovation. Insiders in the industry have strong ties in their relevant fields and can usually rely on strong ties to obtain some of the resources they need. As start-ups are involved in radical innovations, they need new information and knowledge from diverse communities as well. This confirms work by Kim and Aldrich (2005), who argue that

Table 3. Search and Selection in Three Tie-formation Processes and Effects on Mix of Weak and Strong Ties

	Adding weak ties	Selecting some weak ties to develop into strong ones	Dropping ties	Changes in mix of weak/strong ties
Network evolution	A limited number of weak ties are added, limited search and tie formation connecting to similar alters.	A limited number as they rely largely on 'old' strong ties.	Not many, as similar alters are able to provide what is needed.	Gradual change in mix from dominance of strong ties to one with more weak ties. Most of the key ties for development of venture were already strong ties at the start.
Network renewal	Some weak ties (including strangers) are added as they may provide complementary resources. Focused search helped by strong ties who provide access to others (indirect ties) that may be of value. Weak ties to prominent player provides legitimacy benefits.	Some, as they provide complementary resources and trust; multiplexity as way to reduce network overload. Newly developed strong ties to prominent player has additional benefit of more efficient search and selection.	Some weak ties are dropped when it turns out that they do not provide complementary resources and/or no trust.	The balanced mix of weak and strong does not alter very much over time. Of the key ties for the development of the venture, about half of them were already a strong tie at the start.
Network revolution	Large number of weak ties (including strangers) are added as they may provide complementary resources; unfocused search at start, when prominent player in field is found, more focused search. Weak ties to prominent player provides legitimacy benefits.	Some, as they provide complementary resources and trust; multiplexity as way to reduce network overload. Newly developed strong ties to prominent player has additional benefit of more efficient search and selection.	Large number of weak ties are dropped when it turns out that they do not provide complementary resources and/or no trust.	Dominance of weak ties at the start changes as share of strong ties increases over time. Majority of key ties for development of venture were not known at the start of it.

exposure to a diversity of perspectives is beneficial and will enhance creativity (Perry Smith and Shalley 2003). This implies that adding new weak ties is beneficial to these entrepreneurs. Their focus on exploration, and their lack of legitimacy, explains why they need to address all three post-founding entrepreneurial processes. Weak ties enhance an entrepreneur's capacity to spot opportunities, and strong ties are needed to obtain resources, while it is usually a mix of weak and strong ties that is needed to gain legitimacy. Thus, a mix of weak and strong ties is needed in the emergence phase. As a result of the simultaneous effect of the three tie-formation processes, this mix changes very little as a start-up moves into its early growth. New weak ties are added, while others are dropped. Furthermore, some weak ties develop into strong ties. This process of upgrading confirms the findings of Hite (2003) and Jack (2005), who argue that trust and proven usefulness are two important requirements for becoming a strong tie.

The third and final pattern of network development is that of *network revolution*, a pattern that is predominantly associated with relative outsiders pursuing radical innovations. This pattern is characterized by a large number of weak ties in the emergence phase, which is the result of a frantic search for private information on business opportunities and access to ties in the inner circles of the IT industry. In some cases, the entrepreneurs go so far as to contact strangers through 'cold calls', conferences and an internet search, and some of these contacts are transformed into weak ties. A change from an unfocused to a focused search takes place when a prominent player in the IT industry becomes connected to the start-up. Multiplex ties may then develop around such a prominent player, providing additional benefits to the founders by making the search and selection process of ties more efficient. To our knowledge, this pattern has neither been identified before, nor has it been described systematically in literature as a pattern that is the result of particular initial founding conditions and post-founding entrepreneurial processes. It is also a pattern in which the problems associated with network overload (Steier and Greenwood 2000) are more pronounced than they are in the network renewal pattern. Therefore, looking at this pattern in greater detail allows us to increase our insight into the ways entrepreneurs manage their network to avoid network overload.

The results confirm that network overload may pose serious problems (Steier and Greenwood 2000) with regard to network renewal and, in particular, network revolution. Managing weak ties is more difficult and time-consuming than dealing with strong ties (Kim and Aldrich 2005). One way to avoid the danger of network overload is to focus on a number of strong ties that provide multiple benefits and thereby may reduce the problems involved in having to deal with a large number of weak ties. However, although this strategy may solve one problem, it may also make a company dependent on that multiplex tie. Our study adds to the work of Steier and Greenwood (2000) on network overload in two ways. First, we add the important role of dropping ties as a means of reducing network overload, without introducing the problem of dependency. Existing network literature pays some attention to bridge decay or the gradual weakening and eventual dropping of ties (Burt 2002). In entrepreneurship and network literature this has hardly been discussed explicitly, while our study indicates that it is a process that takes place on a substantial scale. Weak ties are dropped more often than strong ties. Tie dissolution may play an important role in reducing the problem of network overload and thus provides additional insight into the way entrepreneurs are culling their network.

Second, our research highlights the significance of the way network ties and legitimacy influence each other. Start-ups pursuing radical innovations lack legitimacy, and existing studies have identified different strategies for gaining legitimacy (Zimmerman and Zeitz 2002). However, in doing so, they ignore to a large extent the role of network ties. Our findings suggest that creating network ties to prominent players in the field is a valuable strategy. Moreover, the results build on the conclusion by Delmar and Shane (2004: 405) that 'legitimacy enhances the abilities of founders to create social ties'. We found evidence of this effect in cases where legitimacy was conveyed through weak ties. Our study adds to those results by showing that strong ties have additional benefits. Not only do they make it easier to add ties, but they make the search for relevant ties more efficient by providing guidance, as well as helping the founders select the weak ties they intend to upgrade. In other words, they help founders manage their network, which means that our study adds to existing work by Larson and Starr (1993), Greve and Salaff (2003) and Steier and Greenwood (2000) on the ability of founders to manage their network effectively.

We have taken a broad perspective on the way ties are conceptualized and on the reasons why they are important to entrepreneurs. Most studies focus on the role that ties play in obtaining resources. The underlying concept of ties is one of pipes through which resources may flow (Podolny 2001), and the reason why that flow is taking place is social obligation (Shane and Cable 2002). We followed Shane and Cable (2002) in recognizing that ties can also be used to acquire private information (in particular, concerning the feasibility of a business plan) without social obligation. Moreover, we agree with Podolny (2001), who argues that ties are not only pipes but also prisms on the market. In this conceptualization of network ties, the presence of a tie between two market actors is 'an information cue on which others rely to make inferences about the underlying quality of one or both the market actors' (Podolny 2001: 34). This broader perspective allowed us not only to examine ties that provide access to resources, but to look at how they serve as a device for searching for information and conveying legitimacy.

This paper has a number of limitations. First, we have looked at only one industry. More extensive studies in other settings are required to test the extent to which our findings can be applied more generally. Nevertheless, we believe that our exploratory study contributes to existing theory, in that we have managed to reconcile the conflicting findings of previous studies, and generated arguments to explain why network development differs across different situations. Second, the retrospective design of our study makes it difficult to identify strong causal mechanisms. There is the danger of recall bias, which, for example, may result in an under-representation of weak ties (Lin 2001). We used two methods to minimize the risk of that happening. Nevertheless, a longitudinal approach in future research will help identify the causal mechanisms more clearly. Finally, the distinction between weak and strong ties is a very crude measure that ignores conceptual refinements, such as active versus dormant and direct versus indirect ties. Future work may incorporate some of those refinements to yield a more accurate picture of the way tie-formation processes affect network development patterns.

The results of this study suggest a number of avenues for future research. First of all, the main challenge is to complete the picture and include more explicitly both the antecedents of tie formation and the consequences in terms of the performance implications of particular patterns of network development. In our material, we found some indications that ambition or entrepreneurial orientation affects tie-formation efforts, which in turn may have implications with regard to performance. For example, the limited entrepreneurial orientation of some of the spin-offs engaged in incremental innovation, in combination with their limited efforts to add new weak ties, may explain why these companies failed to break away from their parent companies. At the same time, in the case of spin-offs pursuing radical innovations, we observed a much higher level of ambition and a willingness to expand the number of weak ties to obtain information regarding opportunities. Furthermore, more work is needed to find out why particular network configurations have negative performance implications. The 'dark side' of networks has received only limited attention. Our material provides some indication that having too many strong ties may result in being 'locked–in'. More work is needed to examine whether relative outsiders entering unknown territory may run the risk of adding too many weak ties in their urgent search for information. Future work may add to our speculation that these outsiders pursuing radical innovations should first use their ties to gain legitimacy, thereby making the search more efficient. If they fail to do so, the costs of having to deal with an overload of weak ties may have a profound negative impact on their performance.

In conclusion, this paper makes three contributions to the area of network and entrepreneurship. First, we propose three distinct patterns of network development, which have enabled us to reconcile conflicting results in previous work. Second, each of these three distinct patterns captures a range of start-ups matching particular sets of initial founding conditions and post-founding entrepreneurial processes. Finally, in this study we have explored ways in which founding entrepreneurs search and select their ties to adapt the mix of weak and strong ties to their venture's changing requirements over time.

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Appendix 1

Overview of the Selected Dutch IT Start-up Firms, Their Entrepreneurs and Their Business

Start-up firm	Year of formation	Entrepreneur interviewed + background founder(s)	Start-up configuration	Degree of innovation	Business activity
Annie-Connect	2000	Leo Dijkgraaf (founder), previously developer of broadcasting programmes, telephone service business entrepreneur	Independent	Radical	Call centre for home-bound people with disabilities
Bibit	1997	Joost Schuijff (co-founder), previously IT manager at a large bank	Incubatee	Radical	Provider of payment services
Bitmagic	1997	Michiel Frackers (founder), former founder of Planet Internet (see below)	Spin-off	Radical	Internet-media company
Career Fever	2000	Harald Swinkels (co-founder), business administration university graduate	Incubatee	Incremental	Virtual career & recruitment centre
Carp Technologies	1996	Danny Lie (co-founder), informatics university graduate	Spin-off	Radical	Software developer (language technology)
Co-makers	2000	2 founders: Daan Kersten (former manager in family-owned business) & Walter Wijdeven (former IT consultant)	Independent	Incremental	Virtual marketplace in manufacturing (meet & match in contracting)
Euronet	1994	Arko van Brakel (co-founder), previously owner PR venture, telecom manager	Independent	Radical	Internet access and service provider
Factory Zoo	1999	Frank Melis (manager IT/electronic publishing at DEC, IBM, AT&T)	Incubatee	Incremental	e-business support (business modelling)
Gopher Publishing	1997	Hans Offringa (co-founder), prior background as media consultant	Incubatee	Radical	Publishing on demand
Hot-Orange	1998	Roel de Hoop (co-founder) founding team previous work experience at software firm	Incubatee	Incremental	Webshop (electronic retailing)
HuQ Speech Technologies	1999	Tjeerd Andringa (co-founder), background PhD candidate & university lecturer	Spin-off	Radical	R&D into speech technology applications
Information Innovation	1999	Robert Liddington (co-founder), background in business development	Incubatee	Incremental	Competitive IT-based intelligence tool
InterXion	1997	Bart van den Dries (founder), former interconnection manager for telecom firm	Independent	Radical	Carrier neutral Internet Exchange Centre

(continued)

Appendix 1 (continued)

Start-up firm	Year of formation	Entrepreneur interviewed + background founder(s)	Start-up configuration	Degree of innovation	Business activity
Keekaboo	1999	Patrick van Zandvoort (co-founder), previous co-founder of web design venture	Independent	Incremental	e-card distributor via internet
Metrixlab	1999	Han de Groot (founder), previously owner wholesale textiles trade, business student	Independent	Incremental	Online marketing research agency
Nedstat	1996	Hans Veldhuizen (co-founder), marketing & communication consultant	Independent	Radical	Provider of website statistics
Oratrix	1998	Dick Bulterman (co-founder), previously project manager at IT Lab CWI	Spin-off	Radical	Multimedia R&D company
Planet Internet	1994	Michiel Frackers (former university student with part-time publishing experience)	Independent	Incremental	Internet service provider & portal
Profuse	1991	Joop de Jong (founder), previous R&D director at Baan	Spin-off	Incremental	Implementer of ERP software (Baan)
Proloq	1990	Peter Gelderblom (co-founder), former manager & consultant at Baan Software	Spin-off	Incremental	IT consultant & customizing softare
Punt Edu	1998	Arko van Brakel (co-founder), previously co-founder of Euronet (see above)	Incubatee	Incremental	e-learning/interactive training centre
Ring	1993	Job Bruggeman (founder), previously IT strategist at major bank and entrepreneur	Independent	Incremental	Computer-telephony integration software
Rits Telecom	1999	Ytsen Kooistra (co-founder), engineering university graduate	Independent	Incremental	Voice-over-IP (VOIP) service provider
Siennax	1998	Herb Prooy (co-founder), background as product developer and IT salesman	Incubatee	Radical	Applications service provider
Tornado Insider	1998	Arjen Pront (co-founder), previously finance executive at parent organization	Spin-off	Radical	Multimedia publisher & event organizer
Tridion	1999	Jouk Pleiter, co-founder of Tridion & parent organization Twinspark	Spin-off	Radical	Content management software provider
Tryllian	1998	Christine Karman (founder), background as IT consultant, software entrepreneur	Incubatee	Radical	Software developer for mobile agents

(continued)

Appendix 1 (continued)

Start-up firm	Year of formation	Entrepreneur interviewed + background founder(s)	Start-up configuration	Degree of innovation	Business activity
Vision Web	1995	Theo Punter (co-founder), background as IT consultant and manager	Independent	Incremental	ICT solutions provider
Vocognition	1992	Hugo Verduin (co-founder), previously consultant	Independent	Incremental	Speech software solutions provider
Wellance	1998	Dennis Blom (co-founder), previously CTO of parent organization Planet/KPN	Spin-off	Incremental	Internet security software company
XOIP	1997	Michiel van Kuijen (co-founder), previously journalist, consultant & entrepreneur	Independent	Radical	Provider of unified messaging services
Xpertbuyer	2000	Nicole Malherbe (co-founder), former purchasing manager at parent firm	Spin-off	Incremental	Online purchasing application provider