Patterns of innovation networking in Dutch small firms

Jeroen P.J. de Jong
Willem Hulsink

Zoetermeer, January 2010

SCALES
SCientific AnaLysis of Entrepreneurship and SMEs

Dit onderzoek is mede gefinancierd door het programmaonderzoek MKB en Ondernemerschap (www.ondernemerschap.nl)

EIM Research Reports

reference number	H201002
publication	January 2010
emailaddress corresponding author	jjo@eim.nl
address	EIM Bredewater 26 P.O. BOX 7001 2701 AA Zoetermeer The Netherlands Phone: +31 79 343 02 00 Fax: +31 79 343 02 03 Internet: www.eim.nl

Patterns of innovation networking in Dutch small firms

Jeroen P.J. de Jong[1]
EIM Business and Policy Research
and
RSM Erasmus University
The Netherlands

Willem Hulsink
RSM Erasmus University
and
Wageningen University
The Netherlands

[1] Corresponding author. P.O. Box 7001, 2701 AA Zoetermeer, The Netherlands, e-mail jjo@eim.nl, tel +31 79 322 22 68.

Abstract
Small firms may rely on a variety of network partners, and in various roles, to identify and exploit opportunities for innovation. This paper adds to the literature on innovation networking by developing a typology at the level of innovation objects, rather than at the firm or industry level. Drawing on data of 594 innovations in Dutch small firms, we find a broad pattern of six types of innovation networking marked by differences in volume, partner types, partner roles and tie characteristics. The patterns are labeled as supplier-based, customer-based, informal-based, new combinations, knowledge-based and system-based innovation. The supplier-based pattern is most dominant and characterized by modest and simple contributions from network partners, while system-based innovation involves the most complex and voluminous kind of networking. We also find significant correlations between innovation networking and firms' internal capabilities, suggesting that complex networking is more demanding in terms of firm-environment fit. Additionally, networking is associated with the newness and competence requirements of innovations. Implications are discussed.

Keywords
Innovation networking, small firms, embeddedness, ties, internal capabilities.

Patterns of innovation networking in Dutch small firms

1. Introduction

External networking has repeatedly been recognized as enabling innovation in small firms (e.g. Rothwell, 1991; Fukugawa, 2006). Past studies identifying relative strengths and weaknesses conclude that innovation in small firms is hampered by lack of financial resources, scant opportunities to recruit specialized workers, and small innovation portfolios, implying limited opportunities to manage the risks of innovation. They therefore need to be parsimonious with their investments and engage in networking to find missing innovation resources. The process of innovation typically transcends the boundaries of small firms (Nooteboom, 1994; Acs & Audretsch, 1990).

In order to clarify how innovations are developed and how external sources influence the process of innovation, researchers have proposed and empirically explored patterns of innovation in businesses. This research was initiated by Keith Pavitt (1984) who concluded that UK manufacturing industries can be classified in four homogenous groups, including supplier-dominated, specialized supplier, scale-intensive and science-based industries. Ever since his typology has been updated and extended to include new industries and indicators as a basis for classification (e.g. Castellaccia, 2008; Evangelista, 2000; Miozzo & Soete, 2001). Another extension is that the industry level of observation has been questioned. As innovation in firms can be heterogeneous within a certain sector due to differences in performance, technologies and strategies, it has been proposed that the level of analysis should be at the level of the firm. In support, recent studies have demonstrated a considerable heterogeneity in patterns of innovation of firms within industries (e.g. Arvanitis & Hollenstein, 1998; De Jong & Marsili, 2006).

However important questions still remain, despite all the work carried out on innovation networking and patterns of innovation. Firstly, although many contributors to small firms' innovation processes have been identified, and their various potential roles, we do not know what are the prevalent types of partners and partner contributions or what patterns of networking small firms engage in and for what purposes. Innovation networking may be enduring and intensive to a greater or lesser extent; it may involve a greater or lesser extent of resource sharing or commitment; and it may be driven by a greater or lesser extent of intention, direction and specificity. Past research has mainly regarded networking in terms of 'more is better' (e.g. Freel, 2003; Bougrain & Haudeville, 2002) and is somewhat biased towards start-ups breaking away from existing practices and introducing radically new products and services (e.g. Ruef, 2002; Elfring & Hulsink, 2003). Secondly, typologies of innovation have so far been explored at the level of industries and firms only. We here propose that this level of analysis may still be too rough. Within a firm, specific innovations are more likely to require different patterns of innovation networking and, to achieve an adequate view of how networking is associated with innovation, the level of specific innovations (as objects) may provide new insights.

Thus, this study identifies patterns of innovation networking in small firms, i.e. how small firms draw on networking to initiate and exploit opportunities for innovation. We follow an inductive, empirical approach in which we analyze detailed survey data of 594 innovations in small firms in the Netherlands. This analysis reveals what types of partners contribute to the innovation process, in what roles, and further characterizes the kind of ties involved. Six patterns of networking are found, each of which is correlated with external variables, including the internal capabilities of the firms and the complexity and newness of exploited innovation opportunities. This follow-up analysis provides further details on how innovation networks correspond with specific innovations, firms and contexts.

The paper is structured as follows. The next section discusses some key concepts from innovation and networking theory that lay the ground for our inductive exploration. Section 3 presents our data and indicators. In section 4 we empirically explore the patterns of innovation networking in small firms and section 5 ends with our conclusions, implications and suggestions for future research.

2. Innovation networking

In today's increasingly complex and knowledge-intensive world with shortened product life cycles, external networking has become probably even more important than before. Scholars have stressed the importance of innovating networking for decades, especially for small firms (e.g. Rothwell, 1983; 1991), but the managerial paradigm of Open Innovation has recently accelerated the pace at which firms consider networking to be important (e.g. Chesbrough, 2003; Lichtenthaler, 2008).

Social network literature suggests when and how innovating actors may benefit from their social capital in order to discover and exploit opportunities for innovation. It is suggested that firms may use individual nodes in their networks - network actors such as suppliers, customers, friends, relatives, etc - for various reasons. In the case of specific innovations networking may be characterized in terms of (i) volume, (ii) partner types, (iii) partner roles, (iv) tie strength, (v) directedness of ties and (vi) structural holes between involved partners. These characteristics represent some of the main dimensions of social networking (Scott, 1991; Granovetter, 1973) that lay the ground for our exploration, and are discussed hereafter.

Innovation networking can firstly be characterized by its volume, i.e. the number of external parties that become involved in the innovation process. Past work demonstrated that networking is beneficial for innovation (e.g. Oerlemans et al. 1998; Tether, 2002; Freel, 2003), and such studies typically include the volume of networks by connecting (dichotomous) indicators of the involvement of network partners with innovation measures such as new product introductions. We anticipate that the volume of networks will vary – some types of innovations will probably be marked by many other parties being involved and other innovations by involving only few.

Secondly, innovation studies have identified various types of actors that may be involved. These can be informal contacts (friends and relatives), direct business contacts (customers, competitors, suppliers) or relatively remote actors such as advisors, universities and government organizations that do not necessarily engage in small firms' daily business. As for informal contacts, the literature on innovative start-ups in particular identifies such actors as being important. Informal contacts may, for example, be important sources of manpower or finance (Shane, 2003; Ruef, 2002). Although past typologies of innovation did not include informal contacts, we feel that in the case of small firms, they should not be ignored. As for direct business contacts, the early Pavitt (1984) classification already identified suppliers and customers as main sources of innovation, and follow-up classifications also contained these partner types (e.g. De Jong & Marsili, 2006; Evangelista, 2000). In the innovation literature, customers have been shown to be a 'custom source' of innovation, especially in small firms (Rothwell, 1991). In this vein, users are increasingly regarded not only as merely potential sources of inspiration, but also as parties that may also develop their own innovations which producers can imitate (von Hippel, 2005). As for suppliers, Rothwell (1991) identified these as a very common source of 'industrial inputs', including many useful technical inputs like machines, equipment or manpower. Moreover, we included competitors in our empirical exploration. Small firms may collaborate with such partners for a variety of reasons, including the desire to manage the risks of innovation, perceived usefulness when firms serve clearly separated markets, or to team up against another, larger competitor (Gomes-Casseres, 1997).

Past typologies of innovation are also consistent in distinguishing universities and other public research organizations as potential sources of innovation. Pavitt (1984) regarded some industries to be 'science-based', indicating that scientific knowledge is among the main sources of opportunity identification and exploitation. This source is also frequently found in updated versions of the typology (e.g. Evangelista, 2000; Castellaccia, 2008). In this context, a vast and still growing literature stresses the importance of university linkages for innovation, also in small firms (e.g. Elfring & Hulsink, 2003).

Other relevant network partners include advisors such as consultants and engineers, financial institutes, intermediaries such as industry associations, and government organizations that may act as a source of innovation subsidies or permits. Although these actors were so far not included in typologies of innovation, we argue that they may well be relevant for small firms. The systems of innovation literature for example identified advisors, financiers, intermediaries and governments as influential actors (e.g. Nelson, 1993; Freeman, 1995).

A third aspect relates to the motives of small firms to engage in networking. In the context of innovative entrepreneurship, network partners have been found to perform various roles, including mobilizing missing capital such as knowledge, finance and capital goods (Burt, 1992; Elfring & Hulsink, 2003). Network partners may also be sources of inspiration, that is, enable opportunity identification, rather than capital deliveries for exploitation. This becomes most evident from Granovetter's (1973) classical essay, which identified network partners as a source of job opportunities. Thus, network partners can play various roles, including being a source of inspiration, providing advice or feedback, contributing to the implementation phase, supplying knowledge or financial or physical means.

Fourthly, networks can be described in terms of relational embeddedness, i.e. the dyadic relationships or ties between the firm and each of its partners (Scott, 1991). Although social networks have many dimensions, the strength of ties is at the core of the debate about network benefits (Uzzi, 1997; Lechner et al. 2006). Strong ties are characterized by frequent contacts, are usually long-term, reciprocal and involve a strong degree of trust and emotional closeness. In contrast, weak ties are transient and normally involve little emotional intensity (Granovetter, 1973; Scott, 1991). Conventional thought suggests that innovators need wide-ranging, weak ties across distant worlds to be inspired to innovate and strong ties to mobilize support for their emerging innovations. Indeed, this is what most empirical studies suggest for both weak ties (e.g. Ahuja, 2000; Ruef, 2002) and strong ties (e.g. Brüderl & Preisendörfer, 1998; Ahuja, 2000).

A fifth aspect of innovation networking is the directedness of ties. A directed tie is here defined as a network partner that is searched for and included in a network primarily for the sake of the innovation (cf. Ruef, 2002). We reasoned that in order to innovate, small firms may need to pro-actively extend their networks. Examples could include the delivery of machines by specialized suppliers, collaborating with representatives from public research organizations to access scientific knowledge and consulting engineers to contribute to the development of new products. The connection between directed ties and innovation is still barely covered in research. Using a sample of business start-ups, Ruef (2002) found that start-ups composed exclusively of family, friends, or work colleagues (strong ties) were found to be slightly less innovative than those consisting of acquaintances or a mix of family, friends, and colleagues (weak ties), who in turn were slightly less innovative than teams involving no prior relationships (directed ties). We here argue that, as innovation in small firms is marked by proactive behavior to obtain missing innovation resources, directed ties should be included when exploring patterns of innovation networking.

Finally, past work suggests that developing innovative solutions requires diverse networks rich in structural holes. These refer to the position of a firm in its network structure.

A structural hole is a relationship of non-redundancy between two contacts (redundant: leading to the same parties and so providing similar resource benefits). It implies that the firm is connected to unconnected others (Burt, 1992). Structural holes provide information advantages to those who can build across cohesive groups. Previous research commonly suggested that structural holes induce better opportunities to initiate and implement innovations. Alternatively, firms that are badly positioned in their network face a 'liability of unconnectedness', which inhibits access to valuable knowledge and strategic partners (Powell et al. 1996). In research among product design firms, Hargadon and Sutton (1997) concluded that a central position in a network enables firms to bridge gaps in the flow of information between various actors. Likewise, McEvily and Zaheer (1999) related structural hole measures to various innovative practices and found that structural holes in the advice network of manufacturers had a positive effect on the acquisition and adoption of innovative practices. In conclusion, patterns of innovation networking can also be characterized by the extent to which small firms manage to connect previously unconnected others.

2.1 Firm and innovation characteristics

Since innovation networking is not an isolated phenomenon, we anticipate that patterns of networking are contingent on firms' internal capabilities and the nature of their innovation opportunities. Thus, we now describe a number of firm and innovation characteristics which we anticipate will correlate with networking. These variables are used to validate and further probe the networking types presented in the sections that follow.

Firstly, innovation networking may depend on the internal capabilities of the firm. Given that small firms have decided to engage in networking, their internal capabilities may be influential in determining their chances of success. Firms' ability to recognize, evaluate, acquire and use external resources, especially when the acquisition of external knowledge is involved, is a function of their prior knowledge and resources (Cohen & Levinthal, 1990). Past research showed that the more absorptive capacity, the better firms are able to acquire external knowledge and to engage in innovation-related collaboration (e.g. Lane et al., 2001; Bougrain & Haudeville, 2002). Likewise, firms' internal capabilities, including technological capabilities, financial resources and entrepreneurial orientation, have been shown to be important for partnership-based networking efforts (Lee et al., 2001). In the current study, we disposed of two internal capability indicators, including whether firms maintain an innovation strategy, and if they employ specialized innovation workers.

Innovation networking may also vary with firm size and industry types. As we already mentioned, past work showed many differences in the innovation processes of smaller and larger firms (e.g. Acs & Audretsch, 1990; Nooteboom, 1994). Larger firms are typically better structured and professionalized. The larger they grow, the better they are equipped for innovation. Firm size may be a proxy for the internal capabilities discussed above, implying that size is associated with innovation networking behavior. As for industry types, we anticipate that there will be differences between manufacturing and services industries. The original Pavitt classification regarded services as 'supplier-dominated', implying a very specific pattern of innovation networking. Given the distinct nature of the offerings of manufacturers and services firms, differences in innovation networking may be present. As physical goods are more separable and homogenous, it may be much easier to outsource parts of their development process and to involve network actors. For services – due to their relatively intangible, simultaneous and heterogeneous nature (Atuahene-Gima, 1996) – the opposite may apply.

Innovation networking is probably also contingent on the kind of opportunities that small firms pursue. Rothwell (1991) concluded that external linkages are particularly important for radical innovations. In this paper, our data contained indicators for the newness of

innovations (new-to-market versus new-to-firm) and whether innovation required the acquisition of new competences (competence-developing versus competence-enhancing innovations). There has been research showing that networking matters more for new-to-market innovations than for innovations which are only new to the firm (e.g. Freel, 2003). As for the acquisition of competences, we argue that innovations requiring new competences are more likely to compel small firms in consulting their outside world (cf. Oerlemans et al. 1998). Such competence-developing innovations may also relatively often require directed ties and structural holes. The specific knowledge required to develop new competences may be less broadly distributed and require more intentionality.

3. Data

We used a database of 594 innovations developed by small firms in the Netherlands. The data were collected by the Dutch research institute EIM Business and Policy Research by means of a telephone survey. Commissioned by the Ministry of Economic Affairs, the survey aimed to map innovation and networking behavior of Dutch small firms. Although the survey was not specifically conducted for the current paper, i.e. it was meant to collect information to inform innovation policy making, its data are well suited for the empirical exploration patterns of innovation networking.

3.1 Sampling and procedures

A survey was conducted in the fall of 2005 by means of computer assisted telephone interviewing (CATI). The sample was disproportionally stratified across four types of industries and two size classes. Potential respondents were selected randomly from the population of all small firms in the Netherlands, defined as firms with at most 100 employees. On average, it took 15 minutes to complete a full questionnaire. All respondents were general managers or business owners responsible for day-to-day business processes.

The survey explored how networking and innovation are related, so accordingly firms were screened as to whether they had developed at least one innovation in the past three years. Innovations were assumed to include both new products and processes as defined by the Oslo manual – the manual for innovation surveys that governs the main public innovation surveys of OECD member states (OECD, 2005). If respondents had multiple innovations, they were asked to select their most recent one. This ensured a random sample of research objects, i.e. of specific innovations within firms (Churchill, 1999).

The initial sample consisted of 1,934 firms, drawn from the Chamber of Commerce Trade Register database which contains all commercial organizations in the Netherlands. Responses were obtained from 1,004 respondents who had been willing to co-operate. The remaining firms could not be contacted successfully or had refused to co-operate. Altogether, 594 firms met the criterion of having at least one recent innovation and completed the full questionnaire. Table 1 shows how these firms are distributed across industries and size classes. Groups of industries were based on the OECD (2001) classification of high-tech industries.

Table 1. Distribution of respondents across industries and size classes

Industry type	*NACE codes*	*Examples*	*Size class*	
			1-9 employees	*10-99 employees*
High-tech manufacturing	23, 24, 29-33, 352, 353, 359	Chemicals, rubber and plastics, machinery, office, electrical, communication and medical instruments	28	31

Low-tech manufacturing	15-22, 25-28, 34, 35 (excl. 352, 353, 359), 36, 37	Food, beverages, textiles, leather, paper, wood, metals, furniture	80	108
High-tech services	64-67, 72-74	Financial services, computer and related services, consultancy, engineering	56	128
Low-tech services	50-52, 55, 60-63, 70, 71, 93	Wholesale, retail trade, hotels and restaurants, personal services, transport	42	121

A comparison of the distribution of respondents and non-respondents by industry types indicated no problems of response bias. A chi-square test between the distributions revealed no significant differences at the 5% level, i.e. $p(\chi^2) = 0.43$. A similar result was found for size classes: $p(\chi^2) = 0.67$.

The Dutch innovation survey does not include any firms with fewer than ten employees (Statistics Netherlands, 2007). Thus, we were not able to assess whether the sample was representative for all innovative firms in the Netherlands. Although the given stratification of the sample may limit the extent to which our results can be generalized, we do not expect that the legitimacy of the networking patterns presented in the next sections will be seriously compromised.

3.2 Variables

Data on network indicators were collected for the specific innovations that respondents had identified. Table 2 presents the variables that we used in our analysis. We note that all networking indicators relate to specific innovations. In this way, our research is object (rather than subject) oriented. The table also includes relevant descriptive statistics.

Table 2. List of variables and descriptive statistics (n=594)

Variable	Description	Frequency/ mean
Volume	Number of network actors involved in the innovation process	2.5
Type:		
Informal	A friend or relative was involved in the innovation process (1=yes, 0=no)	18%
Customer	A customer was involved in the innovation process (1=yes, 0=no)	35%
Competitor	A competitor was involved in the innovation process (1=yes, 0=no)	23%
IT supplier	An IT supplier was involved in the innovation process (1=yes, 0=no)	38%
Other supplier	A non-IT supplier was involved in the innovation process (1=yes, 0=no)	48%
Financial institute	A financial institute was involved in the innovation process (1=yes, 0=no)	19%
Consultant/engineer	An external consultancy/engineering firm was involved in the innovation process (1=yes, 0=no)	22%
Industry association	An industry association was involved in the innovation process (1=yes, 0=no)	15%
University/PRO	An university or public research organization was involved in the innovation process (1=yes, 0=no)	18%
Government	A government organization was involved in the innovation process (1=yes, 0=no)	8%
Content of ties:		
Inspiration	A network actor served as a source of inspiration, i.e. expressed a new need or offered a new opportunity (1=yes, 0=no)	22%
Feedback/advice	A network actor gave feedback or advice to develop the innovation (1=yes, 0=no)	35%
Manpower	A network actor provided manpower to develop the innovation (1=yes, 0=no)	39%
Knowledge	A network actor provided knowledge to develop the innovation (1=yes, 0=no)	26%
Resources	A network actor provided any other resource to develop the innovation, including money or capital goods (1=yes, 0=no)	38%
Embeddedness:		
Strong ties	A network actor with whom the innovating firm maintained regular contacts and discussed private matters at the time was involved (1=yes, 0=no)	31%
Directed ties	A previously unknown network actor that the innovating firm had proactively searched for to contribute to the innovation process was involved (1=yes, 0=no)	33%
Structural holes	A network actor that formerly did not know another network actors that was involved in the innovation process was involved (1=yes, 0=no)	42%
Firm:		
Innovation strategy	Firm had a documented strategy or plan for innovation (1=yes, 0=no)	49%

Variable	Description	Frequency/ mean
Innovation workers	Firm employs workers who are occupied with innovation in their daily work (1=yes, 0=no)	27%
Firm size	Number of employees in full-time equivalents	23.2
Industry type	Industry type (1=high-tech manufacturing, 2=low-tech manufacturing, 3=high-tech services, 4=low-tech services)	10%; 32%; 31%; 27%
Innovation:		
New to market	The innovation was new to the innovating firm's market, rather than new to the firm only (1=yes, 0=no)	52%
Competence-developing	The innovation required the firm to acquire new competences, rather than just building on its current competences (1=yes, 0=no)	48%

Respondents first provided an inventory of the network actors who had been involved in their innovation process. On average, respondents mentioned 2.5 of such. The minimum number of partners was zero, while the maximum was nine. In only 9 percent of the reported innovations were no network partners involved. In 25 percent a single partner made a contribution while another 25 percent involved two partners. The frequency of innovations with three contributing partners was 17 percent, with four partners 13 percent and with five to nine partners 11 percent.

Next, for each of the identified network actors, the survey asked specific questions to document partner types, their roles, tie strength, and more. As for partner type, Table 2 reveals how often each partner type was involved in the innovation process. Suppliers had contributed most often. The survey distinguished between IT suppliers and other suppliers (because in the past two decades a great deal of innovations in small firms involved adopting information technologies) (Statistics Netherlands, 2008). It appeared that IT suppliers were involved in 38 percent of the cases, while other (non-IT) suppliers contributed to 48 percent. Next, in about one out of three cases customers were involved. Obviously, direct business partners with which any firm is basically concerned (i.e. suppliers, customers, competitors) were involved more often than 'remote' actors such as government departments and universities. We also note that informal contacts contributed to only 18 percent of the cases.

The survey also documented the kind of contributions that partners made. In 22 percent of the cases one or several network partners had served as a source of inspiration. Other contributions were providing feedback or advice (35 percent), delivery of manpower (assigning another party to a particular innovation-related task, such as a design or marketing campaign; 39 percent of the cases) and knowledge transfer (26 percent). Finally, 'other resources' were transferred in 38 percent of the cases. This included both finance and deliveries of capital goods. We regretted that the survey administrators had not chosen to distinguish between the two, and elaborate on this on the discussion section.

The survey contained two dichotomous questions to indicate tie strength. Respondents indicated whether they were in touch with a partner on a regular basis (defined as 'at least once a week') and if they discussed private matters with them. When both criteria were met, a network partner was considered a strong tie. It was found that strong ties were involved in 31 percent of the reported innovations.

To measure the directness of ties, respondents indicated whether a partner had already been part of their network before the innovation started and, if not, whether the partner had been proactively contacted for a specific contribution. Given this operationalization directed ties were involved in 33 percent of the sampled innovations. Finally, to indicate structural holes, whenever more than one network actor had contributed, the survey asked whether some of these partners had first met each other due to the innovation. We must stress that 34 percent of the sample involved no or only one network actor, ruling out the presence of structural holes by default in a number of cases. But in cases of multiple network partners a

majority of the respondents (42 percent of the total sample) indicated that structural holes had been present.

Table 2 also lists the firm and innovation characteristics that we used to further explore the patterns of innovation networking. Relevant firm-level characteristics included the presence of an innovation strategy and specialized innovation workers and industry types and firm size (in fulltime equivalent employees). Forty-nine percent of the sampled firms claimed to have an innovation strategy. This may seem fairly high, but it should be remembered that only innovative small firms were included. As for the reported innovations themselves, two relevant indicators were their newness to the market, and whether they demanded the acquisition of new competences. Both indicators were confirmed by about half of the respondents.

4. Results

To explore the patterns of networking in small firms we conducted a range of cluster analyses in which the networking indicators (Table 2) served as a basis for classification. We followed a two-step procedure which generally results in stable and reliable classifications (Milligan & Sokol 1980; Punj & Stewart 1983). This procedure started with hierarchical clustering to group the reported innovations into homogeneous clusters. We used Ward's method based on squared Euclidian distances to obtain a first hierarchy of clusters (cf. Milligan & Cooper, 1987). Visual inspection of the dendogram suggested classifications with either three or six clusters. To assess the robustness of various cluster options, we saved a range of initial solutions with two to eight clusters. In the second step we proceeded with k-means cluster analyses, a non-hierarchical clustering method that iteratively divides cases into clusters based on their distance from some initial starting points. The centroids of our initial hierarchical solutions were always used as initial values for classification. To assess the robustness of the various cluster solution we computed Kappa, the chance corrected coefficient of agreement, between each initial and iterated solution (cf. Singh, 1990). A solution with six clusters proved to be best ($k = 0.78$, while $k < 0.76$ for any other solution).

Thus, the cluster analysis resulted in a typology of six patterns of innovation networking practiced by small firms. Its descriptive statistics are presented in Table 3. Drawing on one-way analysis of variance we found significant differences on all cluster variables, satisfying the minimum criterion for the validity of a cluster solution (Milligan & Cooper, 1987). We labeled the clusters as supplier-based, customer-based, informal-based, new combinations, knowledge-based and system-based innovations.

Table 3. Descriptive statistics for the clusters and tests of significant differences

	Supplier-based (n=226)	Customer-based (n=80)	Informal-based (n=87)	New combinations (n=74)	Knowledge-based (n=84)	System-based (n=43)	Total sample (n=594)	sign.[a]
Volume	1.0	2.1	3.0	2.9	4.2	4.9	2.5	181.4**
Type:								
Informal	0%	8%	93%	1%	8%	23%	18%	251.6**
Customer	10%	71%	34%	33%	58%	63%	35%	36.8**
Competitor	8%	30%	31%	19%	54%	23%	23%	18.5**
IT supplier	33%	25%	39%	46%	55%	37%	38%	4.1*
Other supplier	38%	35%	48%	53%	74%	60%	48%	8.5**
Financial institute	0%	4%	14%	86%	18%	35%	19%	48.0**
Consultant/engineer	6%	16%	14%	35%	46%	60%	22%	116.4**
Industry association	1%	9%	11%	14%	49%	37%	15%	27.1**
University/PRO	5%	8%	15%	7%	62%	49%	18%	33.3**

	Supplier-based (n=226)	Customer-based (n=80)	Informal-based (n=87)	New combinations (n=74)	Knowledge-based (n=84)	System-based (n=43)	Total sample (n=594)	sign.[a]
Government	1%	1%	0%	0%	0%	100%	8%	1562.9**
Content of ties:								
Inspiration	0%	99%	30%	8%	12%	19%	22%	178.9**
Feedback/advice	10%	6%	45%	84%	63%	60%	35%	66.9**
Manpower	31%	24%	56%	49%	45%	44%	39%	6.2**
Knowledge	16%	10%	29%	20%	67%	37%	26%	23.0**
Resources	34%	39%	47%	36%	31%	60%	38%	3.2*
Embeddedness:								
Strong ties	9%	31%	90%	26%	36%	23%	31%	56.8**
Directed ties	20%	35%	30%	57%	38%	51%	33%	9.2**
Structural holes	13%	47%	62%	82%	53%	59%	42%	38.3**

[a] F-tests revealed ** $p < 0.001$, * $p < 0.01$.

Supplier-based innovations are characterized by low involvement of external networks. On average, just one external party makes some sort of contribution. Mostly this is a supplier of IT or other equipment, responsible for the delivery of hardware or manpower to support the development process. As Table 3 shows, 38 percent of the sample (226 reported innovations) could be classified as supplier-based. This makes it the prevalent pattern of networking, i.e. mostly to implement incremental innovations with no complicated contributions from the outside. It can be considered a counterpart of Pavitt's (1984) supplier-dominated industries, but now at the level of specific innovations.

Customer-based innovations usually involve customers who act as a source of opportunity. In 99 percent of the cases in this cluster a network actor is mentioned as a direct trigger to identify the opportunity for innovation, and most often this partner is a customer. Examples include major business-to-business customers asking for products with new specifications, or the needs of early adopters that firms regard as opportunities. Such involved customers may actually be lead users with 'home built' first versions of new machines or other devices which are, in turn, adopted and further improved by the innovating firm (cf. Von Hippel, 2005). The average number of contributors is 2.1, which is still below the average. Customer-based innovations are a counterpart of Pavitt's (1984) specialized supplier industries.

Informal-based innovations draw heavily on personal friends and relatives. Ninety-three percent of the innovations in this cluster involve such informal contacts, mostly to provide manpower, feedback or advice or other resources including money and capital goods (Table 3). This type is obviously marked by high involvement of strong ties (90 percent of the cases). As informal contacts have not been explored in previous typologies of innovation patterns, there is no correspondence with the Pavitt or other typologies of innovation.

New combinations are marked by a high presence of directed ties (57 percent) and structural holes (82 percent). These innovations bring together other previously unconnected parties suggesting that small firms involved in such innovations manage to benefit from building bridges with and between others. Such firms do not seem to be afraid of extending their networks with new partners to enable or support innovation. Another feature is that financial institutes are frequently involved. It also appears that in this cluster, advice is the most important contribution gained from innovation networking – probably on how to connect effectively with others and how to collaborate.

Knowledge-based innovations involve contributions of relatively 'remote' parties such as universities and public research organizations and also industry associations. Such

innovations draw on scientific knowledge as a source of innovation. In doing so, they mirror Pavitt's (1984) science-based industries and similar patterns found in more recent typologies (e.g. Evangelista, 2000; Castellaccia, 2008; De Jong & Marsili, 2006). Nevertheless, other types of partners are important too – for example we find suppliers and customers to be frequent contributors as well. Relatively many parties are contributing, on average 4.2, and knowledge-based innovations indeed involve relatively complex networking activity.

System-based innovations are most scarce, i.e. only 7 percent of the reported innovations were classified as such. The number of involved network partners is highest (on average 4.9), with the most distinguishing feature being that government organizations are involved, for example to provide subsidies or permits. But many others contribute as well, mostly as suppliers of manpower or resources, but also for knowledge or advice. Directed ties and structural holes are relatively common here. Similar to knowledge-based innovation, system-based innovation is marked by voluminous and complex networking.

4.1 Firm and innovation characteristics

Further probing of the clusters with firm and innovation characteristics was helpful to explain the nature of the six innovation patterns. Besides, validation of any typology demands analyzing variables not used to build them, but expected to vary across the clusters (Milligan & Cooper, 1987). In the theory section we already elaborated on why innovation strategy, innovation workers, firm size and industry types may correlate with innovation networking. The same was done for new-to-market and competence developing innovations.

Table 4 gives relevant descriptive statistics for the external variables and tests of significant differences. With the exception of industry types, we found significant results for all variables that support the validity of the clusters. As a rule of thumb, innovation types with voluminous and complex patterns of networking are more likely to be new to the market and competence-developing, and they also seem to be more demanding in terms of internal capabilities.

Table 4. Firm and innovation characteristics across clusters and tests of significant differences

	Supplier-based (n=226)	Customer-based (n=80)	Informal-based (n=87)	New combinations (n=74)	Knowledge-based (n=84)	System-based (n=43)	Total sample (n=594)	sign.[a]
Firm:								
Innovation strategy	39%	48%	39%	58%	63%	74%	49%	6.7**
Innovation workers	17%	28%	15%	29%	42%	65%	27%	15.3**
Firm size	22.8	24.3	18.7	21.3	29.4	23.2	23.2	2.7^
Industry type								
- high-tech manufacturing	9%	11%	7%	10%	14%	12%	10%	n.s.[b]
- low-tech manufacturing	29%	34%	40%	31%	29%	30%	32%	
- high-tech services	33%	29%	26%	30%	31%	35%	31%	
- low-tech services	29%	26%	26%	30%	26%	23%	27%	
Innovation:								
New to market	48%	60%	52%	43%	55%	74%	52%	2.9^
Competence-developing	40%	40%	45%	54%	74%	49%	48%	6.7**

[a] F-tests revealed ** $p < 0.001$, ^ $p < 0.05$.
[b] χ^2-test revealed no significant differences.

As Table 4 shows, voluminous and complex patterns are associated with firms that are more likely to maintain a formal strategy for innovation. One-way analysis of variance revealed that the differences are significant ($F=6.7$, $p<0.001$). Further exploration by means of contrast

analyses showed that new combinations, knowledge-based innovations and system-based innovations were associated with innovation strategies relatively often. For supplier-based and informal-based innovations, the frequency of innovation strategy was significantly lower (output not shown here, but available from the authors on request). Likewise, we found that innovation networking varied with the presence of specialized innovation workers within the firm ($F=15.3$, $p<0.001$). Knowledge-based and system-based innovations were developed by small firms employing such workers relatively often, while the opposite applied to (again) supplier-based and informal-based innovations. This supports our presupposition of firms' internal capabilities being connected with the volume and complexity of innovation networking.

Another result is that some of the patterns are associated with firms of different sizes ($F=2.7$, $p<0.05$). Follow-up contrast tests confirmed that knowledge-based innovations were found more often in larger firms, while informal-based innovations were found in smaller ones. This gives some support for our presupposition that larger firms are better equipped to benefit from external sources, and t particularly when the transfer of (tacit) knowledge is involved (echoing Cohen & Levinthal, 1990). To further explore what was happening to produce the low score for informal-based innovations, we followed-up by enriching our dataset with the year of establishment of the innovating firms (as registered by the Dutch Chambers of Commerce). At the time of the survey, firms reporting informal-based innovations were 13.5 years of age, although the average in the sample was 17.0 years. Thus, informal-based innovations were conducted by younger and smaller firms.

We also investigated differences between industry types, but chi-square tests showed no significant differences ($\chi^2=7.8$, $df=15$, $p > 0.05$). We also varied with the classification of industries, but found nothing significant. There was no evidence of manufacturers engaging in innovation networking differently to service firms.

Any innovations that are more intense and complex in their networking we expected to be marked by a higher degree of newness and to require the acquisition of new competences. Table 4 shows that some patterns are more likely to associate with new-to-market innovations ($F=2.9$, $p<0.05$). Follow-up contrast analyses indicated that this applied to system-based innovations, which is the most voluminous and complex type, but also to customer-based innovations (60 percent of the reported cases in this cluster were new to the market). Significant differences were also found for competence developments ($F=6.7$, $p<0.001$). Knowledge-based innovations were more likely to require the acquisition of new competences, but supplier-based and customer-based innovations were less likely to do so.

5. Discussion

This paper explored the patterns of innovation networking in Dutch small firms, and these were connected with firms' internal capabilities and with the newness and competence requirements of innovative opportunities. Unlike previous classifications of how firms innovate, the analysis was at the level of specific innovations (as objects), rather than at the industry or firm levels.

We found six homogenous patterns of innovation networking as practiced by small firms. The classification is based on a broad range of indicators dealing with the volume of networks, partner types and roles, strength and directedness of ties, and structural holes between involved network partners. The patterns were labeled as supplier-based, customer-based, informal-based, new combinations, knowledge-based and system-based innovations. In support of their validity we found the patterns to correlate significantly with indicators for the internal capabilities of firms and the newness and new competence requirements of innovations.

Our results confirm that by far most innovations in small firms are developed with support or input from external networks. On average, 2.5 other parties made some sort of contribution. Only nine percent of the sampled innovations did not involve any networking, echoing Van de Ven's (1986) early proposition that 'innovation does not exist in a vacuum' (p. 601).

Obviously, we found substantial differences in the volume and complexity of innovation networking. Supplier-based innovation is the most prevalent pattern, capturing 38 percent of our sample of innovations. It is characterized by low volume networking, mostly by a single supplier of IT or other capital goods. Such innovations tend to be only new to the firm and to build on existing competences. They are developed by firms with fewer internal capabilities, i.e. less likely to maintain innovation strategies and to employ specialized innovation workers. In contradiction, knowledge-based and system-based innovations represent voluminous and complex patterns of networking, including higher numbers of partners (4.2 and 4.9, respectively) and in various roles. Most distinctive for knowledge-based innovations is that universities or public research organizations are frequently involved, usually by providing (tacit) knowledge inputs. System-based innovations also include government organizations that may provide either subsidies or permits. Both types of innovation are relatively demanding in terms of internal capabilities. Small firms engaging in these types of networking have better odds of maintaining strategies for innovation and to employ specialized innovation workers. Both types of innovations are also more likely to be new to the market and to require new competences, rather than just building on existing competences. We note that these types represented 14 and 7 percent of the sampled innovations, indicating that voluminous and complex innovation networking is relatively scarce.

Customer-based innovations involve customers as a source of opportunity. One result that we had not anticipated is that these innovations have slightly better odds of being new to the market. In this context, the work of Von Hippel (2005) on user innovation has shown that customers are generally an excellent source of need information, i.e. they are better able to identify new product functions (which they need themselves) than are producing firms. Thus, assuming that some of the customers involved are lead users, innovations which are initiated and maybe partly developed by customers are more likely to contain genuinely new elements, and accordingly have better odds of being new to the market.

Despite that our clustering was done at the level of innovation objects and was based on new cluster variables, some of the identified patterns seemed to match with those in previous studies. More specifically, it was confirmed that suppliers, customers and universities were important sources of innovation, as the corresponding patterns can be regarded as counterparts of Pavitt's (1984) supplier-dominated, specialized supplier and science-based industries. However, we also found some new, previously undocumented patterns of innovation networking. Firstly, system-based innovation (already discussed) indicates that governments can be relevant innovation actors. Moreover, informal-based innovation and new combinations reflect types of networking that are characteristic for small firms as well.

Informal-based innovations are marked by strong ties, usually friends and relatives. As this type concerns 15 percent of the sample, only a minority of the innovations in small firms seems to be supported by such ties. This result deviates from previous studies of start-ups that are faced with a 'liability of newness', i.e. lack of track record and references as a trustworthy partner, and therefore have an extra need to call upon their strong ties (e.g Brüderl & Preisendörfer, 1998; Elfring & Hulsink, 2003). Thus, in our broad sample of established small firms informal contacts did contribute, but they did not seem as dominant as in the case of start-ups. Strikingly, we found that informal-based innovations were developed by smaller

and younger firms, confirming that the older and larger the firm, the less it needs strong ties in order to innovate.

New combinations are marked by high presence of directed ties and structural holes. Such innovations bring together previously unconnected others, suggesting that some small firms manage to innovate by building bridges with and between others. This pattern frequently involves financial institutes providing resources and advice – presumably on how to connect and/or how to finance the innovation. New combinations are more frequently conducted by firms with explicit innovation strategies, suggesting that such innovations require purposeful action.

While early typologies of innovation assumed that firms within industries share similar patterns, more recent empirical studies showed considerable heterogeneity in patterns of innovation of firms within industries (e.g. Arvanitis & Hollenstein, 1998; De Jong & Marsili, 2006). Our results demonstrated that similar heterogeneity is found at the level of innovations as objects. We found no evidence for manufacturers engaging in innovation networking differently than service firms, or, more generally, for any distinctions between industry types. Small firms in various industries rather seem to maintain very similar patterns of innovation networking, indicating that the industry level is too rough as a basis for classification.

For business owners and managers, our results confirmed that in order to benefit from networking, firms also need to develop their internal capabilities. Small firms with voluminous and complex patterns of networking were more likely to be positive on two internal capability indicators. The typology may also inform other practitioners, including lecturers, consultants and policy makers using patterns of innovation networking as a basis for teaching, advice and the development of policy interventions, respectively. Policy makers have increasingly recognized networking as being important in the past two decades. It has been acknowledged that innovation demands sufficient interaction between the actors in an innovation system (Nelson, 1993; Freeman, 1995) and, accordingly, all developed countries nowadays offer policies on this matter. However, in doing so the focus is on interactions between private and public actors i.e. university-industry linkages to stimulate the 'valorisation' of scientific knowledge and, to a lesser extent, the development of incumbent firms' networking competences (Guy, 2007). That innovation networking in small firms includes much more than public-private interaction tends to be overlooked. As suppliers and customers are the most prevalent types of network actors and knowledge transfer is only one of the potential roles of network partners, our findings suggest that current policies may be unbalanced. More attention is warranted to support innovation networking of small firms that do not engage in collaborations with universities. In this vein, although our data showed that a significant deal of innovations is developed with the help of directed ties (33 percent), few policy instruments in developed countries actually support small firms to track and interact with new private partners for valuable contributions (Guy, 2007).

One opportunity to balance current policy mixes would be to finance matchmaking services by means of 'go-betweens' in order to better connect pairs of private enterprises – an intervention that was recently also advocated by Nooteboom and Stam (2008). Alternatively, policy makers could consider broadening an increasingly popular intervention called 'innovation vouchers'. These are publicly funded small grants for private enterprises to consult universities and public research organizations for missing knowledge (Cornet et al., 2006). Voucher schemes are offered in a growing number of countries but again the focus is exclusively on public-private collaborations (also see www.proinno-europe.eu). If vouchers can be forwarded to other private enterprises however, they would be useful to many more innovating firms and support other types of innovation networking as well.

An inductive typology of six networking patterns creates multiple opportunities for future research. To mention only a few examples - what internal capabilities small firms need in

order to benefit from networking, and for what types of innovation, these are items that should be studied in much more detail. The role of directed ties is still uncharted, and as we find directedness to be important for at least some of the innovations, and especially for the pattern of 'new combinations', more work is called for. Moreover, our analysis included a limited number of key networking variables, but many more dimensions of networking can be included in future work (e.g. closeness, centralization, structural cohesion) (Scott, 1991).

More opportunities for future research arise directly from a number of caveats in our paper. Firstly, we were not able to assess the extent to which our sample is representative. As innovation surveys in basically all OECD countries do not include firms with fewer than ten employees (OECD, 2005), it is not possible to assess whether a sample adequately reflects a population of innovative small firms in a country (i.e. population statistics remain unknown). Although we found no differences in the patterns of networking across industry types, implying that weighing our data for industry types would not provide different outcomes, we recommend that our analysis should be validated on another, independent sample.

Secondly, we were faced with survey questions that had already been formulated by its administrators. The measurement of tie strength is debatable. Strong ties were considered to be external parties characterized by frequent contacts (at least once a week) and conversations on private matters. We would rather not have classified all ties as either strong or weak. The distinction between strong and weak ties is probably of a gradual nature rather than dichotomous, and with the given questions we were unable to explicitly identify weak ties. Another caveat is that the survey did not distinguish between networks' finance and capital goods contributions. These were merged into a single partner role category of 'other resources'. In the context of small firms this is an obvious drawback. We cannot exclude the fact that our typology overlooks external sources of finance, which we would have liked to be measured explicitly and more work on this matter is warranted.

6. References

Acs, Z.J. & D. Audretsch (1990), Innovation and Small Firms, MIT Press: Cambridge.

Ahuja, G. (2000), Collaboration networks, structural holes, and innovation: a longitudinal study, Administrative Science Quarterly, 45: 425-455.

Arvanitis, S. & H. Hollenstein (1998), Innovative Activity and Firm Characteristics - a Cluster Analysis with Firm-Level Data of Swiss Manufacturing, EARIE 25th Annual Conference, Copenhagen, 27-30 August 1998.

Atuahene-Gima, K. (1996), Differential Potency of Factors Affecting Innovation Performance in Manufacturing and Services Firms in Australia, Journal of Product Innovation Management, 13: 35-52.

Bougrain, F. & B. Haudeville (2002), Innovation, collaboration and SMEs' internal research capacities, Research Policy, 31: 735-748.

Brüderl, J. & P. Preisendorfer (1998), Network support and the business of newly founded businesses, Small Business Economics, 10: 213-225.

Burt, R. S. (1992), Structural Holes: The Social Structure of Competition, Cambridge, MA: Harvard University Press.

Castellaccia, F. (2008), Technological paradigms, regimes and trajectories: Manufacturing and service industries in a new taxonomy of sectoral patterns of innovation, Research Policy, 37: 978-994.

Chesbrough, H. (2003), Open Innovation: The new imperative for creating and profiting from technology, Harvard Business School Publishing: Boston, MA.

Churchill, G.A. (1999), Marketing Research Methodological Foundations, Forth Worth: Dryden Press.

Cohen, W. & D. Levinthal (1990), Absorptive Capacity: A New Perspective on Learning

and Innovation, Administrative Science Quarterly, 35: 128-152.
Cornet, M., B. Vroomen & M. van der Steeg (2006), Do innovation vouchers help SMEs to cross the bridge towards science?, CPB Discussion Paper 58, Den Haag: the Netherlands.
De Jong, J.P.J. & O. Marsili (2006), The fruit flies of innovations: A taxonomy of innovative small firms, Research Policy, 35(2): 213-229.
Elfring, T. & W. Hulsink (2003), Networks in entrepreneurship: The case of high-technology firms, Small Business Economics, 21: 409-422.
Evangelista, R. (2000), Sectoral patterns of technological change in services, Economics of Innovation and New Technology, 9: 183-221.
Freel, M. (2003), Sectoral patterns of small firms innovation, networking and proximity, Research Policy, 32: 751-770.
Freeman, C. (1995), The National System of Innovation in Historical Perspective, Cambridge Journal of Economics, 19: 5-24.
Fukugawa, N. (2006), Determining factors in innovation of small firm networks: a case of cross industry groups in Japan, Small Business Economics, 27: 181–193.
Gomes-Casseres, B. (1997), Alliance strategies of small firms, Small Business Economics, 9(1): 33-44.
Granovetter, M. (1973), The strength of weak ties, American Journal of Sociology, 78: 1360-1380.
Guy, K. (2007), Policy Mix Peer Reviews Synthesis Report, OMC CREST: EU.
Hargadon, A. & R.I. Sutton (1997), Technology brokering and innovation in a product development firm, Administrative Science Quarterly, 42: 716-749.
Lane, P., J.E. Salk & M.A. Lyles (2001), Absorptive capacity, learning and performance in international joint ventures, Strategic Management Journal, 22: 1139-1161.
Lechner, C., M. Dowling & I. Welpe (2006), Firm networks and firm development: The role of the relational mix, Journal of Business Venturing, 21(4): 514-540.
Lee, C., K. Lee & J.M. Pennings (2001), Internal capabilities, external networks, and performance: a study on technology-based ventures, Strategic Management Journal, 22: 615-640.
Lichtenthaler, U. (2008), Open Innovation in Practice: An Analysis of Strategic Approaches to Technology Transactions. IEEE Transactions on Engineering Management, 55(1): 148-157.
McEvily, B., & A. Zaheer (1999), Bridging Ties: A Source of Firm Heterogeneity in Competitive Capabilitites, Strategic Management Journal, 20: 1133-1156.
Milligan, G.W. & L.M. Sokol (1980), A two-stage clustering algorithm with robust recovery characteristics, Educational and Psychological Measurement, 40: 755-759.
Milligan, G.W. & M.C. Cooper (1987), Methodology Review: clustering methods, Applied Psychological Measurement, 11(4): 329-354.
Miozzo, M. & L. Soete (2001), Internationalization of Services: A Technological Perspective, Technological Forecasting and Social Change 67(2-3): 159-185.
Nelson, R.R. (1993), National Innovation Systems a Comparative Analysis, New York and Oxford: Oxford University Press.
Nooteboom, B. & E. Stam (2008), Micro-foundations for innovation policy, Amsterdam University Press: Amsterdam.
Nooteboom, B. (1994), Innovation and Diffusion in Small Firms: Theory and Evidence, Small Business Economics, 6: 327-347.
OECD (2001), Science, Technology and Industry Scoreboard, Paris: OECD, URL: http://www1.oecd.org/publications/e-book/92-2001-04-1-2987/D.5.htm.
OECD (2005), Oslo Manual: Proposed Guidelines for collecting and interpreting Innovation data, Paris: OECD.

Oerlemans, L., M. Meeus & F. Boekema (1998), Do networks matter for innovation? The usefulness of the economic networks approach in analysing innovation, Tijdschrift voor Economische en Sociale Geografie, 89(3): 298-309.
Pavitt, K. (1984), Sectoral patterns of technical change: towards a taxonomy and a theory, Research Policy, 13(6): 343-373.
Powell, W., K. Koput & L. Smith-Doerr (1996), Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology, Administrative Science Quarterly, 41: 116-145.
Punj, G. & D.W. Stewart (1983), Cluster analysis in marketing research: review and suggestions for application, Journal of Marketing Research, 20: 134-148.
Rothwell, R. (1983), Innovation and firm size: a case for dynamic complementarity; or is small really beautiful?, Journal of General Management, 8: 5-25.
Rothwell, R. (1991), External networking and innovation in small and medium-sized manufacturing firms in Europe, Technovation, 11(2): 93-112.
Ruef, M. (2002), Strong ties, weak ties and islands: Structural and cultural predictors or organizational innovation, Industrial and Corporate Change 11(3): 427-449.
Scott, J. (1991), Social Network Analysis, London: Sage.
Shane, S.A. (2003), A General Theory of Entrepreneurship: The Individual-Opportunity Nexus, Aldershot, UK: Edward Elgar.
Singh, J. (1990), A typology of consumer dissatisfaction response styles, Journal of Retailing, 66(1): 57-99.
Statistics Netherlands (2008), De digitale economie (the digital economy), Statistics Netherlands: Den Haag.
Statistics Netherlands (2007), Kennis en Economie (Knowledge and Economy), Statistics Netherlands, Voorburg: The Netherlands.
Tether, B.S. (2002), Who co-operates for innovation, and why? An empirical analysis, Research Policy, 31 (6): 947-967.
Uzzi, B. (1997), Social structure and competition in interfirm networks: the paradox of embeddedness, Administrative Science Quarterly, 42: 35–47.
Van de Ven, A. (1986), Central problems in the management of innovation, Management Science, 32: 590-607.
Von Hippel, E. (2005), Democratizing Innovation, MIT Press: Cambridge, MA.

The results of EIM's Research Programme on SMEs and Entrepreneurship are published in the following series: Research Reports and Publieksrapportages. The most recent publications of both series may be downloaded at: www.entrepreneurship-sme.eu.

Recent Research Reports and Scales Papers

H201001	4-1-2010	Administratieve lasten en ondernemerschap
H200911	24-9-2009	Ambitious entrepreneurship, high-growth firms and macroeconomic growth
H200910	4-6-2009	Entrepreneurial exit and entrepreneurial engagement
H200909	10-3-2009	Entrepreneurship Education Monitor (EEM)
H200908	3-3-2009	Internationale samenwerking door het Nederlandse MKB
H200907	2-3-2009	The Dynamics of Entry and Exit
H200906	2-3-2009	Bedrijfsgrootteverdelingen in Nederland
H200905	2-3-2009	Start-ups as drivers of incumbent firm mobility: An analysis at the region-sector level for the Netherlands
H200904	16-2-2009	Een reconstructie van het beleidsprogramma Ondernemerschap en Starters 1982-2003: een eclectische analyse
H200903	16-2-2009	Determinants and dimensions of firm growth
H200902	2-2-2009	The decision to innovate: Antecedents of opportunity exploitation in high tech small firms
H200901	7-1-2009	The Relationship between Successor, Planning Characteristics, and the Transfer Process on Post-Transfer Profitability in SMEs
H200825	19-12-2008	Isomorfie en het beloningspakket van werknemers in het MKB
H200824	16-12-2008	The relation between entrepreneurship and economic development: is it U-shaped?
H200823	11-12-2008	International Entrepreneurship: An Introduction, Framework and Research Agenda
H200822	11-12-2008	The two-way relationship between entrepreneurship and economic performance
H200821	5-12-2008	Spin-outs
H200820	27-11-2008	Innovative Work Behavior: Measurement and Validation
H200819	17-11-2008	Open innovation in SMEs: Trends, motives and management challenges
H200818	10-11-2008	High-Growth SMEs Evidence from the Netherlands
H200817	3-11-2008	Internationalization of European SMEs towards Emerging Markets
H200816	27-10-2008	Measuring business dynamics among incumbent firms in The Netherlands
H200815	20-10-2008	Vergrijzing van het arbeidsaanbod
H200814	16-10-2008	User Innovation in SMEs: Incidence and Transfer to Producers
H200813	30-9-2008	How Does Entrepreneurial Activity Affect the Supply of Business Angels?
H200812	16-9-2008	Science and technology-based regional entrepreneurship in the Netherlands: building support structures for business creation and growth entrepreneurship
H200811	8-9-2008	What Determines the Growth Ambition of Dutch Early-Stage Entrepreneurs?
H200810	6-8-2008	The Entrepreneurial Advantage of World Cities; Evidence from Global Entrepreneurship Monitor Data
H200809	25-7-2008	The Entrepreneurial Adjustment Process in Disequilibrium: Entry and Exit when Markets Under and Over Shoot

H200808	2-7-2008	Entrepreneurial Career Capital, Innovation and New Venture Export Orientation
H200807	24-6-2008	Twee decennia ondernemerschapsbeleid in beeld: een jong beleidsprogramma in sociaaleconomische context geplaatst
H200806	18-6-2008	Overcoming Resource-Constraints through Internationalization? An Empirical Analysis of European SMEs
H200805	9-6-2008	Whither a flat landscape? Regional differences in Entrepreneurship in the Netherlands
H200804	19-2-2008	Samenwerken op afstand
H200803	1-1-2008	Explaining Preferences and Actual Involvement in Self-Employment: New Insights into the Role of Gender
H200802	5-6-2008	Intrapreneurship; Conceptualizing entrepreneurial employee behaviour
H200801	12-11-2008	Investigating Blue Ocean *v.* Competitive Strategy: A Statistical Analysis of the Retail Industry
H200723	21-12-2007	Overoptimism Among Entrepreneurs in New Ventures: The Role of Information and Motivation
H200722	21-12-2007	The relevance of size, gender and ownership for performance-related pay schemes
H200721	21-12-2007	The Role of Export-Driven New Ventures in Economic Growth: A Cross-Country Analysis
H200720	21-12-2007	Entrepreneurial exit in real and imagined markets
H200719	21-12-2007	Modelling latent and actual entrepreneurship
H200718	21-12-2007	Knowledge Management and Innovation: An empirical study of Dutch SMEs
H200717	21-12-2007	Entrepreneurship and innovation
H200716	21-12-2007	Employment Growth of New Firms
H200715	21-12-2007	Entrepreneurial Culture and its Effect on the Rate of Nascent Entrepreneurship
H200714	21-12-2007	Creative industries
H200713	19-11-2007	New Ventures' Export Orientation: Outcome And Source Of Knowledge Spillovers
H200712	29-10-2007	SME Choice of Direct and Indirect Export Modes: Resource Dependency and Institutional Theory Perspectives
H200711	24-10-2007	Family Orientation, Strategic Orientation and Innovation Performance in SMEs: A Test of Lagged Effects
H200710	15-10-2007	Drivers of entrepreneurial aspirations at the country level: the role of start-up motivations and social security
H200709	12-10-2007	Does Self-Employment Reduce Unemployment?
H200708	10-9-2007	Social security arrangements and early-stage entrepreneurial activity
H200707	11-5-2007	Competition and innovative intentions: A study of Dutch SMEs
H200706	eind maart	High-Growth Support Initiatives
H200705	14-2-2007	The relationship between economic development and business ownership revisited
H200704	2-2-2007	The relationship between knowledge management, innovation and firm performance: evidence from Dutch SMEs
H200703	26-1-2007	Family orientation, strategy and organizational learning as predictors of knowledge management in Dutch SMEs
H200702	3-1-2007	Ambitious Nascent Entrepreneurs and National Innovativeness
H200701	3-1-2007	Entrepreneurial diversity and economic growth
H200627	21-12-2006	Motivation Based Policies for an Entrepreneurial EU Economy