International Journal of Innovation Management
Vol. 14, No. 2 (April 2010) pp. 179–199

DOI: 10.1142/S136391961000260X

Imperial College Press
www.icpress.co.uk

R&D COLLABORATION IN THE LIFE SCIENCES: FINDING PARTNERS AND THE ROLE OF RESOURCE-BASED INDUCEMENTS AND OPPORTUNITIES

T. VAN DER VALK[*,‡] and M. T. H. MEEUS[†]

[*]*TNO Innovation Policy Group, Wassenaarseweg 56*
2301CE Leiden, The Netherlands

[†]*Department of Organisation Sciences*
Faculty of Social Sciences, Tilburg University, The Netherlands
[‡]*t.vandervalk80@gmail.com*

E. H. M. MOORS and J. FABER

Department of Innovation Studies, Faculty of Geosciences
Utrecht University, The Netherlands

This paper addresses interorganisational collaboration by science-based firms active in the Dutch life sciences. More specifically, we focus on two aspects (1) processes of finding partners; and (2) resource-based inducements and opportunities guiding these processes. Overall, there appears to be an evolution from untargeted to targeted search as the firms become more established within the technological field. Unestablished firms largely depend on accepting invitations for collaboration offered to them by partners while more established firms are able to successfully initiate partnerships themselves. Considering more than one potential partner, e.g. actual partner selection, does not occur regularly, especially not in the case of partnerships initiated by the partner instead of the focal organisation. The use of a standardised list of preconditions to be considered in partner selection could be relevant here.

Introduction

In high technology sectors, the pace of technological change and complexity of technologies make it impossible for a single firm to rely on in-house R&D only (Powell *et al.*, 2005). This results in a distribution of knowledge across

[‡]Corresponding author.

organisations within such sectors. Access to complementary knowledge then becomes pivotal, rather than its actual acquisition (Grant and Baden-Fuller, 2004). The distribution of resources drives the emergence of networks of collaboration among high technology organisations. Individual firms use these networks to complement their internal R&D (Chesbrough and Crowther, 2006).

Studies on collaboration have addressed the relation between different firm-level (resource-related) variables and the propensity to collaborate (Eisenhardt and Bird Schoonhoven, 1996; Ahuja, 2000; Meeus *et al.*, 2001; Sakakibara, 2002; Meeus *et al.*, 2004), while other studies have devoted attention to explaining the emergence of dyadic relationships (Gulati, 1995; Mowery *et al.*, 1998; Nooteboom *et al.*, 2007). These studies have mostly attempted to find causal explanations for collaboration. Other studies have provided insights into motives and objectives for collaboration (Hagedoorn, 1993; Bayona *et al.*, 2001; Miotti and Sachwald, 2003; Yasuda, 2005), while other studies have related such motives to the organisational structure chosen for the partnership (Smith Ring and Van de Ven, 1992; Hagedoorn and Narula, 1996; Das and Teng, 2000). Finally, other studies have been aimed at unravelling the explanatory factors of partnership performance and its contribution to firm performance (Stuart *et al.*, 1999; Baum *et al.*, 2000; Belderbos *et al.*, 2004; Arend and Amit, 2005).

Building on this work, this paper aims to provide an exploration of search and selection processes. In a high technology sector, it may be difficult to find an appropriate partner due to the high specificity of the technological knowledge sought. This is especially challenging for relatively young firms, which do not have stable network relations (Van der Valk, 2007), and often lack information on potential partners. The question then arises what search processes lead to the formation of partnerships by these firms. Providing an answer to this question constitutes an important contribution of this paper.

Building on the resource-based view, the process of searching for partners can be conceived as being guided by the resources of the organisations involved. The rationale behind this is that when formulating new objectives for R&D, organisations identify a need for certain resources, to which access is sought externally. The objectives for development then become starting points of the objectives of the partnership to be formed, and the need for a resource constitutes the motive for choosing a certain partner organisation (Nooteboom, 1999). Therefore, the resources of individual organisations constitute a crucial criterion in two ways: selecting a partner, or being selected by a partner (Hitt *et al.*, 2000). This constitutes a paradox: in order to fulfil a resource need by collaborating with other organisations, an organisation needs to have resources that it can contribute to this collaboration. By exploring search and selection processes, this paper aims to give insight into how firms deal with this paradoxical situation.

This study adopts a resource-based framework that distinguishes between inducements and opportunities for collaboration (Arend and Amit, 2005; Sakakibara, 2002), and the subsequent processes of partner search and selection. In this respect, inducements for collaboration are the assets that are sought, whereas the processes of search and selection describe *how* these assets are found. As these processes operate at the micro-level of the individual partnership we are inclined to restrict our research to the case of collaboration by Dutch dedicated life sciences firms (DDLSFs), but we aim to provide findings that are applicable to other emerging populations of high technology firms as well. Our central research question is: *Which inducements and opportunities guide interorganisational R&D collaboration of DDLSFs and in what ways do these firms find partners?*

By addressing this question, we focus both on the antecedents of collaboration, as well as on the processes of collaboration that result from these antecedents (Street and Cameron, 2007). Adding to the work of Smith Ring and Van de Ven (1994) on the formation and evolution of partnerships, we explore different kinds of search mechanisms organisations can employ to find partners. While a study conducted by Supphellen *et al.* (2002) focused on the use of sources of information on partners once an alliance was planned, this study focuses on the phase prior to this. The relevance of this paper for management derives from the importance of partner selection for the subsequent success of the partnership. Adequate partner selection can decrease both the performance risk and relational risk of the partnership (Das and Teng, 1998) and can thereby be considered pivotal in the subsequent performance of the partnership (Supphellen *et al.*, 2002).

The theoretical framework is discussed in the following section. Next, the methods of data collection and analysis are illustrated, and this is followed by an overview of the results obtained. The paper ends with a discussion of results and conclusion.

Theoretical Framework

We build on the resource-based view of the firm, in which a firm is perceived as a bundle of resources which are defined as "those (tangible and intangible) assets which are tied semi-permanently to the firm" (Wernerfelt, 1984, p. 172). The main focus of a firm is then on the exploitation of existing resources and simultaneously on the development of new or improved resources to ensure future possibilities for exploitation (Wernerfelt, 1984). The heterogeneity of resources across firms is the main cause of differences in the competitive advantage. We continue by addressing the role of inducements and opportunities for collaboration in guiding the process of searching for partners. Also, possible ways of conducting this search are discussed.

Inducements and opportunities guiding partner search

As was stated by Van de Ven (1976): "the end objectives of organisations involved in an IR (ed.: interorganisational relationship) is the attainment of goals that are unachievable by organisations independently" (p. 25). One explanation for the existence of unachievable goals is the lack of certain resources to achieve them. This makes collaboration a prerequisite for survival in the long term (Lichtenthaler and Ernst, 2006).

From a resource-based perspective, the heterogeneity of resources of firms is the main reason for collaboration: some firms may be lacking resources that others may be able to offer (Street and Cameron, 2007). An organisation (ego), after identifying a resource need, starts searching for an appropriate partner (alter). The primary factor determining the appropriateness of alter is the extent to which alter is able to fulfil the resource needs of ego, hence alter should offer complementary resources. In prior research this has been referred to as 'strategic fit' (Bierly and Gallagher, 2007). This implies that these resource needs of ego give direction to the search for partners as they constitute *inducements* for collaboration. Another organisation has *opportunities* for collaboration if it is able to fulfil a resource need of ego (Ahuja, 2000). On the other hand, to become receptive to ego's invitation, this alter should also have an inducement for collaboration with ego, as the benefits should at least to some extent be mutual. This inducement of alter constitutes ego's opportunity. Overall, the inducements for collaboration of ego may be considered to primarily *drive* the establishment of the partnership while its opportunities *enable* it to make other organisations interested in collaboration. This process is summarized in Fig. 1. For organisations that are in need of resources this represents a paradox: they need to have resources to obtain resources through collaboration. In other words, accumulating knowledge in-house and

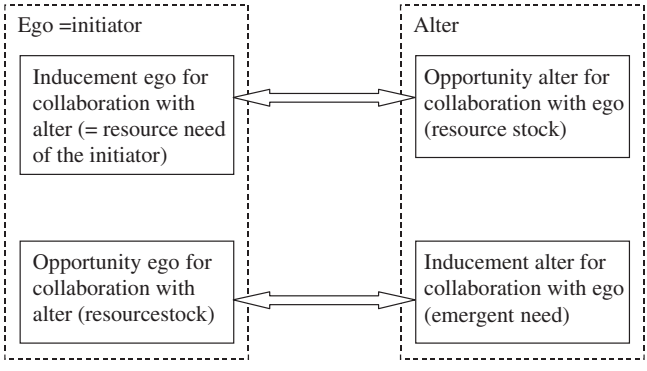

Fig. 1. The relation between motives of partnership formation of ego and alter.

accessing knowledge externally are complementary processes (Rothwell and Dodgson, 1991).

Other than as depicted in Fig. 1, partnerships can be formed jointly by partners that are already in contact with each other. This option will also be taken into account in the remainder of this paper.

Resource complementarities can occur within a resource type, e.g. technological complementarity, as well as across types of resources (Teece, 1986). In the case of high technology firms technological resources as well as resources related to commercialisation and finance may be important (Pyka and Saviotti, 2001).

Inducements and opportunities for collaboration could differ for DDLSFs that are relatively unestablished — young and small — and DDLSFs that are relatively established, as these firms may have accumulated different resources in-house. Also, relatively unestablished firms may especially be subject to the paradox of resource-based collaboration illustrated earlier, as they generally lack resources.

Searching for potential partners

One might argue that the partnering process illustrated above implies a rather rational course of events. However, in searching for partners, organisations generally act based on incomplete information which hinders rationality (Bierly and Gallagher, 2007). Also, as stated by Ahuja (2000): "linkages are only formed when actors with inducements are successful in finding collaboration opportunities" (p. 318). Based on inducements for collaboration, an organisation starts searching for appropriate partners within its environment. A firm then requires information on potential partners within its environment (Gulati, 1998), i.e. sufficient social capital (Burt, 1997). Furthermore, to be identified as a partner by others, an organisation needs to be visible within a technological field or sector. As was proposed by Smith Ring and Van de Ven (1994), social capital can shorten the process of alliance formation as an increased level of trust in a partner decreases relational risk, e.g. risk introduced by the possibility of opportunistic behaviour of a partner (Das and Teng, 1998; Ahuja, 2000).

In general, empirical studies on the influence of an organisation's social capital on partnership formation have related proxies of the stock of social capital to the number of partnerships of the firm (Eisenhardt and Bird Schoonhoven, 1996; Ahuja, 2000; BarNir and Smith, 2002; Sakakibara, 2002). In this regard, some studies focused on the effects of networks of prior partnerships on partnership formation (Stuart, 1998; Gulati, 1999). However, relationships of any kind can lead to new partnerships, indirectly, through contacts of the organisation, as well as directly with such a contact (Gulati, 1998). For instance, the social networks of managers of small firms have also been found to be important for partnership formation (BarNir and Smith, 2002).

This study addresses partner search in an exploratory manner. For instance, participating in events such as conferences and workshops is a more 'coincidental' way of finding partners. A more deliberate way is by making use of an organisation's internal knowledge, for instance, on a specific market. Public sources of knowledge, such as patent databases, can be used to complement this knowledge. The specificity of the resources sought may also influence the search process. While many different organisations are able to provide financial resources, technological resources may be highly specific. This limits the number of relevant partners and increases the importance of partner selection.

Processes of partner search and selection can differ for firms with different characteristics. For instance, relatively unestablished firms might have limited opportunities for collaboration, which might reduce the extensiveness of their selection processes. We will explore these differences in the results section.

Overall, both resource complementarity and social capital influence collaboration. Resource complementarity may be expected to be decisive; as Gulati (1998) states: "firms don't form alliances as symbolic social affirmations of their social networks, but rather, base alliances on concrete strategic complementarities that they have to offer each other" (p. 301). But the availability of information can have a profound effect on the partner selection process, especially in rapidly changing environments where strategic fit is difficult to assess. It is therefore interesting to explore processes of partner selection in a high technology field such as the life sciences. In the following section, the data collection and measurements are discussed.

Methods and Operationalisation

The population of DDLSFs comprised 160 firms at the end of 2005. To gather the data required for this study, in-depth interviews were conducted. Given the exploratory nature of this study, making a selection among firms active in the sector was considered justifiable. We made sure to interview firms of differing size and age. Overall, interviews were held with the managers[a] of nine DDLSFs. The characteristics of these firms are provided in Table 1. To ensure confidentiality, they are referred to as DDLSF 1 to 9.

In general, young firms are small, while older firms are larger. Figures 2 and 3 provide the frequency distributions of firm age and firm size in 2005. The data used to compile these graphs were obtained from a questionnaire distributed among DDLSFs with a response rate of about 43%.

[a]The majority of the managers interviewed were CEOs of the DDLSFs.

Table 1. Number of employees and age of the firms included in this study.

	Firm size 2005 < 10 fte	Firm size 2005 > 20 fte
Firm age (2005) < 4 years	DDLSF 1 DDLSF 4 DDLSF 2 DDLSF 6 DDLSF 5	
Firm age (2005) > 4 years	DDLSF 3	DDLSF 7 DDLSF 8 DDLSF 9

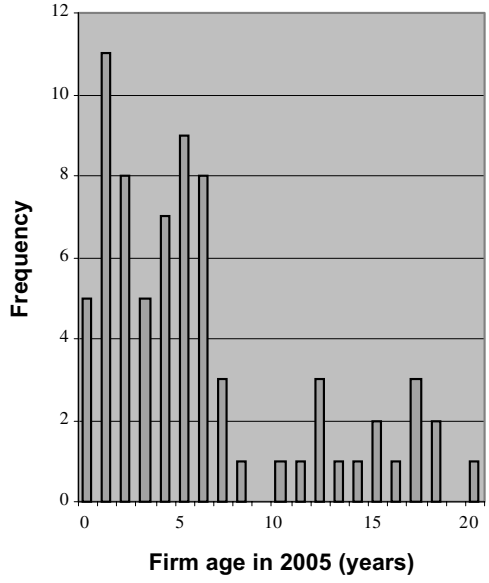

Fig. 2. Frequency distribution of firm age of DDLSFs in 2005 ($N = 73$).

In comparison with Figs. 2 and 3 it can be concluded that some of the firms interviewed are relatively large (DDLSFs 7 to 9), while others are relatively small. Also, some firms are relatively old (DDLSFs 7 and 9) while others are young (DDLSFs 1, 2 and 4). Based on data on these data, more established firms include DDLSFs 7 to 9, while all other firms are less established. DDLSF 3 is attributed to this latter category, as it is still very small. The firms that are considered more established here might also be regarded as start-ups in more established life sciences firms. However, taking into account the frequency distributions given in Figs. 2 and 3, and the data in Table 1, it is justifiable to refer to firms 7, 8 and 9 as

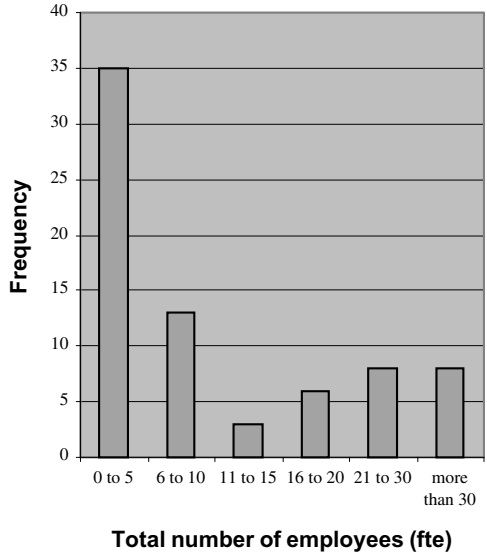

Fig. 3. Frequency distribution of the total number of employees of DDLSFs in 2005 ($N = 73$).

'more established'. This distinction between the firms studied will be used in the results section.

The interviews focused on the most important partnership of the firm with another firm and with a research institute, and were semi-structured. All firms were collaborating with another firm, while 7 out of 9 firms also collaborated with research institutes. Conducting these interviews thus provided results on 16 R&D partnerships. In retrospect, questions were asked on the processes of search and selection.

To analyse the 16 R&D partnerships, we made use of the case study survey method as described by Yin and Heald (1975). This method entails the analysis of several heterogeneous cases using a predefined, (partly) closed-ended questionnaire and makes it possible to generalise about the cases (Yin and Heald, 1975). As the objective of this study was to provide insight into inducements and opportunities for collaboration and finding partners, questions asked focused on these subjects. Table 2 provides an overview of the operationalisation of each of the subjects discerned in the theoretical framework.

In order to analyse the data obtained in the interviews we make use of the categories belonging to the different concepts given in Table 2. A limitation of the case study survey method in general is that it diverts attention away from the unique aspects of each individual case (Yin and Heald, 1975). It is a useful method for this study because the aim here is to assess whether patterns in the behaviour of firms occur across cases, and not to examine in detail the specific aspects of individual cases.

Table 2. Operationalisation of concepts/issues.

Concept/issue	Operationalisation
Inducements for collaboration	On a scale of 1–10, how important were the following inducements in choosing this specific partner: obtaining access to: (1) technological knowledge; (2) facilities; (3) knowledge of the market; (4) market entry; (5) knowledge related to management; (6) knowledge on regulatory affairs; (7) other resources. After grading the inducements, the managers were asked to rank the three most important ones.
Opportunities for collaboration	On a scale of 1–10 how important were the following inducements in choosing this specific partner: obtaining access to: (1) technological knowledge; (2) facilities; (3) knowledge of the market; (4) market entry; (5) knowledge related to management; (6) knowledge on regulatory affairs; (7) other resources. After grading the inducements, the managers were asked to rank the three most important ones.
Finding partners	Managers were asked how the very first contact with this partner was established. From the answers it was derived: (1) who was responsible for the establishment of this first contact; and (2) which sources of knowledge were used to find the partner. The sources mentioned were subdivided into: (1) through the network of contacts of the firm; (2) by using knowledge of the field internal to the firm; and (3) (relatively coincidental) meetings at events.
Partner selection	Managers were asked to indicate whether or not other potential partners were also considered.

Results

We start with a description of the inducements and opportunities that were relevant and the processes of finding partners and partner selection. We relate these aspects to characteristics of the DDLSFs involved, namely whether the DDLSF is relatively unestablished or established, as well as distinguish between partnerships with research institutes and firms.

Inducements and opportunities for collaboration with a specific partner

Tables 3 and 4 provide data on the primary inducements and opportunities of DDLSFs for collaboration with research institutes and firms.[b]

[b]'Technological knowledge' and 'facilities' are grouped here, as are the different commercialisation-related inducements.

Table 3. Primary inducements for collaboration of different types of DDLSFs.

Primary inducement	Unestablished firms (6 firms, 11 projects)		More established firms (3 firms, 5 projects)		Total
	RI	F	RI	F	
Technology/facilities	DDLSF 1 DDLSF 2 DDLSF 3 DDLSF 4	DDLSF 1 DDLSF 4	DDLSF 7 DDLSF 9	DDLSF 8	9
Commercialisation	—	DDLSF 3 DDLSF 6	—	DDLSF 9	3
Finance	—	DDLSF 2 DDLSF 5	—	DDLSF 7	3
Other	DDLSF 5	—	—	—	1
Total No. of DDLSFs	5	6	2	3	16

Note: RI = partnership with research institute; F = partnership with firm.

Table 4. Primary opportunities for collaboration of different types of DDLSFs.

Primary opportunity	Unestablished firms (6 firms, 11 projects)		More established firms (3 firms, 5 projects)		Total
	RI	F	RI	F	
Technology/facilities	DDLSF 3 DDLSF 5	DDLSF 2 DDLSF 3 DDLSF 4 DDLSF 5 DDLSF 6	DDLSF 7 DDLSF 9	DDLSF 9	10
Commercialisation	DDLSF 1 DDLSF 4	—	—	DDLSF 7 DDLSF 8	3
Finance	DDLSF 2	DDLSF 1	—	—	3
Other		—	—	—	0
Total No. of DDLSFs	5	6	2	3	16

Note: RI = partnership with research institute; F = partnership with firm.

The inducements of DDLSFs for collaboration with research institutes are straightforward: DDLSFs collaborate to access technological knowledge and facilities, especially related to biology and pharmacology. Research institutes collaborate with DDLSFs to obtain access to technological knowledge and resources related to commercialisation. Management skills and finance are also important to these research institutes.

Inducements of DDLSFs for collaboration with other firms are diverse such as access to technological knowledge and market-related motives. Collaboration with other firms also provides access to financial resources and therefore enables a DDLSF to commercialise its technology. In partnerships of several DDLSFs (3, 5 and 6) with firms, DDLSFs commercialise their patented knowledge. As indicated by the Manager of DDLSF 3 that develops a platform technology: "We decided that only if we acquire the patent we applied for, we will engage in further development of specific applications of this platform technology. Otherwise, it will never become a success anyway" (Manager of DDLSF 3). The Manager of DDLSF 5 explained: "the decision of this firm to partner with us was solely based on the fact that we had a specific patent. If we did not have the patent, we would not have had the deal" (Manager of DDLSF 5). The patented knowledge *of a partner* can also be decisive, as was indicated by another manager: "the fact that this firm had protected its knowledge with patents was crucial. Otherwise they could have had very promising technological knowledge but it still would not have been interesting to collaborate" (Manager of DDLSF 8). Patents were thus perceived to be a decisive factor in the formation of several partnerships.

Overall, organisations mainly collaborate because of relatively specific resources held by the partner, namely technological resources. In this respect, patents are important. Less specific resources such as financial resources are only important in a few cases. Given that collaborating organisations mostly seek highly specific resources, the question arises: how do these organisations find partners? This issue will be addressed in the next section.

Partnership initiation and ways of finding partners

Table 5 provides information on the search process, including which of the organisations conducted the search and how the partner was eventually found.

In jointly initiated partnerships the phase of partner search was skipped. Two of these relationships were repeated ties (DDLSF 9 with a research institute and DDLSF 1 with a firm), and one was a jointly initiated partnership with a direct contact of the DDLSF (DDLSF 9 with a firm).

Initiation of the collaboration

In some cases the search was conducted by the DDLSF, whereas in others by the partner. As is clear from Table 5, especially relatively unestablished firms depend on opportunities for collaboration offered to them by partners — seven out of eleven partnerships of these DDLSFs were initiated by a searching partner. These firms thus take up the position of alter in Fig. 1, i.e. they are invited to collaborate by their partner. For more established DDLSFs this was different — only one out

Table 5. Initiation and search in partnership formation (N = 16).

Method of search: searching DDLSF	Unestablished firms		More established firms		Total
	RI	F	RI	F	
IK	—	—	DDLSF 7	—	1
DNW	DDLSF 2	DDLSF 6	—	—	2
INW	—	—	—	DDLSF 8	1
EV	DDLSF 3	—	—	—	1
Method of search: searching partner					
IK	DDLSF 5	DDLSF 5	—	—	2
DNW	DDLSF 4	DDLSF 2	—	DDLSF 7	3
INW	DDLSF 1	DDLSF 3	—	—	2
EV	—	DDLSF 4	—	—	1
Jointly initiated partnerships		DDLSF 1	DDLSF 9	DDLSF 9	3
Total	5	6	2	3	16

Note: IK: internal knowledge; DNW: directly with a contact of the firm; INW: indirectly through the network of contacts of the firm; EV: at events.

of five partnerships was initiated by the partner. To further illustrate these findings and quoting a manager:

> "Until now, the engagement of our firm in partnerships has been opportunity-driven. At first, you do not have a reputation and you depend on your partner's confidence in your firm. At this moment, this tendency seems to be reversing: in the next stage we will determine the most promising long-term strategy… We will then approach organisations that have passed our own due dilligence." (Manager of DDLSF 4).

Adding to this, the Manager of more established DDLSF 8 indicated that "We search for partners based on the knowledge we have of the market. We determine with whom the project can be carried out best, and then approach that organisation" (Manager of DDLSF 8). On the other hand, the patents of DDLSF 5 provided it with many opportunities for collaboration:

> "A lot of other organisations approach us with proposals for collaboration. The field we are working on is 'hot' and we are the front-runners. Our patents are a clear signal of this. Our leading researcher is also very well-known in the Netherlands and abroad, which is also important." (Manager of DDLSF 5).

Finding partners and being found

As is shown in Table 5, in five cases a DDLSF initiated collaboration by searching for a partner. In three cases, they found their partners through the network of the firm's contacts (twice directly, once indirectly), whereas in the two remaining cases other sources of information were considered. In one case the DDLSF knew the partner was an expert in a relevant knowledge field (DDLSF 7). In the other case both partners met at a conference and decided to collaborate directly thereafter (DDLSF 3).

In several cases, DDLSFs were invited by partners to form a partnership. This occurred in two partnerships with research institutes, one in which prior occupations were important and one where patents and publications were important.

With regard to partnerships with other firms, DDLSFs are found in four cases, two of which were directly through the network of contacts of the collaborating firm. In one other case, the partner found the DDLSF through its patents (DDLSF 5). In the remaining case, a meeting at an event directly resulted in formation of the partnership (DDLSF 4).

Furthermore, Table 5 shows that more established firms do not directly make use of events to find partners.

Overall, the results show that the methods of searching for partners that are applied by DDLSFs and their partners are diverse, but networks of contacts are important. The extent to which unestablished DDLSFs initiate partnerships themselves is limited. This may have implications for partner selection, which are discussed in the next section.

Selection of partners

The results in Table 6 answer the question whether different types of firms have considered other partners in addition to the partner that was eventually chosen. In the table a distinction is made between partnerships initiated by the DDLSF and initiated by the partner.

In jointly initiated partnerships, the DDLSFs involved did not think that considering other potential partners was relevant. As a manager explained: "The idea for establishing this partnership originates from discussions with this firm" (Manager of DDLSF 9). In the project of DDLSF 9 with a research institute, no other organisations were considered either. "This research institute was also involved in the project preceding this one. This is why they are involved in this project now" (manager DDLSF 9).

In three cases where DDLSFs initiated the partnership, other potential partners were also considered, whereas in two cases no others were considered. These two cases are particularly interesting as considering multiple partners is generally

Table 6. Selection of partners by a specific type of DDLSF.

Others considered by DDLSF after initiation by the DDLSF?	Unestablished firms (6 firms, 11 projects)		More established firms (3 firms, 5projects)		Total
	RI	F	RI	F	
Yes	DDLSF 2	DDLSF 6	—	DDLSF 8	3
No	DDLSF 3	—	DDLSF 7	—	3
Others considered by DDLSF after initiation by partner?					
Yes	—	DDLSF 5	—	—	1
No	DDLSF 1 DDLSF 4 DDLSF 5	DDLSF 2 DDLSF 3 DDLSF 4	—	DDLSF 7	6
Jointly initiated partnerships	—	DDLSF 1	DDLSF 9	DDLSF 9	3
Total	5	5	1	2	16

Note: RI = partnership with research institute; F = partnership with firm; jointly initiated partnerships are omitted from this table.

expected. As explained by the manager of DDLSF 3: "This research institute had knowledge of the techniques that were required for the project. The project could probably have been carried out with another organisation, but then we would have had to specifically search for partners with similar competences and knowledge" (manager DDLSF 3). Similar reasoning was used in a collaboration by DDLSF 7 with a research institute: "Collaborating with this research institute was the most logical decision to make because the professor there was *the* specialist in this specific field. We connected during the first meetings, and then, if it is not strictly necessary, you do not search any further" (manager DDLSF 7).

Only once did any of the DDLSFs consider other potential partners after initiation of the partnership by a partner. This was DDLSF 5, whose IP was the primary reason for establishing the partnership. Since there were other organisations that also had an interest in obtaining this patent, the DDLSF was able to select from offers. As recalled by the manager of this firm: "When they contacted us, they made a concrete proposition. At that moment, we already had the patent and were already negotiating with other organisations. However, this firm was prepared to pay a huge amount of money up front, twice as much as any of the other firms that were interested" (manager DDLSF 5). In this case, patents clearly put a firm in a better position for negotiation.

In all other cases, after initiation by the partner no other potential partners were considered. In the two partnerships in which the DDLSF was asked to conduct

contract research, this was not considered to be relevant. As explained by the Manager of DDLSF 2: "considering other partners was not an issue because we received an order from this firm" (Manager of DDLSF 2). A similar rationale was involved in the partnership of DDLSF 7 with a firm. However, in other more complex partnerships, other organisations were also often not considered after initiation by the partner. With respect to the partnership of DDLSF 4 with a research institute, the Manager indicated that "For us the establishment of this partnership was opportunity-driven. In retrospect, this project could also have been carried out in collaboration with another partner" (Manager of DDLSF 4). This statement is similar to the one made by the Manager of DDLSF 5: "Because we were asked by this research institute to collaborate, considering other partners was not relevant. The project could have been carried out with another partner organisation." (Manager of DDLSF 5). With regard to the partnership with a firm, the manager of DDLSF 3 indicated that "The fact that this partner was active in this market *and* wanted to innovate made it unique. Such organisations are difficult to find." (Manager of DDLSF 3).

Overall, in half of the cases when a DDLSF initiated a partnership, multiple organisations were considered as partners. In partnerships initiated by the partner, the DDLSF usually does not consider other potential partners, except for one case in which patents had improved the negotiating position of the DDLSF.

Summary of the results obtained

To summarize, the results presented here indicate that inducements and opportunities for collaboration in the life sciences are highly specific because gaining access to technological knowledge is a dominant motive for collaboration. However, in several partnerships, resources for commercialisation and finance were most important. Furthermore, the ways in which organisations search for partners are diverse, but networks of prior contacts play an important role. Relatively unestablished DDLSFs do not regularly initiate partnerships; they depend on their partners for partnership initiation. DDLSFs are more likely to take the initiative as

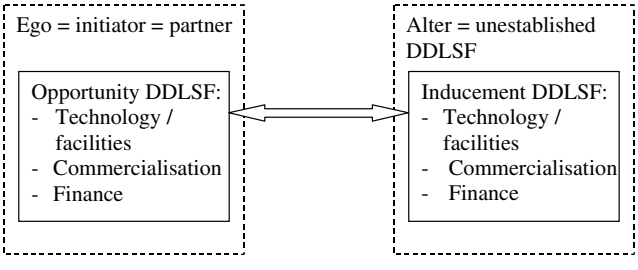

Fig. 4. Partnership formation by unestablished DDLSFs.

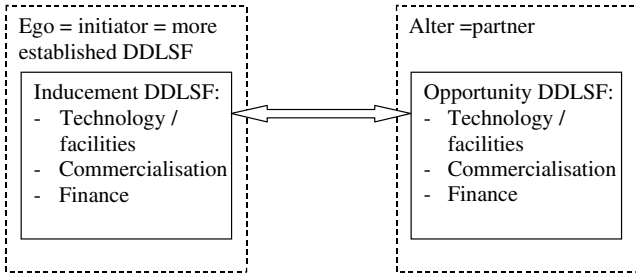

Fig. 5. Partnership formation by more established DDLSFs.

they become more established. These findings are roughly sketched in Figs. 4 and 5, which are based on the model presented in Fig. 1.

In many cases the DDLSFs involved do not consider multiple potential partners, especially not where partnerships initiated by the partner are concerned.

Discussion

The aim of this paper is to provide insight into the process of searching for partners, and resource-based inducements and opportunities of DDLSFs for collaboration.

With respect to partner search, other studies stressed the role of existing networks of collaboration (Gulati, 1999; Ahuja, 2000), which may directly and indirectly contribute to the identification of partners (Gulati, 1998). While we did find that 2 out of 16 R&D partnerships are repeated ties between organisations, and one in which the DDLSF met its partner through a previous partner, contacts were not previous partners in most cases. These other contacts might especially be relevant in emerging technological fields such as the life sciences, as networks of collaboration are only just emerging and relationships that make up these networks are highly volatile.

Other studies have shown that more established firms have more partnerships. From our exploratory study, we believe that this is mainly attributable to the increased ability of a firm to successfully initiate partnerships based on its own inducements as well as increased possibilities for jointly initiating partnerships. While relatively unestablished firms might be highly motivated to collaborate due to a lack of resources, these firms are more dependent on proposals for collaboration offered to them by induced partners. The effects of how established the companies are on the collaborative behaviour of firms examined here may be related to effects of newness (Stinchcombe, 1965; Freeman *et al.*, 1983). Among other things, these effects include a lack of social approval of new organisations and the specific ensuing consequences of this, such as their lack of stable

relationships with other organisations (such as suppliers). This makes it difficult for new firms to find organisations that are willing to collaborate, which increases their dependence on (a limited number of) initiatives taken by potential partners. From the exploratory analysis conducted here it became clear that once the initiative for collaboration was taken by a potential partner, the DDLSF involved usually does not consider other potential partners for purpose of comparison.

As explained before, the resource-based inducements and opportunities framework for explaining collaboration leads to a paradoxical situation where organisations experiencing a lack of resources are concerned: they are in need of resources and therefore want to partner, but in order to find partners they need to have resources to contribute to the partnership. They seem to deal with the paradox of resources and collaboration by displaying satisficing behaviour, as introduced by Simon (1957); because it is difficult for them to find partners, they are inclined to make use of opportunities offered to them by potential partners and do not consider other alternatives. This tendency is depicted in Fig. 4 and is the most important finding of this paper. This satisficing behaviour potentially makes the position of new firms even more fragile as it potentially increases the performance risk and relational risk of these projects (Das and Teng, 1998). Young organisations are thus in a difficult position with regard to finding partners. This emphasizes the importance of policy initiatives aimed at improving the embeddedness of young organisations. Such initiatives, would increase their visibility and therefore, their opportunities for collaboration.

In addition to these findings and their implications, this study also provides interesting insights for further research on collaboration in an emerging technological field. The most important suggestion for further research is that it should examine the consequences of the different patterns of partnership formation depicted in Figs. 4 and 5 in terms of partnership performance. It may be expected that partnerships in which a firm has acted as the "ego" are in the end more successful for this firm, as these partnerships are deliberately sought for and actual selection more often occurs. However, this is not necessarily true. Several limitations of this research can also be dealt with in further research. One of these limitations concerns its focus on partnerships that have been established, thereby neglecting project proposals that have been turned down by a partner. Addressing these could provide additional insights into the extent to which organisations are actually selective when potential partners offer possibilities for collaboration to them. Also, as all the processes of search and selection based on inducements and opportunities studied here have led to the formation of a partnership, the managers of the DDLSFs that were interviewed might have rationalised this process in retrospect. However, as we gathered the data through interviews, we were able to follow up with inquiries into, for instance, how the two partners met.

Finally, when looking at the inducements and opportunities of the DDLSFs for collaboration, we only interviewed the managers of these DDLSFs and not their partners. The result was that we only gained insight into the opportunities of the DDLSF *as perceived* by the DDLSF. It may be preferable to gather this informaton through interviews with the partner. Also, interviewing the partners of DDLSFs would have provided more insights into the processes of search and selection initiated by them.

Conclusion

The central research question of this paper was: "Which inducements and opportunities guide interorganisational R&D collaboration of DDLSFs and in what ways do these firms find partners?" In total, data on 16 R&D partnerships were used to answer this question.

Primary inducements for collaboration of the DDLSFs were gaining access to technological resources, especially in partnerships with research institutes. DDLSFs perceive their technological as well as their commercial resources as primary opportunities for collaboration with research institutes. DDLSFs collaborate with other firms to obtain access to technological and commercial resources, while they perceive their opportunities to benefit from their technological resources. Overall, specific technological resources were most important in the decision to collaborate with a certain partner and in several cases, patents were decisive.

Networks of the firm's contacts constitute an important source of finding partners and being found. In three cases, such contacts represented previous partners. However, in eight cases those contacts represented other types of contacts. These findings indicate the relevance of examining the influence of different types of networks of organisations, connected by types of relationships other than just previous partnerships.

The results obtained in this study indicate the following possible pattern: relatively unestablished firms are more dependent on being invited to collaborate by potential partners. They thus primarily take up the role of alter in Fig. 1. As selection among multiple potential partners is often not considered to be relevant after being invited to partner, this implies a reduction of the extent of rationality of the process. In these cases, DDLSFs seem to display satisficing behaviour. As DDLSFs become more established, the importance of such invitations to collaborate decreases. More established firms are more likely to take the initiative to partner or jointly initiate a partnership together with their partner than to accept the invitation of a potential partner. Thus, they move more towards the role of ego in

Fig. 1. Further research should provide insight into the recurrence and validity of this proposed pattern derived from this exploratory study. Furthermore, attention should be paid to its possible consequences for the performance of partnerships.

Acknowledgements

We thank an anonymous reviewer for providing useful feedback on an earlier version of this paper.

References

Ahuja, G (2000). The duality of collaboration: Inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal*, 21(3), 317–343.

Arend, RJ and R Amit (2005). Selection in strategic alliance activity: Effects on firm performance in the computing industry. *European Management Journal*, 23(4), 361–381.

BarNir, A and KA Smith (2002). Interfirm alliances in the small business: The role of social networks. *Journal of Small Business Management*, 40(3), 219–232.

Baum, JAC, T Calabrese and BS Silverman (2000). Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology. *Strategic Management Journal*, 21(3), 267–294.

Bayona, C, T Garcia-Marco and E Huerta (2001). Firm's motivations for cooperative R&D: An empirical analysis of Spanish firms. *Research Policy*, 30(8), 1289–1307.

Belderbos, R, M Carree and B Lokshin (2004). Cooperative R&D and firm performance. *Research Policy*, 33(10), 1477–1492.

Bierly, PE and S Gallagher (2007). Explaining alliance partner selection, Fit, trust and strategic expediency. *Long Range Planning*, 40, 134–153.

Burt, RS (1997). The contingent value of social capital. *Administrative Science Quarterly*, 42(2), 339–365.

Chesbrough, H and AK Crowther (2006). Beyond high tech: Early adopters of open innovation in other industries. *R&D Management*, 36(3), 229–236.

Das, TK and BS Teng (1998). Resource and risk management in the strategic alliance making process. *Journal of Management*, 24(1), 21–42.

Das, TK and BS Teng (2000). A resource-based theory of strategic alliances. *Journal of Management*, 26(1), 31–61.

Eisenhardt, KM and C Bird Schoonhoven (1996). Resource-based view of strategic alliance formation: Strategic and social effects in entrepreneurial firms. *Organization Science*, 7(2), 136–150.

Freeman, C, GR Carroll and MT Hannan (1983). The liability of newness: Age dependence in organizational death rates. *American Sociological Review*, 48(5), 692–710.

Grant, RM and C Baden-Fuller (2004). A knowledge accessing theory of strategic alliances. *Journal of Management Studies*, 41(1), 61–84.

Gulati, R (1995). Social structure and alliance formation patterns: A longitudinal analysis. *Administrative Science Quarterly*, 40(4), 619–652.

Gulati, R (1998). Alliances and networks. *Strategic Management Journal*, 19(4), 293–317.

Gulati, R (1999). Network location and learning: The influence of network resources and firm capabilities on alliance formation. *Strategic Management Journal*, 20(5), 397–420.

Hagedoorn, J (1993). Understanding the rationale of strategic technology partnering: Interorganizational modes of cooperation and sectorial differences. *Strategic Management Journal*, 14(5), 371–385.

Hagedoorn, J and R Narula (1996). Choosing organisational modes of strategic technology partnering: International and sectoral differences. *Journal of International Business Studies*, 27(2), 265–284.

Hitt, MA, T Dacin, E Levitas, JL Arregle and A Borza (2000). Partner selection in emerging and developed market contexts: Resource-based and organizational learning perspectives. *The Academy of Management Journal*, 43(3), 449–467.

Lichtenthaler, U and H Ernst (2006). Attitudes to externally organising knowledge management tasks: A review, reconsideration and extension of the NIH syndrome. *R&D Management*, 36(4), 367–386.

Meeus, MTH, LAG Oerlemans and J Hage (2001). Patterns of interactive learning in a high-tech region. *Organization Studies*, 22(1), 145–172.

Meeus, MTH, LAG Oerlemans and J Hage (2004). Industry-public knowledge infrastructure interaction: Intra- and inter-organizational explanations of interactive learning. *Industry and Innovation*, 11(4), 327–352.

Miotti, L and F Sachwald (2003). Co-operative R&D: Why and with whom? An integrated framework of analysis. *Research Policy*, 32(8), 1481–1499.

Mowery, DC, JE Oxley and BS Silverman (1998). Technological overlap and interfirm cooperation: Implications for the resource-based view of the firm. *Research Policy*, 27(5), 507–523.

Nooteboom, B (1999). *Interfirm Alliances: Analysis and Design*. New York: Routledge.

Nooteboom, B, W Vanhaverbeke, GM Duysters, V Gilsing and A Van den Oort (2007). Optimal cognitive distance and absorptive capacity. *Research Policy*, 36(7), 1016–1034.

Powell, WW, KW Koput, DR White and J Owen-Smith (2005). Network dynamics and field evolution: The growth of interorganizational collaboration in the life sciences. *American Journal of Sociology*, 110(4), 1132–1205.

Pyka, A and P Saviotti (2001). Innovation networks in the biotechnology-based sectors. *Discussion papers*, Universitaet Augsburg, Institute for Economics.

Rothwell, R and M Dodgson (1991). External linkages and innovation in small and medium-sized enterprises. *R&D Management*, 21(2), 125–137.

Sakakibara, M (2002). Formation of R&D consortia: Industry and company effects. *Strategic Management Journal*, 23(11), 1033–1050.

Simon, HA (1957). *Models of Man: Social and Rational*. New York, John Wiley and Sons.

Smith Ring, P and AH Van de Ven (1992). Structuring cooperative relationships between organizations. *Strategic Management Journal*, 13(7), 483–498.

Smith Ring, P and AH Van de Ven (1994). Developmental processes of cooperative interorganizational relationships. *The Academy of Management Review*, 19(1), 90–118.

Stinchcombe, AL (1965). Social structure and organizations. In *Handbook of Organizations*, JG March (ed.), pp. 49–72. Chicago: Rand McNally & Company.

Street, CT and AF Cameron (2007). External relationships and the small business: A review of small business alliance and network research. *Journal of Small Business Management*, 45(2), 239–266.

Stuart, TE (1998). Network positions and propensities to collaborate: An investigation of strategic alliance formation in a high-technology industry. *Administrative Science Quarterly*, 43(3), 668–698.

Stuart, TE, H Hoang and RC Hybels (1999). Interorganizational endorsements and the performance of entrepreneurial ventures. *Administrative Science Quarterly*, 44(2), 315–349.

Supphellen, M, SA Haugland and T Korneliussen (2002). SMBs in search of international strategic alliances. Perceived importance of personal information sources. *Journal of Business Research*, 55, 785–795.

Teece, D (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, 15, 285–305.

Van de Ven, AH (1976). On the nature, formation and maintenance of relations among organizations. *The Academy of Management Review*, 1(4), 24–36.

Van der Valk, T (2007). Technology dynamics, network dynamics and partnering: The case of Dutch dedicated life sciences firms. Dissertation, Utrecht University.

Wernerfelt, B (1984). A resource-based view of the firm. *Strategic Management Journal*, 5(2), 171–180.

Yasuda, H (2005). Formation of strategic alliances in high-technology industries: Comparative study of the resource-based theory and the transaction cost theory. *Technovation*, 25(7), 763–770.

Yin, RK and KA Heald (1975). Using the case study survey method to analyze policy studies. *Administrative Science Quarterly*, 20(3), 371–381.