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Abstract

Small and medium sized enterprises (SMEs) are widely recognised as forming a vital set of actors within economies. Moreover, the interaction between industry and the public sector is generally highlighted as being a key factor in sustainable economic development and innovation-driven competitiveness. In this paper, we focus on this pattern and study SMEs and their collaboration activity with a large research and technology organisation (RTO) in Finland, VTT. We base our analysis on a comparison of two different collaboration strategies; maters and daters.

Half of the collaborating SMEs are conducting consecutive RTO cooperation (i.e. maters), while the other half have a more occasional relationship with the RTO (i.e. daters). We discover that the consecutive collaborators are, compared to the occasional ones, more often larger in firm and project size, have subtle growth, are active in patenting, are relatively older and are more R&D experienced. While the occasional collaborators are more often experiencing high growth, the consecutive collaborators dominate in the group of patenting and growing firms.

VTT's role in the Finnish innovation system is significant as it serves a relatively large share of SMEs from various sectors and across different size classes.

Contents

List of symbols

NIS	National Innovation System
RTO	Research and Technology Organisation
SME	Small and Medium-sized Enterprise
Tekes	Finnish Funding Agency for Technology and Innovation
VTT	Technical Research Centre of Finland

1. Introduction

1.1 Motives and aims

Small and medium-sized enterprises (SMEs) are widely recognised as forming a vital set of actors within economies. Similarly, a very high importance has been given to the role of technological development and innovation for long-term economic growth. Empirical evidence from Finland (Saarinen 2005) and the UK (Pavitt et al. 1987) shows, for instance, that smaller firms have increased toward the position of having generated a major share of innovations over the last decades. Hence, it is imperative to consider those elements of innovation systems affecting SMEs' ability to renew and thereby adapt to their business environment in the longer run. In the national innovation systems (NIS) literature, the interaction between industry and the public sector is generally highlighted as being a key factor in sustainable economic development and innovation-driven competitiveness. By contrast, both SMEs and research and technology organisations (RTOs), and particularly their interaction, are given a far less prominent place in this body of literature and even more so in empirical work in this vein.

In this paper, we focus precisely on this gap: the interaction between SMEs and a large RTO. We analyse the role of one of Northern Europe's largest RTOs – the Technical Research Centre of Finland (VTT) – for its SME customers in the light of their development. The main question we address is what are the characteristics of RTO – SME interaction in Finland? This is divided into more specific research questions as follows:

1. What kinds of SMEs and with what types of strategies practice RTO collaboration?
2. What is the role of VTT in the Finnish innovation system in the case of SMEs?
3. What is the relationship between collaboration, patents and growth over time, and is there an impact of various forms of collaboration?

1.2 Background

An NIS refers to " …a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts, which define new technologies" (Metcalfe 1995). The concept of national innovation system was introduced by Freeman (1987) in his work on the Japanese science and technology system and policy. As Edquist (2005) points out, there is a need to clarify the activities and components within innovation

systems, and the relationships between them. In his review, Edquist (pp. 190–91) distinguishes 10 activities generally deemed important in innovation systems (below). A priori, we can assign as much as all ten of these activities to VTT (i.e. not exclusively, of course), which underscores its qualitative significance as an RTO in the Finnish innovation system.

Functions and activities in innovation systems: (Source: Edquist 2005, pp. 190–91)

1	Provision of R&D, creation of new knowledge
2	Competence building (training/learning skills for innovation and R&D)
3	Formation of new product markets
4	Articulation of quality requirements for new products
5	Creating and changing organisations for development of new fields of innovation (e.g. entre- and intra-preneurship)
6	Networking, incl. Inter-organisational learning, integrating new knowledge elements
7	Creating and changing institutions (incl. environmental and safety regulations)
8	Incubating activities (facilities & support for new innovative efforts)
9	Financing of innovation processes, and activities supporting commercialisation of knowledge
10	Provision of consultancy services relevant to innovation processes (e.g. technology transfer, legal advice, commercial information)

The idea that hybrid, novel combinations of diverse resources underlie original innovation as laid down by Schumpeter (1934) continues to be seen as relevant (Fleming 2001). However, smaller sized firms' resource bases have a more limited capacity in this respect (Smith et al. 1991, Wolf & Pett 2006). Collaborative networks of organisations have been identified as an important vehicle for 'novel combinations' (e.g. Freeman 1991, Rothwell 1992), and are supportive for small firm growth as well as for the prerequisite competence building more directly (Macpherson & Holt 2007, Narula 2004). This reverberates the systemic, network-based view taken in the NIS literature. The distribution of collaborations has been found to be virtually equal across different sized groups of innovating firms in Finland (Saarinen 2005).

The role of RTOs, on the other hand, has been considered as providing services to firms in order to support innovation and enhance the competitiveness of industry (e.g. Hales 2001). In general, RTOs provide more practical industrial and business know-how than universities (e.g. Tann et al. 2002); although convergence with universities takes place

under policy pressures in the Finnish context for instance (Konttinen et al. 2006). NISs and the role of and conditions for RTOs within them are subject to continuous change, with ambiguous consequences for the role of RTOs for SMEs (Galli & Teubal 1997, Tan 1998, Diez 2000, Laredo & Mustar 2004, Konttinen et al. 2006).

Whereas Tann et al. (2002) studied RTO-SME interaction in the UK mainly from the RTO's perspective, our approach emphasises the SME side in more detail. We theoretically follow the seminal work of Penrose (Penrose 1995), in departing from the idea that the use and development of knowledge, configured as resources, significantly shape the trajectory of firm growth. Conceptually, we apply therefore the resulting Resource Based and Dynamic Capabilities Views (Helfat & Peteraf 2003, Teece et al. 1997, Wernerfelt 1984). We typify the patterns of external knowledge sourcing by SMEs from VTT, and link patterns of interaction to patterns of SME growth and innovative activity by SMEs. We are interested in positioning the role of VTT in strategies of creating de-novo capabilities or continue to build on extant capabilities for SMEs and in which way this relates to patterns of growth.

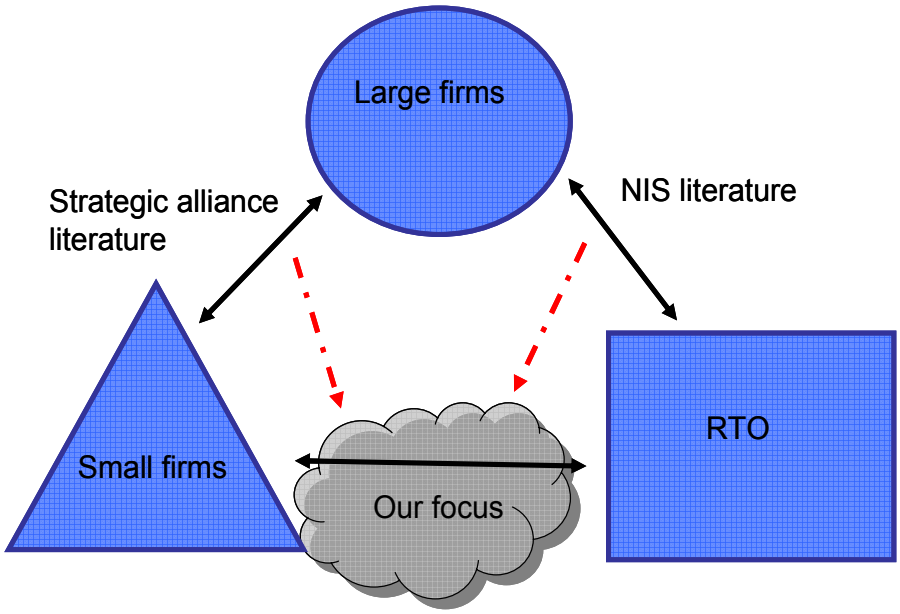

Figure 1. The focus of the study in the framework of RTOs, large and small firms.

2. The relationship of SMEs and RTOs in the innovation system

2.1 The big picture

After its introduction, the concept of a national innovation system (NIS) has proved to be useful in illustrating educational, scientific and technological structures and actors of countries, as was done by the Finnish National Council of Science and Technology since the triennial reviews of the early 1990s. Moreover it has given a framework for related innovation policy analysis in many countries (e.g. Lundvall 1992, Nelson 1993, Edqvist 1997, Saarinen 2001). In the literature, the NIS concept has developed particularly within the evolutionary economic community of researchers (e.g. McKelvey 1997). In almost twenty years, the analysis of NIS has developed essentially in different and versatile directions. The term NIS has been established in the empirical and theoretical terminology of innovation policy literature, although it has sometimes been replaced by such expressions as innovation infrastructure (e.g. Tassey 1992) or innovation environments. Some relevant epistemological analysis of the concept itself has also been made, although not too many (Miettinen 2002).

The next paragraphs will provide a short description of Finnish NIS. Special attention is paid to the role of innovating firms, and on the role of VTT in Finnish innovations.

Figure 2 illustrates the distribution of the size of innovating firms over time. As the figure shows, innovations have increasingly originated relatively more often from larger firms (more than 100 employees) compared with smaller ones. This was the case particularly during the period before the 1990s. For that period, the most innovative size class was the largest firms (800+ employees) with shares varying between 29 and 43 per cent. It was only once, during the five-year period 1955–59, when firms with 100–799 employees overtook this leading position with 36 per cent of the share. During the 1990s, the size group of 1–9 employees was largest with about a third of the innovations.

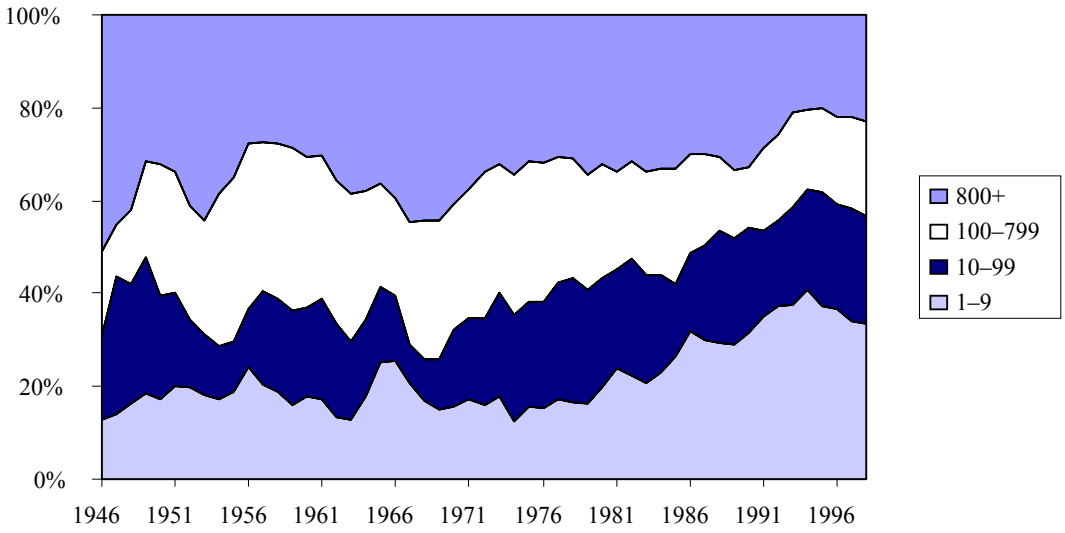

Figure 2. Size of innovating firms, number of employees. (Data and sources: Innovation database Sfinno).

In the years since the late 1960s, there can be seen a clear trend from the figure indicating a continuously increasing share of smaller firms with less than 100 employees and, on the contrary, larger firms had a decreasing share. Particularly, the biggest increase has been experienced by the firms with 1–9 employees, whose share has increased by twenty percentage units (from 15.6 to 35.5 per cent) since 1975 until the end of the studied period. This increase is important in the sense that it strengthens the significance of the object oriented method in innovation-related studies, particularly in small countries like Finland where the number of small firms is notable. In subject based innovation studies (like CIS), the group of firms with less than ten employees are neglected due to the high collection costs of the data. By excluding the group of firms with less than ten employees from the figure above, the conclusions to be drawn from the long industrial renewal of the Finnish industry would be something totally different.

Considering the increased role of small firms, a similar pattern was also noticed in the SPRU innovation data, in which the 1970s witnessed a clear change in trend (Tether et al. 1997). These results together coincide with the wider identification of the mid 1970s as a turning point in the economic role of smaller firms (Oakey 1993). Evidence both from the Finnish and British databases suggests that small firms are becoming an increasingly important source of innovation (Rothwell 1984, 1989). Hence, it should be kept in mind that, in different countries, there are some great variations in the categorisation of firms according to their sizes. In the Finnish context, firms with less than a hundred employees are considered as small and medium ones, whereas in the UK, the number of employees is 500.

2.2 The small picture: conceptualising 'the Firm'

The resource based view (RBV) can be regarded as an evolutionary economic theory of the firm, and therefore provides us with more detailed insights into its principal workings. After Schumpeter (1934, 1942) and Penrose (1995/1959) set the course, further development took place in the strategic management literature. The RBV of the firm conceptualises 'resources' as firm-specific attributes of both physical and knowledge-based, productive assets, which are developed over time and therefore harder to imitate, or to deploy by simply buying them in the markets (Helfat & Peteraf 2003, Teece et al. 1997, Wernerfelt 1984, Winter 2003). Firms display heterogeneous resource positions, which are conceived to be built up as a response to the idiosyncratic situations in which firms find themselves (Ahuja & Katila 2004). In order to create significant value, resources need to co-operate in synergetic bundles in the firm. Such resource bundles form the basis of idiosyncratic internal activities, referred to as routines, or competences (Teece et al. 1997). This makes firms also unique and distinctive from each other. Moreover, firms' resource positions and the competences developed around them are dynamic in that they change over time as an adaptive process in changing conditions. This dynamic adaptation occurs when firms find (through either deliberate search or more serendipitous discovery) and subsequently try to exploit the value of new resource combinations (Mathews 2002, Teece et al. 1997). This also creates the variety found among firms, given their distinctive paths of development. The ability of firms to adjust in this manner is referred to as 'dynamic capability' (Teece et al. 1997), and can take place in activities such as product development and inter-firm collaboration (Eisenhardt & Martin 2000, Eisenhardt & Schoonhoven 1996). Thus, of ultimate interest in this strand of firm-theoretic literature is a) the effect of idiosyncratic resource configurations, and b) how these unique bundles of resources are reconfigured over time as a process of dynamic adaptation by firms. A crucial organisational process therefore is learning, which occurs both in repetitions of existing activities, as well as in experimentation, both of which are important at different stages of the innovation processes. One potential consequence of more experimental or explorative learning is the identification of previously unseen opportunities (Teece et al. 1997), leading to new ideas.

The RBV traditionally has most of its concern within the boundary of the firm in that it treats firms as producing and exploiting their resources mainly endogenously. However, a number of publications in this strand (Das & Teng 2000, Eisenhardt & Martin 2000, Eisenhardt & Schoonhoven 1996, Lavie 2006, Teece et al. 1994) have also been concerned with the mobility aspects of resources such as resource-exchange or trading, as well as sharing resources both within and across the boundary of the firm. Thus, such a 'resource economy' (Mathews 2002) is illustrated by, e.g. external sourcing and strategic alliances by firms in inter-organisational relationships. Interestingly, then,

a firm does not necessarily need to own a resource any longer in order to encapsulate it in its activities and create value from it. The firm may choose to licence technology or in-source specialised services, for example, those of an RTO. This seems particularly relevant to SMEs, which frequently lack the financial- and man-power to perform complex and resourceful innovation work, which increasingly requires a multitude of technological competencies (Narula 2004).

Thus, creation of value is not only derived from constructing resource synergies from a given set's congruent exploitation (internal economies), but also depends on discovering new activities and virtuous knowledge-links by means of exploration in which search is a key activity on the long run. This is a way for firms to engage in combining innovation (Fleming 2001). As part of this, firms search for complementary resources from other firms or organisations (e.g. illustrated by Narula & Hagedoorn 1999), such as RTOs. The relationship between RTOs and SMEs therefore rises an important subject of inquiry for policy makers seeking insight into their 'innovation environment'.

2.3 SMEs and R&D collaboration

As mentioned above, companies' resources might be lacking in order to succeed in innovation activities. Therefore they are compelled to seek complementing resources from external sources and form inter-organisational alliances. These alliances can be created with several types of partners, e.g. customers, suppliers, universities or public sector organisations. Our study focuses on studying the characteristics of R&D collaboration between SMEs and RTOs, which in general is a less explored area whereas collaboration in SMEs is more vastly addressed in previous studies (e.g. Freel & Harrison 2006, Tether 2002).

The strategic management literature in general offers us a starting point to tackle the issue in question. In particular, the formation of strategic technology alliances gives some indication about the expectations of inter-organisational R&D collaboration even though our aim is not to analyse the formation and performance of alliances in detail.

Hagedoorn (1993) divides the motives for establishing strategic technology alliances into three groups directed at three different phases in the firm's innovation activities. Reducing or minimising the R&D costs and uncertainty are motives for alliance formation in the starting phase of an innovation development. This also includes motives such as acquiring complementary technology and accessing scientific knowledge. The second group of motives relates to the actual innovation process. It includes, e.g. technology transfer and leapfrogging, as well as reducing the length of innovation process. The last set of motives consists of those related to market access

and searching for opportunities, such as internationalisation, market entry and the expansion of product range. The differing motives also provide differing expectations for the structure of an alliance.

The several types of technology alliances can be classified according to their various characteristics including strategic depth and length. Investment intensive collaboration agreements like joint ventures, research corporations and minority investments have extensive strategic significance and are often long-lasting (Hagedoorn 1993). On the other hand, less investment-intensive contractual arrangements are usually relatively short term or for a fixed period. Examples of these types of alliances are R&D consortia, technology licensing, subcontracting in which strategic involvement is lower than, e.g. in joint venture agreements (Tidd et al. 1997).

Considering the depth of strategic technology alliances, it is reasonable to assume that collective learning and knowledge sharing will be enhanced in longer-term cooperation. This in turn would have a greater effect on a firm's performance. Several studies indicate the positive benefits between alliance participation and firm performance (see e.g. Stuart 2000, Hagedoorn & Schakenraad 1994). The findings of Stuart's (2000) study on high-technology companies demonstrate that smaller and younger companies benefit from innovative and large alliance partners more than older and larger firms. His main argument was that the strategic partner's abilities and resources rather than amount of alliances that a focal firm is affiliated with, has more importance for performance. Even though the results of Hagedoorn & Schakenraad (1994) do not support the straightforward link between strategic partnering and company performance, the results support the conclusions of Stuart's study above. They state that the use, e.g. learning and knowledge sharing, of technology alliance is more relevant to enhancing performance than merely the number of alliances. In addition, the size of the firm seems to reflect to the intensity of the alliance. In other words, larger companies are able to better seek and utilise external opportunities that strategic partnering offers.

2.4 Role of VTT in Finnish innovations

VTT is a public research organisation whose aim is to sustain and intensify the technological expertise of Finland, as well as to meet the needs for both private and public research and testing. It operates under the jurisdiction of the Ministry of Trade and Industry. (Konttinen et al. 2006)

One of the tasks appointed to VTT is to endorse the innovation activities and innovation environment of SMEs. However, according to Kutinlahti & Hyytinen (2002) several problems, such as differing operational cultures or lacking technological competences,

hinder this objective to materialise effectively. Smaller companies seek more routine tasks from VTT compared to larger firms that might create motivation and communication problems for researchers to serve SMEs. The same type of results came out from a study into the role of public research organisations in innovation networks in Barcelona, Vienna and Stockholm (Diez 2000). Smaller companies are not reached by research organisations.

During the last eleven years, VTT Innovation Studies has undertaken a large research project (the Sfinno-project) with the aim of providing a grassroots account of the rise in R&D expenditures through identifying and surveying a large number of innovations developed in Finland during the period 1945–2005. For the last two decades, the results indicate that the number of innovations has grown over time alongside the rise in R&D expenditure, particularly due to the entry of small innovative electronics- and ICT-related firms during the late 1990s. A majority of the innovations are novel both from the company and market perspective, and reach commercialisation and profitability remarkably quickly in less than 3 years on average.

This data also reveals the position that VTT has in Finnish R&D activity. Collaboration with VTT has been important for almost 20 per cent of the identified innovations. This highlights the role of VTT as an important mediator through collaboration with companies developing technologies for international markets. Moreover the role of VTT as a collaborative partner has increased over time as Figure 3 clearly shows.

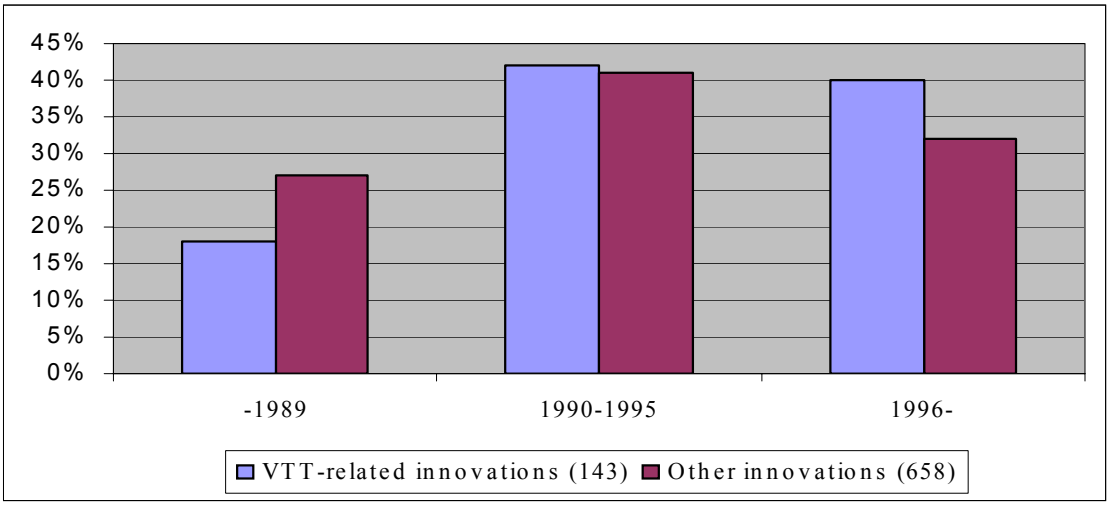

Figure 3. Share of innovations involving collaboration with VTT 1985–2000. (Data and sources: Innovation database Sfinno)

The importance of VTT as a collaborative partner raises the question whether there are some general features that characterise VTT-related innovations compared to others. The first issue that helps us to sketch some general features of VTT-related innovations

is whether there are some sectors or firms that have relatively more collaboration with VTT than others. Is the targeting of SMEs or strategic and pioneering new technologies reflected in the distribution of VTT-related innovations across product groups and firm size classes?

Collaboration with VTT seems to be pronounced within high-technology product groups such as electronics, where higher R&D-intensities implies greater scope for joint projects, compared to the less R&D-intensive product groups such as foodstuffs and metal products. Nonetheless, the relatively lower share of VTT-related innovations in software is surprising given that this product group has been the fastest growing since the mid 1990s.

The importance of VTT for the development of innovations decreases by firm size. For micro-firms with less than 10 employees, the share of VTT-related innovations is the highest, suggesting that start-up or spin-off firms are particularly viable customer groups. Large firms with over 100 employees consider collaboration with VTT as relatively less important.

In conclusion, the distribution of VTT-related innovations across product groups and firm size classes seems to be compatible with VTT's targeting of SMEs and new pioneering technologies in high-technology sectors, by and large. Nonetheless, collaboration also covers innovations from the more traditional sectors. The second interesting question is to what degree VTT-related innovations differ in their qualitative characteristics in terms of novelty, development times and commercial significance? These types of issues can be analysed through the related survey addressed by innovators at the innovating firms.

A common characteristic of VTT-related innovations is that they are developed in collaboration with a larger number of different partners compared to other innovations. These partners range from customers, subcontractors and competitors to consultants and universities. Moreover, VTT-related innovations are typically related to technology programmes funded by the Finnish Funding Agency of Technology and Innovation (Tekes). Over half of the VTT-related innovations were developed within technology programmes. In addition, the importance of new technologies or scientific breakthroughs, as well as the role of environmental issues and regulations, in the origin of innovation is highlighted compared to other innovations. This suggests that the role of VTT as a mediator between research and innovation has the greatest scope in rapidly changing scientific and technological fields, or product groups where environmental considerations and regulations induce innovation.

The significance of new technologies and scientific breakthroughs for VTT-related innovations is reflected in the novelty of those innovations. 55 per cent of VTT-related innovations have been completely new products, which are also new to the world market. The corresponding figure for other innovations is 45 per cent. On the other hand, in general, it takes longer for VTT-related innovations to reach commercialisation and profitability than for other innovations. This is in line with VTT-related innovations often embodying new technologies or scientific breakthroughs, and thus they probably also involve complex development work and larger investments.

3. Data and methods

In this paper, we define an SME as a privately owned company employing 249 persons at maximum following the Commission Recommendation[1] and exclude micro-enterprises having fewer than 10 employees. Furthermore, we focus on the biggest RTO in Finland, VTT Technical Research Centre of Finland, as a collaborative partner of SMEs.

We use various data sources for the empirical part of the study. There are four main sources that we apply in order to get answers to the research questions set above. Firstly, VTT's customer database[2] is used as our start-up data pool to identify a useful firm sample for deeper analysis as well as to provide basic firm-level data of the selected sample. More thorough firm-level information is obtained from Suomen Asiakastieto Oy[3], including financial data and employee figures. Thirdly, we exploit PRH's (National Board of Patents and Registration of Finland) PatInfo patent database[4] to get the patent data of the firms used in the study. Finally, more in-depth data is collected by carrying out a survey.

To construct our firm sample, we used the VTT customer database. We searched all of the companies (with the given firm size criterion) that had been a customer of VTT in 2005. This operation yielded an initial set of 1,687 SMEs. The second criterion in our data collection was the project size in 2005, which we used as a measure for the rate of interaction between VTT and the SME in question. By setting a minimum of 1,000 euro for the amount of money the firm had paid to VTT for its services, we excluded cases where practical collaboration did not exist, or where it can be considered to have been insignificant. There was found to be 1,066 small and medium -sized companies having relevant collaboration activity with VTT in 2005; the name of the CEO was available for 1,010 of them. We also removed public organisations and funding agencies, and ended up with a target population of 1,007 SMEs.

More detailed information on the nature of innovation activity of the studied SMEs was obtained from survey data concerning collaboration with VTT and particularly the

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[1] See Commission Recommendation of the Commission of European Communities 1996. (http://europa.eu.int/ISPO/ecommerce/sme/smedef_EN.pdf)

[2] VTT customer database covers all of the customer firms of VTT and includes basic information about them like firm name, company code, firm size, industry classification code and location.

[3] Suomen Asiakastieto Oy provides business and credit information of companies in Finland. (http://www.asiakastieto.fi/en/)

[4] PatInfo - The Finnish Patent Register contains basic data, procedural status, validity and payment information on Finnish patent applications filed since 1970 and utility model applications filed since 1992. (http://www.prh.fi/en.html)

development projects in 2005. The survey questionnaire was sent out to the CEOs of the firms in our target population via e-mail. After getting 281 error mails indicating the firms that were not reached, we conducted a double-check of the e-mail addresses in order to get them corrected. Still, 182 firms remained as not-contactable meaning that the survey questionnaire reached a total of 825 firms. With two reminder e-mails[5] sent to companies who had not yet answered, we were able to achieve a satisfying 21.2% response rate, resulting in a total of 175 respondent SMEs. In the present analysis and report, we apply the survey data to describe the innovation activity of the collaborating SMEs[6].

Characteristics related to the technological development of SMEs are identified by using patent count data to approximate the R&D intensity of the firms in the target population. A number of authors point to the closeness of patents to the outcome of R&D activity (Archibugi & Pianta 1996, Comanor & Scherer 1969, Griliches 1984, Pavitt 1985). As such, patents provide a proxy for the level of R&D. We count all applications and granted patents in Finland during the period 2000–2006, using PRH's patent database. As a measurement for firm size, we apply employment figures from VTT's customer database concerning the year of collaboration. In order to monitor firm growth, we use turnover figures from 2000–2005 and calculate the average growth over the years[7]. We recognise the possibility of acquisitions or mergers causing defective quality in growth figures and patent counts of some cases and exclude the cases where the firm code had changed between 2000 and 2005 as a result of the mentioned inorganic growth actions. The likelihood of small start-ups included in our study, with concerns of their probable high-growth aspect, is limited by the minimum firm size criterion. To compare our study group of SMEs by size and sector distribution, a 'peer group' of all SMEs in Finland is used. We also conduct a data description in order to see if there is any bias towards one size group or industry in our target and respondent groups. In our classification of collaboration strategy with the RTO, we use two firm categories. We name the first group 'consecutive collaborators', in which a firm is defined as having collaboration with VTT for the last four consecutive years where data is available (2002–2005). We label the second group as 'occasional collaborators', where firms have had no prior collaboration with VTT, or collaboration has not been consecutive over the four observed years. These firm groups are also referred to as 'maters' and 'daters', respectively. Table 1 describes the key variables of our data.

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[5] Survey was sent out in April 2007 and the follow-ups after this, each with a two weeks lag.

[6] More detailed information on the collaboration process, its results and the impacts for the firms are not discussed in the present publication. They are regarded as strategic information for VTT, and thus used for developing in-house strategy only.

[7] Only firms, for which turnover figures were available for at least four consecutive years, and thus a growth rate of not less than three years, are treated as reliable cases and included in analyses where growth is needed. All other cases are treated as no data available.

Table 1. The descriptives for some key variables.

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Project € size	1 007	1848246,29	1000,00	1849246,29	21965,56	85540,47
Average turnover 00-05	946	589539210,83	0,00	589539210,83	17796163,00	46509824,05
Average personnel 00-05	945	530,33	1,00	531,33	67,36	66,31
Patent count 00-06	1 007	64,00	0,00	64,00	1,04	3,71
Valid N (listwise)	940					

Before interpreting any results derived from the survey part of our study, it is useful to look at the representativeness of our respondents compared to our target population. To this end, we look at their commonly available data, and compare these 'key variables' between the groups of respondents and non-respondents to see if any significant differences occur in the frequency distributions between these two groups. As we cannot assume a normal distribution and have some ordinal variables, we apply non-parametric tests for this purpose, of which the results are presented in Tables 2 & 3 below. For the scale variable we use a Mann-Whitney test (A):

Table 2. Results Mann-Whitney Test(a).

	Consecutive yrs of collaboration	Project size in €	Turnover size class	Personnel size class	Average turnover growth	Average personnel growth	Average turnover 00-06	Average personnel 00-06
Mann-Whitney U	70 149,0	24 311,5	67 654,5	66 661,0	43 786,0	32 264,0	57 752,0	56 485,5
Wilcoxon W	417 510,0	371 672,5	82 879,5	81 886,0	296 902,0	227 889,0	69 998,0	68 575,5
Z	-0,723	-13,802	-1,446	-1,726	-1,874	-2,559	-1,240	-1,526
Asymp. Sig. (2-tailed)	0,469	0,000	0,148	0,084	0,061	0,010	0,215	0,127

For the grouped, ordinal key variables, we apply a Kolmogorov-Smirnov test for the same purpose (Table 3):

Table 3. Results Kolmogorov-Smirnov Test(a).

		Consecutive yrs of collaboration	Turnover size class	Personnel size class
Most Extreme Differences	Absolute	0,066	0,058	0,056
	Positive	0,066	0,000	0,000
	Negative	-0,017	-0,058	-0,056
Kolmogorov-Smirnov Z		0,795	0,694	0,674
Asymp. Sig. (2-tailed)		0,553	0,720	0,754

As can be seen from the tables above, the null hypothesis – namely that both groups of respondents and non-respondents are identical – cannot be rejected ($\alpha = 0.05$) for most of the variables. The only exceptions here are 'Average personnel growth' and 'Project size in €' (Asymp. Sig. < 0.05). The most central variable of our analysis, namely the number of consecutive years of collaboration, or 'dating vs. mating', fortunately comes out as one of the consistent features across our target population (N = 1007).

4. Results

4.1 Characteristics of SMEs collaborating with an RTO

We begin with the issue put forward in our first research question, and start our analysis by characterising SMEs in collaboration with an RTO. We use a peer group of Finnish SMEs to reveal what kinds of firms tend to collaborate with the RTO in question by industry and size. We also study other factors to characterise SMEs, including patenting, growth and project size. Throughout the analysis, our framework is based on the collaboration frequency of SMEs and we aim at revealing the characteristics of the daters and the maters, and whether dating really becomes mating.

When comparing the overall number of SMEs in Finland[8] and the number of cases in our firm sample, we notice that VTT had some interaction with almost 11% of all SMEs (initial data set) in Finland, and collaboration with some 6.5% (target population). This indicates that VTT is an active partner with a multitude of small and medium -sized firms, and it has a major role in the Finnish innovation system. It should be noted that these percentages only concern collaboration during the calendar year of 2005. If the studied period would be longer, the share of SMEs collaborating with VTT would most probably be even higher, given the fact that small companies, in general, have more limited resources to acquire external knowledge than large firms (see e.g. Narula 2004, North et al. 2001) and a more occasional need for development projects with an RTO. In other words, some small firm might have collaboration with VTT in 2004 and 2006, but not necessarily in 2005. This view is also supported by the fact that, while many SMEs have more or less permanent co-operation with VTT, there are a number of small and medium -sized enterprises executing only temporary projects with VTT. The high share of Finnish SMEs collaborating with VTT also implies that smaller firms are relatively willing to collaborate with VTT. This notion is in hand with the findings of the Sfinno-project, which stated that smaller firms regarded VTT as more important for the development of their innovations than larger firms did.

Table 4 shows that over half (51%) of the SMEs collaborating with VTT have been doing so for at least four consecutive years, from 2002 until 2005. This half of the firms refers to the maters, as they have consecutive collaboration with VTT. The other half, including firms having less constant collaboration (2 or 3 years), or more occasional collaboration within the last four years, is referred to as the daters. Quite accurately, in every other case, dating truly becomes mating and SMEs deepen their acquaintanceship

[8] There are 15,672 firms in Finland with personnel from 10 to 249. These figures are collected from Statistics Finland's StatFin -Online Service. (http://statfin.stat.fi/)

to a deeper, continuous relationship. This willingness of SMEs to engage strategic alliance and acquire external R&D has also been noted by Narula (2004).

Table 4. Daters and maters – Duration of collaboration in 2005 (consecutive years).

	1	2	3	> = 4	Total
Target population (N = 1007)	28%	13%	8%	51%	100%

In table 5 we illustrate the distribution of SMEs using Standard Industry Classification (SIC) and compare this between all firms in the economy and firm samples used in the study in hand.

Table 5. Sectoral distribution of SMEs.

	Total in Finland (N = 15672)	Initial set (N = 1687)	Target population (N = 1007)	Respondents (N = 175)
Total manufacturing	24%	48%	58%	60%
Electricity, gas and water supply	1%	2%	2%	5%
Construction	13%	14%	6%	3%
Wholesale and retail trade	21%	8%	8%	3%
Transport, storage and communication	8%	1%	2%	1%
Financial intermediation	2%	1%	1%	0%
Real estate and renting	3%	3%	2%	2%
Computer and related business activities	3%	3%	3%	5%
Research and development	0%	2%	3%	2%
Other business activities, e.g. testing, consultancy	10%	10%	10%	11%
Education	1%	2%	1%	1%
Other service activities, incl. health work	6%	4%	4%	6%
Other	7%	2%	1%	1%

A more thorough investigation of SME distribution by different industries reveals the nature of VTT as a collaborative RTO. In our initial set of 1,687 firms, the manufacturing sector is highly emphasised covering nearly half of the companies, while in Finland the manufacturing sector includes only a quarter of all SMEs. In the target population, which we defined as including firms with relevant collaboration activity, the share of manufacturing firms is even higher stressing the view that SMEs collaborating with an RTO have some sort of production activities. This is no surprise when thinking that manufacturing enterprises are generally seen as developing products and, in particular, process improvements, which in turn are related to SME growth and furthermore to profit (Wolff & Pett. 2006). From the RTOs perspective, the emphasis of manufacturing is in line with the findings of Diez (2000), who stated that, '... from the point of view of the research institutes, providing support for manufacturing firms is a very important issue'. As VTT is more focused on serving SMEs in the manufacturing sector, it is also needful to see if the share of SMEs across more specified manufacturing classes differs between RTO customers and the total in Finland. This comparison gives the same result than in the case of total manufacturing; SMEs throughout the variety of manufacturing industries are more eager to collaborate with

RTO than with firms in other sectors[9] . This also implies that VTT does not concentrate on some specified manufacturing technologies. The observation holds for all of the sample groups in the study; initial set, target population and respondents, and is no surprise when considering VTT's nature as a multidisciplinary technology organisation.

There are two obvious industries where VTT is not so active in collaborating with SMEs; Wholesale and retail trade, and Transport, storage and communication. In the first case, firms are not so tightly involved in developing technology, rather their core competences are based on logistics and marketing activities. In the second case, the argument of non-technology intensiveness holds more or less for transport and storage. In the construction industry, the gap between the share of VTT customers (initial set) and substantive collaborators (target population) shows that SMEs seem to have a mainly small-scale interaction with VTT rather than larger collaboration projects (over 1,000 €). This might be explained by their need for testing services, e.g. low-budget concrete strength testing.

When focusing on our study groups of SMEs, the overall sectoral distribution shows that we widely cover different industries, keeping in mind also that different manufacturing industries are well represented. Between the target population and the respondents, there does not seem to be significant bias towards one or two industries.

With our size criterion, there are 15,672 SMEs in Finland, which excludes over 200,000 micro firms (under 10 employees). Most of the SMEs in Finland are small, less than 20 people companies, and the number of firms' decrease when moving to size categories with a higher number of personnel (Table 6). SMEs in RTO collaboration are much more evenly distributed by their size. This shows that larger firms (over 49 employees) are more eager RTO collaborators than smaller ones, supporting the findings of Diez (2000).

Table 6. Size distribution of SMEs by employees.

	10–19	20–49	50–99	100–249	Total
Total in Finland (N = 15672)	54%	31%	9%	6%	100%
Initial set (N = 1687)	23%	32%	22%	23%	100%
Target population (N = 1007)	22%	33%	22%	23%	100%
Consecutive collaborators (N = 508)	*18%*	*31%*	*24%*	*27%*	*100%*
Occasional collaborators (N= 499)	*26%*	*35%*	*20%*	*19%*	*100%*
Respondents (N = 175)	26%	34%	22%	18%	100%
Consecutive collaborators (N = 94)	*24%*	*30%*	*27%*	*19%*	*100%*
Occasional collaborators (N = 80)	*28%*	*39%*	*16%*	*17%*	*100%*

[9] The eagerness of technology-based firms in seeking external advice to support their innovation process has also been noted by North et al. 2001.

In our sample group, only the category of 20–49 personnel is slightly emphasised, but in general it can be argued that our firm sample covers all of the firms from 10 to 249 employees quite well. Neither the small companies nor the larger ones are dominating and thus it is justified to talk of SMEs when analysing our results, and not only SEs or MEs. Size distribution across our datasets in the study remains relatively stable. Only in the respondent firms, the shares of the smallest and the largest firms – compared to target population – are one step closer to the distribution of SMEs in the whole economy.

Following the issue placed in our title, we study the differences between consecutive and more occasional collaborators in different firm characteristics. When looking at the firm size in our target population sample, we see that larger SMEs are relatively more eager to engage in sustainable RTO collaboration, whereas in the smallest size-group at hand, firms tend to have more temporary collaboration with an RTO. The same phenomenon is repeated in the respondent group; larger firms with 50 to 249 employees are relatively more often consecutive RTO collaborators and smaller firms more occasional collaborators.

The size factor is highlighted even more between consecutive and occasional collaborators, when considering the project size of SME-RTO collaboration. As table 7 illustrates, in the smallest project size category, occasional collaborators are clearly dominating. In the last four categories, including firms that had a co-operation project costing over 10,000 euro, the continuous collaborators are slightly more active. In the biggest project category counted by firm count (2,001–10,000 €), collaboration continuation does not seem to make a distinction between firms.

Table 7. Project size of SME-RTO co-operation in 2005.

	1 000– 2 000 €	2 001– 10 000 €	10 001– 25 000 €	25 001– 50 000 €	50 001– 100 000 €	100 001– €	Total
Target population (N = 1007)	20%	46%	17%	9%	4%	4%	*100%*
Consecutive collaborators (N = 508)	*12%*	*46%*	*19%*	*13%*	*5%*	*5%*	*100%*
Occasional collaborators (N = 499)	*28%*	*46%*	*15%*	*5%*	*4%*	*3%*	*100%*

In our analysis of firm growth during the period 2000–2005, there were data for 848 firms available. The distribution of these firms, divided into daters and maters, is displayed by average growth in Table 8. From this table, we see that 19% of SMEs in RTO collaboration had negative growth and 81% positive. The share of negative growth firms is quite low, at least when comparing to the SME group of Tekes' customers in which as many as 39% of firms had negative growth (Autio et al. 2007). SMEs in RTO collaboration have usually been growing already before the collaboration or at the same time. The most surprising result in the growth of SMEs is that in the high-growth group over 30%), the daters seem to be dominating. The cause of this is a bit difficult to piece

together[10], because one might think that it is precisely the other way around and the maters in continuous collaboration with an RTO would be growing fast when constantly developing their technology, acquiring new knowledge and resources, and widening their network and possibly even markets. In the most usual growth category of RTO collaborative SMEs (under 10%), the consecutive partners are dominating, indicating that continuous RTO collaboration is relatively slightly more probable to go hand in hand with a positive and steady growth of under 10% a year.

Table 8. Firm growth of SMEs in 2000–2005.

	Under 0%	Under 10%	Under 20%	Under 30%	Over 30%	Total
Target population (N = 848)	19%	38%	22%	7%	15%	100%
Consecutive collaborators (N = 456)	*20%*	*40%*	*21%*	*7%*	*12%*	*100%*
Occasional collaborators (N = 392)	*18%*	*34%*	*23%*	*7%*	*18%*	*100%*

The group of mater firms, who had continuous RTO collaboration in 2002–2005, have been more active in patenting in 2000–2006 than the group of temporary dater firms (Table 9). The biggest differences between the distribution of the daters and the maters are in non-patenting category and high-patenting category. In consecutive collaborators, there are relatively more firms who have 4 or more patents, while the occasional collaborators are more likely to have zero patents. This indicates that there is a correlation between collaboration strategy and patenting, whether it is seemingly small or not is impossible, at least at this point of study, to say which one is the cause of the other.

Table 9. Patenting of SMEs.

	0 patents	1 patent	2 patents	3 patents	4 or more patents	Total
Target population (N = 1007)	77%	8%	4%	3%	8%	100%
Consecutive collaborators (N = 508)	*74%*	*8%*	*5%*	*3%*	*10%*	*100%*
Occasional collaborators (N = 499)	*81%*	*9%*	*2%*	*3%*	*5%*	*100%*

In our survey, we acquired firm-specific information on SMEs collaborating with an RTO. Table 10 displays aggregate values of the year of establishment and starting years of some innovation activities of the daters and the maters[11]. The consecutive collaborators are, on average, five years older than their peers. This finding is well in line with the previous findings on the typical characteristics of 'the maters', that is they are relatively more often larger firms and have a lower yearly growth rate. When focusing on the aggregate years of starting different innovation activities, the average

[10] Because all of the firms for which growth was calculated are at least four years old, there are no start-ups in the group which would otherwise be quite an obvious reason for the high-growth of occasional collaborators.

[11] In calculating the aggregates, all unreliable values like 0 and 1, were excluded.

and median values tell the same story. The maters (consecutive collaborators) started their R&D activities earlier and introduced the first product some years sooner than the daters (occasional collaborators). Thus, it is also obvious that firms in both of the groups are on average relatively experienced in development activities and have been involved in R&D for over 15 years. Both firm groups have also started exporting quite a while ago, on average. The pattern repeats itself in VTT collaboration. The SMEs being in continuous relationship with the RTO nowadays had their first RTO collaboration sooner than the present day temporary collaborators. But neither one of the firm groups are newcomers to VTT collaboration. On the contrary, an average mater-SME had its first co-project with VTT over fifteen years ago, and an average dater not so many years later. This draws us to the conclusion that whether the collaboration is constant or temporary, the first steps of the acquaintanceship have usually been taken a long time ago. It also arouses the question that are even those companies that did not have more than one year of consecutive collaboration with VTT (28% of the 1,007 firms; see table 4) seeking RTO collaboration for the first time? In other words, is it mostly the SMEs that have previous experience in RTO collaboration that keep coming back for further R&D collaboration, or are there new partners as well?

Table 10. Year of establishment and maturity of different innovation activities of SMEs.

	Year of establishment (N = 9 70)	R&D started (N = 100)	First product (N = 74)	Export started (N = 60)	VTT collaboration started (N = 86)
Average value					
Consecutive collaborators	*1981*	*1990*	*1988*	*1990*	*1991*
Occasional collaborators	*1986*	*1992*	*1994*	*1994*	*1994*
Median value					
Consecutive collaborators	*1989*	*1991*	*1991*	*1991*	*1994*
Occasional collaborators	*1990*	*1993*	*1995*	*1995*	*1998*

As shown in Table 11, on average, the consecutive collaborators are more intensive in research and development activities, and more eager to outsource them. Interestingly, the median values of R&D's share of turnover indicate quite the opposite. That is, the occasional collaborators have slightly higher relative investments in R&D than the occasional ones. Otherwise, the maters are on average more R&D-oriented. One output measure for R&D intensity of the maters, as already dealt with, was their higher rate of patenting compared to the daters. The higher rate of R&D outsourcing of the consecutive RTO partners is, of course, one of the results of continuous collaboration itself, which requires R&D investments allocated outside the company boundaries. This was brought up in the case of the project size of the RTO collaboration, in which the consecutive collaborators were discovered to have had larger projects with VTT, on average. The money paid to VTT is a part of outsourced R&D and thus affects the share of R&D conducted outside the company.

Table 11. Share of R&D and outsourced R&D of SMEs.

	R&D of turnover, % (N = 93)	Outsourced R&D of total R&D, % (N = 92)
Average value		
Consecutive collaborators	*8.4*	*16.3*
Occasional collaborators	*6.1*	*13.8*
Median value		
Consecutive collaborators	*3.3*	*5.0*
Occasional collaborators	*3.7*	*1.3*

4.2 The relationship of collaboration strategy, patenting and growth

Our comparison of different collaboration strategies continues by interlinking them with patenting and firm growth. As previously discovered, the consecutive collaborators are relatively more probable patenters and more often have less growth. The second group of firms, having occasional co-operation, are relatively greater in the high-growth category but have not had patents in the new millennium as often. The relation of these two factors, patenting and growth, in different collaboration strategies reveals an interesting pattern illustrated in Figure 4.

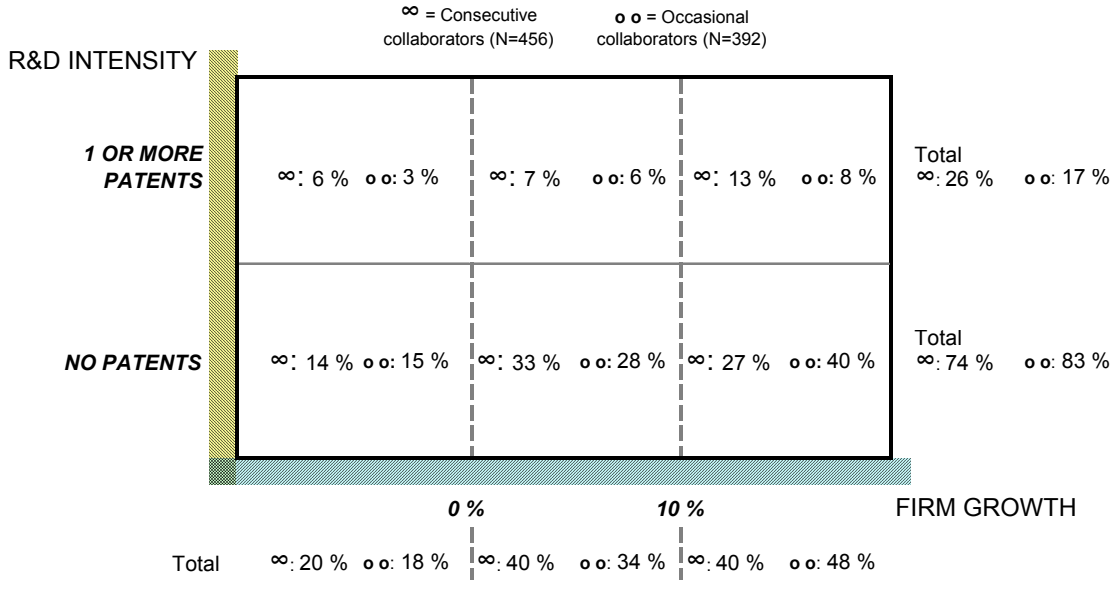

Figure 4. Distribution of the maters and the daters by patenting and growth.

When we look at the upper division of Figure 4, i.e. patenting firms, we see that a different collaboration strategy has a different linkage with firm growth. There is no obvious rise in firm shares when concentrating on consecutive collaborators and moving

from negative to positive growth, but it occurs in the category of over 10 per cent average growth. There, in the upper right corner of the figure, the continuous collaborators are dominating and this group of firms is actually as big as all the other continuous, patenting collaborators together (upper left box and upper middle box). In the non-patenting category of consecutive collaborators, the largest share of firms have a growth of 0 to 10 per cent, on average, and not over 10 per cent like in the case of patenting firms. Thus it is justified to argue that the maters, who are constantly executing RTO collaboration, are relatively more involved in creating new technology and are, at the same time, experiencing greater firm growth, compared to the daters.[12]

For occasional collaborators, patenting and high growth does not seem to have as strong positive relation. However, the share of RTO-daters has a somewhat positive correlation to growth in general in both, non-patenting and patenting categories. When moving towards a higher growth, the share of firms increases in both cases. Interestingly, the biggest group of occasional collaborators is the one having no patents, but a growth over 10 per cent. The differences in firm distribution, between patenting and non-patenting in the high growth section, are considerable for maters and daters. In maters, one third of high growth firms have patents, while in daters the same ratio is one to six. Hence, even when occasional collaborators tend to have higher growth than consecutive ones, they are not nearly as R&D intensive.

While patenting and firm growth have a positive correlation in both groups of collaboration strategies of SMEs, in consecutive collaborators the correlation is stronger, particularly in terms of high growth and patenting. This observation means that neither the patenting, nor the consecutive collaboration alone lead to rapid growth, but concurrently they have a stronger link with high growth. Continuous RTO collaboration or patenting is not, by far, the only or even the primary seed to be planted in order to grow firm size. This is shown in the case of firms that do not patents and practice more or less temporary RTO collaboration, but still have high growth. These companies form also the largest firm group (40%) in figure 4. One explanation for the dominance of daters in high growth firms can be the fact that it is only their recent growth, that has provided resources and need for RTO collaboration. Thus, they have engaged RTO collaboration and aim at developing novel knowledge in order to continue growing.

[12] In this figure we do not monitor the effect of a firm's sector, size or any other variable, which might affect these results. For instance, in some sectors, patenting and growth can have a much stronger correlation than in some other ones.

4.3 The project size of SMEs in relation to patenting and growth

From the RTO's perspective, one of the most interesting issues is the size of projects that companies are conducting with it. As defined in our study, the bigger the project is, the more turnover it generates for the RTO. Thus it is necessary to look at what types of SMEs execute larger projects, which are presumably the most desirable for the RTOs. Figure 5 displays the average and median values of the project size in RTO-SME collaboration by patenting and firm growth of SMEs.

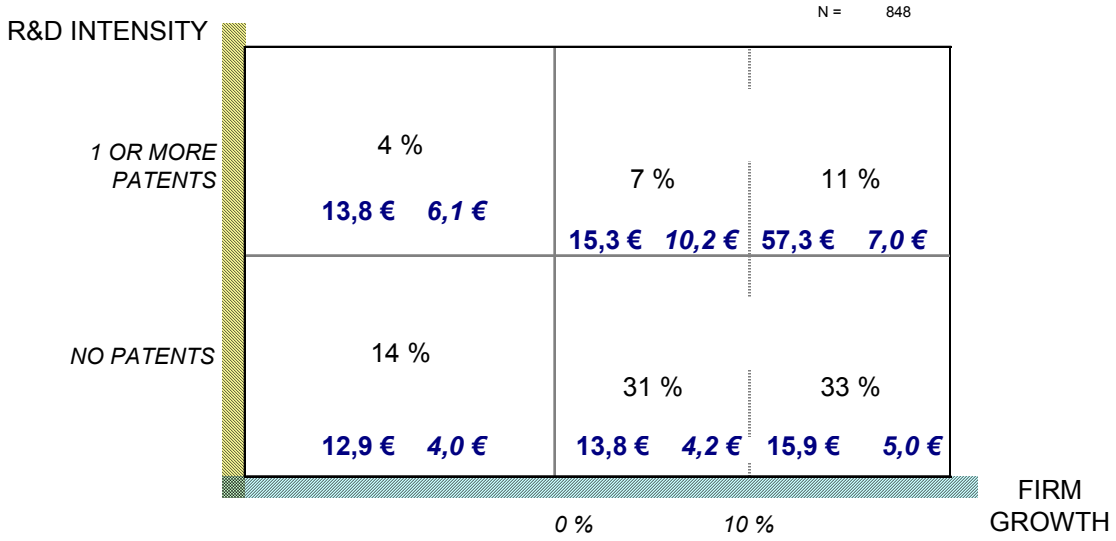

Figure 5. Share of firms (%), average project size (in blue, in thousands €) and median project size (in blue and italic, in thousands €) by growth and patenting.

As we can see from project size figures, the average and median values tell quite a similar story; R&D intensive growth firms have larger collaboration projects with the RTO compared to other firms. The average project of patenting high-growth firms (> 10% growth), 57.3 k€, is approximately four times as big as the average project conducted by the rest of the SMEs. As this figure can be affected by the few, extremely large projects, it is necessary to look at the median values as well. Of the median values we note that largest projects are implemented by patenting firms with modest growth (0...10%), 10.2 k€. Overall, it can be stated that R&D intensive firms tend to have larger RTO projects, and, in particular, the R&D intensive SMEs with positive firm growth.

5. Concluding discussion

This study reveals the firm characteristics of SMEs in different types of RTO collaboration strategies – consecutive and occasional collaboration – as well as their relationship with patenting (R&D intensity) and growth. It also sheds more light on the role of the biggest RTO in Finland in terms of the share, and the types of SMEs it cooperates with.

In this study, we concentrated on a large multidisciplinary RTO in Finland, namely VTT, and its SME customers. There are some typical characteristics of small and medium -sized companies that collaborate with VTT. First of all, half of the SME customers conduct a constant collaboration with the RTO in question on a yearly basis. The other half of the firms tend to have more occasional cooperation not having significant R&D collaboration consecutively with VTT. We called this phenomenon the dating of an RTO and an SME becomes mating roughly in every other case.

5.1 Collaboration strategies of SMEs

We typified two separate strategies that SMEs implement in their collaboration with VTT, based on the frequency and consecutiveness of the relationship. We called the group of consecutive collaborators 'the maters' and the group of more short-term or occasional collaborators 'the daters'. These groups have specific firm characteristics, which were compared across the intensiveness of collaboration with VTT. A 'mater', that has had an on-going collaboration with the RTO for at least last four years, is typically more often:

- A larger SME by number of employees
- Having larger RTO co-projects in terms of investments
- Growing less than 10% per year
- Active in patenting
- Slightly older and more R&D experienced company
- More R&D intensive firm and outsourcing a higher share of R&D.

While a typical 'dater', that has had occasional or short-term collaboration with the RTO, is relatively more often characterised as:

- A firm with under 50 employees
- Having relatively small projects with the RTO
- Having higher firm growth

- A non-patenting firm
- Established a few years later, more inexperienced in R&D but not a newcomer in RTO collaboration
- Less R&D oriented firm.

Our examination of the relationship of collaboration strategy, R&D intensity and firm growth revealed interesting results. Firstly, consecutive RTO collaboration does not guarantee firm growth for an SME as such. Patenting and firm growth have a positive correlation in both groups of the collaboration strategies of SMEs, but the correlation is stronger for consecutive collaborators. In other words, continuous RTO collaboration, R&D intensity and high firm growth seem to be linked and occur more within the same context. Secondly, the occasional RTO collaborators that are not R&D intensive in terms of patenting, are still more often experiencing high growth. For the 'daters', the R&D intensity did not have as strong correlation with high growth.

5.2 The role of VTT

VTT is an active partner for the SMEs in Finland having as much as 11% of all the companies employing 10 to 249 people as a customer in 2005. Over 6% of Finnish SMEs have relevant R&D collaboration (over 1,000 € projects) with VTT. A big share of these companies belongs to the manufacturing sector, but they are not concentrated to any specific industry class or technology. Thus, VTT's nature as a multidisciplinary RTO is reflected in the firm group it serves. Most of the collaborative companies have continued or restarted previous R&D activity with VTT, indicating that the collaboration is rarely a new relationship. Half of the customer SMEs are in consecutive interaction with VTT.

VTT does not seem to focus on any firm group in terms of size, but has roughly as many small customers as it has medium ones, and the same again falling between these. Comparing to the size distribution of all Finnish SMEs, larger SMEs are relatively more active in collaborating with VTT. Most of the VTT-SME projects are relatively small in terms of money, under 10,000 euro per year, but the large projects of over 100,000 euro per year are not excluded. Patenting and growing SMEs have larger projects with VTT than other SMEs.

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References

Ahuja, G. & Katila, R. 2004. Where do resources come from? The role of idiosyncratic situations. Strategic Management Journal, Vol. 25, No. 89, pp. 887–907.

Archibugi, D. & Pianta, M. 1996. Measuring technological change through patents and innovation surveys. Technovation, Vol. 16, pp. 451–468.

Autio, E., Miikkulainen, K. & Sihvola, I. 2007. Innovative growth firms (in Finnish), Teknologiakatsaus 201/2007. TEKES, Helsinki.

Comanor, W.S. & Scherer, F.M. 1969. Patent Statistics as a Measure of Technical Change. The Journal of Political Economy, Vol. 77, pp. 392–398.

Das, T.K. & Teng, B.S. 2000. A Resource-Based Theory of Strategic Alliances. Journal of Management, Vol. 26, No. 1, pp. 31.

Diez, J.R. 2000. The Importance of Public Research Institutes in Innovative Networks – Empirical Results from the Metropolitan Innovation Systems Barcelona, Stockholm and Vienna. European Planning Studies, Vol. 8, No. 4, pp. 451–463.

Edquist, C. 2005. Systems of Innovation. Perspectives and Challenges. In: The Oxford Handbook of Innovation. Fagerberg, J., Nelson, R.R. & Mowery, D.C. (Eds.). Oxford University Press, New York, NY. Pp. 181–208.

Edqvist, C. (Ed.). 1997. Systems of Innovation. Technologies, Institutions and Organizations, Pinter.

Eisenhardt, K.M. & Schoonhoven, C.B. 1996. Resource-Based View of Strategic Alliance Formation: Strategic and Social Effects in Entrepreneurial Firms. Organization Science, Vol. 7, No. 2, pp. 136–150.

Eisenhardt, K.M. & Martin, J.A. 2000. Dynamic capabilities: what are they? Strategic Management Journal, Vol. 21, No. 10–11, pp. 1105–1121.

Fleming, L. 2001. Recombinant uncertainty in technological search. Management Science, Vol. 47, No. 1, pp. 117.

Freel, M.S. & Harrison, R. 2006. Innovation and Cooperation in the Small Firm Sector: Evidence from Northern Britain. Regional Studies, Vol. 40, No. 4, pp. 289–305.

Freeman, C. 1991. Networks of innovators: A synthesis of research issues. Research Policy, Vol. 20, No. 5, pp. 499–514.

Freeman, C. 1987. Technology Policy and Economic Performance: Lessons from Japan. Pinter: London.

Galli, R. & Teubal, M. 1997. Paradigmatic Shifts in National Innovation Systems. In: Systems of Innovation. Technologies, Institutions and Organizations. Edquist, C. (Ed.). Pinter: London. Pp. 342–370.

Griliches, Z. 1984. R and D, Patents, and Productivity. University of Chicago Press, Chicago, IL.

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

Hagedoorn, J. & Schakenraad, J. 1994. The effect of strategic technology alliances on company performance. Strategic management journal, 15(4), 291–311.

Hales, M. 2001. Birds were dinosaurs once – The diversity and evolution of research and technology organisations. RISE final report, CENTRIM Brighton.

Helfat, C.E. & Peteraf, M.A. 2003. The dynamic resource-based view: capability lifecycles. Strategic Management Journal, Vol. 24, No. 10, pp. 997–1010.

Konttinen, J., Hyytinen, K. & Hyvönen, J. 2006. The Impact of Public Research Organisation on Firm's Innovation Process. Conference Paper edn, Innovation pressure, International ProAcy Conference, Tampere, Finland.

Kutinlahti, P. & Hyytinen, K. 2002. VTT:n yhteiskunnalliset vaikutukset. VTT Research Notes 2176, Espoo. 58 p. + app. 2 p. http://www.vtt.fi/inf/pdf/tiedotteet/2002/T2176.pdf.

Laredo, P. & Mustar, P. 2004. Public sector research: A growing role in innovation systems. Minerva, Vol. 42, pp. 11–27.

Lavie, D. 2006. The Competitive Advantage of Interconnected Firms: an Extension of the Resource-Based View. The Academy of Management Review, Vol. 31, No. 3, pp. 638–658.

Lundvall, B.-A. (Ed.). 1992. National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning, Pinter Publishers, London.

Macpherson, A. & Holt, R. 2007. Knowledge, learning and small firm growth: A systematic review of the evidence. Research Policy, Vol. 36, No. 2, pp. 172–192.

Mathews, J.A. 2002. A resource-based view of Schumpeterian economic dynamics. Journal of Evolutionary Economics, Vol. 12, No. 1, pp. 29–54.

McKelvey, M. 1997. Using Evolutionary Theory to Define Systems of Innovation. In: Edqvist, C. (Ed.). Systems of Innovation, Technologies, Institutions and Organizations. Pinter. Pp. 200–222.

Metcalfe, S. 1995. The Economic Foundations of Technology Policy. In: Stoneman, P. (Ed.). Handbook of the Economics of Innovation and Technological Change. Blackwell, Oxford.

Miettinen, R. 2002. Scientific concept or political rhetoric? Helsinki: Edita.

Narula, R. & Hagedoorn, J. 1999. Innovating through strategic alliances: Moving towards international partnerships and contractual agreements. Technovation, Vol. 19, No. 5, pp. 283–294.

Narula, R. 2004/2. R&D collaboration by SMEs: new opportunities and limitations in the face of globalisation. Technovation, Vol. 24, No. 2, pp. 153–161.

Nelson, R.R. (Ed.). 1993. National Innovation Systems. A Comparative Analysis. Oxford University Press.

North, D., Smallbone, D. & Vickers, I. 2001. Public sector support for innovating SMEs. Small Business Economics, Vol. 16, No. 4, pp. 303–317.

Oakey, R. 1993. High technology small firms: A more realistic evaluation of their growth potential. In: Karlson, B., Johannison, B. & Storey, D. (Eds.) Small Business Dynamics: International, National and Regional Perspectives. Routledge, London.

Pavitt, K., Robson, M. & Townsend, J. 1987. The Size Distribution of Innovating Firms in the UK: 1945–1983. The Journal of Industrial Economics, Vol. 35, No. 3, pp. 297–316.

Pavitt, K. 1985. Patent Statistics as Indicators of Innovative Activities: Possibilities and Problems. Scientometrics, Vol. 7, No. 1, pp. 77–99.

Penrose, E.T. 1995/1959. The Theory of the Growth of the Firm. Third Edition edn, Oxford University Press, Oxford.

Rothwell, R. 1984. The role of small firms in the emergence of new technologies. Omega, Vol. 12, No. 1, pp. 19.

Rothwell, R. 1989. Small firms, innovation and industrial change. Small Business Economics 1(1): 51–64.

Rothwell, R. 1992. Successful industrial innovation: critical factors for the 1990s'. R&D Management, Vol. 22, No. 3, pp. 221–239.

Saarinen, J. 2005. Innovations and Industrial Performance in Finland 1945–98. Almqvist & Wiksell International, Stockholm, Sweden.

Saarinen, J. 2001. From mass-production to knowledge-based industries: Introducing the Finnish National Innovation Systems. Summer School European Historical Economics Society Structural Change in Historical Perspective: The Role of Institutions. Trinity College. Dublin, IR, 21–25 Aug. 2001.

Schumpeter, J.A. 1942. The Process of Creative Destruction. In: Capitalism, Socialism and Democracy. Schumpeter, J.A. (Ed.) (1976) edn. HarperPerennial, New York, NY. Pp. 81–86.

Schumpeter, J.A. 1934. The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle. Third printing, 1963 edn, Oxford University Press, New York, USA.

Smith, H.L., Dickson, K. & Smith, S.L. 1991. There are two sides to every story: Innovation and collaboration within networks of large and small firms. Research Policy, Vol. 20, No. 5, pp. 457–468.

Stuart, T.E. 2000. Interorganizational Alliances and the Performance of Firms: A Study of Growth and Innovation Rates in a High-Technology Industry. Strategic Management Journal, Vol. 21, No. 8, pp. 791–811.

Tan, H.B. 1998. The contribution which RTOs make to innovation and competitiveness among SMEs in UK industry. Online:
http://www.sbaer.uca.edu/research/1998/ICSB/r007.htm.

Tann, J., Platts, A.E. & Stein, J. 2002. The Roles of Independent Research and Technology Organizations in the United Kingdom's Technology Transfer Mechanism to SMEs'. Technology Analysis and Strategic Management, Vol. 14, No. 2, pp. 241–249.

Tassey, G. 1992. Technology, Infrastructure and Competitive Position. Kluwer Academic Publishers.

Teece, D.J., Pisano, G. & Shuen, A. 1997. Dynamic capabilities and strategic management. Strategic Management Journal, Vol. 18, No. 7, pp. 509–533.

Teece, D.J., Rumelt, R., Dosi, G. & Winter, S. 1994/1. Understanding corporate coherence: Theory and evidence. Journal of Economic Behavior & Organization, Vol. 23, No. 1, pp. 1–30.

Tether, B. 2002. Who co-operates for innovation, and why: An empirical analysis. Research Policy, Vol. 31, No. 6, pp. 947–967.

Tether, B., Smith, I. & Thwaites, A. 1997. Smaller enterprises and innovation in the UK – the SPRU innovations database revisited. Research Policy, Vol. 2, pp. 19–32.

Tidd, J., Bessant, J. & Pavitt, K. 1997. Managing innovation; Integrating technological, market and organizational change. Chichester: John Wiley & Sons.

Wernerfelt, B. 1984. A Resource-Based View of the Firm. Strategic Management Journal, Vol. 5, No. 2, pp. 171–180.

Winter, S.G. 2003. Understanding dynamic capabilities. Strategic Management Journal, Vol. 24, No. 10, pp. 991–995.

Wolff, J.A. & Pett, T.L. 2006. Small-Firm Performance: Modeling the Role of Product and Process Improvements. Journal of Small Business Management, Vol. 44, No. 2, p. 268.

Appendix 1: Integrated datasets

VTT customer data: project size, firm size, SIC-code, location, prior VTT collaboration (2002–2004)

Collected patent data (applications + granted patents in Finland) for all firms for period 1960–2006 (source: PRH)

Financials, employee figures, (2000–2005), SIC-classification, number of business units, birth + exit -data of firm, geographical data (source: Asiakastieto Ltd.)

Survey data (Company information and characteristics of innovation activity)

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Dating or mating?
On the relationship of SMEs with an RTO in Finland

Abstract

Small and medium -sized enterprises (SMEs) are widely recognised as forming a vital set of actors within economies. Moreover, the interaction between industry and the public sector is generally highlighted as being a key factor in sustainable economic development and innovation-driven competitiveness. In this paper, we focus on this pattern and study SMEs and their collaboration activity with a large research and technology organisation (RTO) in Finland, VTT. We base our analysis on a comparison of two different collaboration strategies; maters and daters.

Half of the collaborating SMEs are conducting *consecutive* RTO cooperation (i.e. maters), while the other half has a more *occasional* relationship with the RTO (i.e. daters). We discover that the consecutive collaborators are, compared to the occasional ones, more often larger in firm size and project size, have subtle growth, are active in patenting, are relatively older and more R&D experienced. While the occasional collaborators are more often experiencing high growth, the consecutive collaborators dominate in the group of patenting and growing firms.

VTT's role in the Finnish innovation system is significant as it serves a relatively large share of SMEs from various sectors and across different size classes.

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This study examines the relationship between small and medium -sized enterprises (SMEs) and a large research and technology organisation (RTO). It explores the importance of our case RTO in the national innovation system (NIS) framework. By searching the origins of relationship and by analysing the collaboration strategies, the study reveals the types of firms collaborating with the RTO. In addition, there is a clear relationship between patenting, growth and the collaboration strategies of SMEs.

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