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R&D Collaboration by SMEs: new opportunities and limitations in the face of globalisation

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Abstract

Globalisation has systemically affected the way all firms undertake innovation. First, there has been a growing use of non-internal technology development, both by outsourcing and strategic alliances. Second, products are increasingly multi-technology. This has led to the growing use of networks by all firms, previously a primary competitive advantage of SMEs. These developments have created both opportunities and threats for the SME. On the one hand, large firms have increasingly sought out SMEs as they have developed their use of external networks. On the other hand, by doing so, larger firms are able to avail themselves of the flexibility long-enjoyed by SMEs. This is particularly so in the electronics hardware-based sector, where we have evaluated the R&D activities of both large and small firms. Although SMEs continue to have the advantages of flexibility and rapid response, the traditional disadvantages due to size limitations may have worsened due to the demand for multiple technological competences and by increased cross-border competition.

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Introduction

The literature on innovation indicates that the last two decades there has been a systematic – and fundamental -change in the way firms undertake innovatory activities. In particular, there has been have seen a tremendous growth in the use of external networks by firms of all sizes (Hagedoorn 1996). Indeed, Duysters *et al* (1999) note that alliances have shifted from being regarded as a peripheral aspect, to a cornerstone of the firm's technological strategy. In addition to the declining costs of monitoring and exploiting networks, there has also been a growing need for firms to possess multiple technological competences (Granstrand, Patel and Pavitt 1997). This trend has largely been a result of the increased knowledge content of products in general, and the cross-fertilisation of previously distinct technological areas. Firms have sought to utilise 'non-internal' means to undertake innovation, and by this I refer specifically to the use of strategic alliances and outsourcing. This trend has been noted by Tidd and Trehwalla (1997), Hagedoorn (1996), Narula and Hagedoorn (1999) among others. The facilitating role of globalisation has expanded firms' use of external resources to reduce, *inter alia*, innovation time spans, costs and risks, and acquire greater flexibility in their operations (Hagedoorn 1993). At the same time, however, there has also been an increased level of inter-firm and cross-border competition, which has created new risks and threats for the technology-intensive firm.

The growing use of networks by a broader cross-section of technology-based firms reflects a catch-up by larger firms: It has long been recognised that one of the major competitive advantages SMEs have over large firms has been their flexibility. Indeed, the very success of the SME vis-à-vis their larger competitors may be due to their ability to utilise external networks more efficiently (Nooteboom 1994, Rothwell and Dodgson 1994). In general, SMEs have overcome barriers to growth due to absolute limits to resources by the astute use of alliances (Ahern 1993, van Dijk et al 1997). Mytelka (1991) goes so far as to suggest that a firm's competitiveness may in fact be determined more by its external network than its size.

The literature on the innovative activities of SMEs highlights the fact that they have a behavioural advantage over large firms, which have material advantages (Rothwell and Dodgson 1994). There is considerable evidence to suggest that SMEs tend to have a higher R&D productivity, and this is largely due to their ability to innovate by exploiting knowledge created outside the firm (Audretsch and Vivarelli 1996). Of course, there is great variation by

industry. SMEs have tended to have an innovation advantage in highly innovative industries where the use of skilled labour is relatively important (Acs and Audretsch 1991).

Although the wider use of alliances has benefited the SME, because, by and large, large firms seek to partner with smaller firms in order to exploit their flexibility and innovativeness. However, at the same time, the use of external networks as a core part of the strategy of large firms has increased their flexibility, thereby diminishing one of the major advantages that SMEs have had when competing against larger firms. That is, there are more opportunities to collaborate with large firms, but fewer opportunities to compete successfully against their larger counterparts. In this paper I will argue that inasmuch as the improvements in communication, and the ease of enforceability of contracts has helped the SME to 'network' more efficiently, it has provided at least as much benefit to the large firm too. Nowhere is this more obvious than in collaborative activity with regards innovation. This is particularly so where the SME is in direct competition with the larger firm. Although SMEs have the advantages of being flexibility and rapid response to change, there are also disadvantages due to their absolute size limitations which may now have been enhanced due to increased need for multiple technological competences and by increasing cross-border competition. In other words, what has always been an important issue for the SME has now become more commonplace amongst firms of all sizes.

Although this paper primarily focuses on the collaborative innovative activity of the SME, it is not possible do so in isolation from the large firm. The interdependence of large firms and small firms during the evolution of new technologies and industries is best described as 'dynamic complementarities' (Rothwell and Dodgson 1994).

I do not intend to challenge the evidence on the R&D productivity of SMEs, or two evaluate the efficacy of their use of external networks. In order to avoid any bias due to industry differences, I have focused on the ICT sector, an R&D intensive sector where SMEs have played a dominant role. Furthermore, I have excluded software companies as the dynamics of innovation are different in services (Nooteboom 1994), and I have concentrated on firms primarily engaged in design and manufacture of electronics based hardware, sold to end-users.

In the following sections I will discuss the how these firms utilise R&D collaboration relative to large firms. I shall attempt to discuss the reasons for the preference of one type of collaboration over another, and the limitations of collaboration as an alternative to in-house R&D. The last section presents some conclusions.

Data and Methodology

The analysis here is derived from an ongoing study of European technology firms. Although the database consists of 110 European firms, 47 of the total are in the ICT sector. As mentioned earlier, in order to avoid any possible bias due to industry differences the sample is further narrowed by excluding firms primarily engaged in software and ICT service firms. Firms in the sample are engaged in the design and manufacture of electronics-based hardware, including medical electronics, avionics, scientific and measuring equipment, and industrial electronics. I have attempted to match 'similar' firms together, in terms of technology intensity, primary technologies, but not nationality, structure of ownership or age of firms. Furthermore, SMEs that act primarily as suppliers to larger firms were excluded, because they are involved in a 'keiretsu' –like symbiotic relationship. The final sample available for the analysis is 13 SMEs and 12 large firms. The UN definition of SMEs to include firms with less than 500 employees has been used.

I will use a combination of anecdotal evidence and survey results to illustrate my arguments. The criteria for selection of these firms has been, a) That they were majority-European owned as of 1998, b) engaged in manufacturing, c) have annual R&D expenditures greater than (approximately) US$1 million and/or 10 full-time R&D employees. All interviews were conducted with the head of the R&D department or vice-president of technology development, or equivalent. In case of multi-divisional firms, interviews were conducted with several divisions. Detailed information on internal and external activities were not collected through the questionnaire survey, which was undertaken during 1998, and was only undertaken during the interviews, conducted after the survey. In all interviews, without exception, the interviewees expressed concern about the sensitive nature of the information provided, and have insisted on confidentiality. Therefore, given the relatively small sample size, and the very specific nature of their products and competences, and the small number of firms in each industry, I can only give a limited statistical overview regarding the sample. Wherever necessary, I have excluded certain details which might reveal the identity of the parent firm, and therefore the firm in question.

I use the terms alliances and outsourcing as understood and used in relation to the MERIT-CATI database. By outsourcing is taken to mean agreements that are more arms-length in nature, where active collaboration does not take place. There is generally a clear customer-supplier relationship, with no joint innovative activity, although coordination for systems integration may be undertaken. Alliances are taken to be agreements where there is a

clear, significant, and systematic interdependence between the parties involved, with both firms undertaking innovative activities.

Differences in R&D between SMEs and large firms

The firms in my sample have distinctive competences that are broadly paradigmatic, although some elements of their technological portfolio (particularly those that are niche and peripheral) are pre-paradigmatic. Clear dominant technologies have presented themselves, and *de facto* standards established. Unambiguous technological trajectories exist, and most innovatory activity is focused around the dominant paradigms. Technological change remains rapid, but mainly through incremental, rather than radical innovation. Innovation also tends, for the most part, to be undertaken either in applied research, or in development, and rarely in basic research. Since innovation is built around clear trajectories, the nature of the incremental innovation is known, what is unclear who will be first to the market. Although property rights are clearly defined, the rapidity of change means that firms maintain their competitive advantage by being first to innovate and exploiting the lead time of being 'first'. In the sample used here, the life cycle of products averaged around 12-18 months, a pace usually dictated by 'major players' (i.e. large firms).

FIGURE 1 ABOUT HERE

Most products are multi-technology in nature, and multiple competences are needed. Figure 1 illustrates the kinds of technologies for one of the firms in the sample. Few firms, regardless of size, can afford to maintain R&D facilities with world-class competences in so many different sectors. This is particularly so in the case of SMEs, which by definition have limited resources. Even if SMEs maintain twice the level of R&D intensity as a large firm in the same industry (which typically might be 5%), a company of 500 employees might maintain an R&D department of about 50 people, while a large firm with 5000 employees have an R&D facility of 250 people.

TABLE 1 ABOUT HERE

Table 1 gives a rough idea of the differences in size between the large firms and the SMEs. Large firms in our sample spent 5 times more on R&D than the SMEs. However, in terms of R&D employees, large firms were on average only three times larger. Nonetheless, the average size in terms of R&D employees of SMEs in my sample was 42. There are only

so many specialisations that an SME can maintain with such small absolute R&D headcount. There is a certain minimum threshold size of a research group within any area, and this represents a real constraint to SMEs. In addition – and this is true for firms of all sizes - there is no guarantee that the research group in any given facility will in fact consistently innovate at the technological frontier, and within the dominant paradigm, even if world class researchers are present. In other words, there are cognitive limits on what firms can and cannot do (Pavitt 1998). Firms therefore are dependent on the *last-best* (i.e., state-of-the-art) innovation. If a firm is engaged in developing an innovation in a given technological paradigm, it must strive to improve (or at least take into account) not its own last-best innovation, but the last-best innovation that has been patented, or that is the dominant design on the market[1], even if this was created by another firm. Thus its path-dependency is always tempered by the state-of-the-art, and this means that roughly speaking technological trajectories of different firms within any given technological paradigm are similar.

There are therefore two pressures on ICT firms – firms are forced to maintain an equivalent breadth of R&D competences as other firms in the same industry, and at the same time maintain their innovative activities at the industry rate of evolution. The benefits of smallness – which are variously associated with greater flexibility and rapid response – compensate for some of the disadvantages of size, and may allow SMEs to maintain the rate of technological change. But they do not necessarily help SMEs when it comes to the absolute limit on its resources.

Keep in mind too, that SMEs have also to devote resources to other aspects of the value chain. They must seek to achieve economies of scale in production, and also to effectively market their products, and provide support services. In this sector, market share considerations are at least as important as technological assets – it is insufficient simply to have the best product, if no one will buy it. More importantly, if a competitor's technology is accepted as the industry standard, it can threaten the existence of the firm.

It is impressive, nonetheless, that the SMEs in our sample employ more people relative to their R&D expenditures than large firms, and the answer lies to some extent in their greater use of non-internal R&D sources, as emphasised by the literature on SMEs and innovation (see Rothwell and Dodgson 1994 for a review). Larger firms tend to use a smaller percentage of their R&D budgets (on average 12.4%) to outsource and engage in strategic

[1] Numerous examples of technically sub-optimal innovations defining the technological trajectory exist (e.g., Betamax vs. VHS, Macintosh vs. PC). Perhaps the best documented example is of the QWERTY keyboard (David 1985)

alliances than SMEs which utilise on average 21.9% of their R&D budget (Table 1). The limitation in resources, and the need to maintain the firm's position on the technological frontier of the various technological areas that it requires is mainly responsible for the growth in the use of non-internal R&D activities in both large and small firms. The use of the term 'non-internal' is a deliberate one, and is intended to include both external activities (arms-length relationships such as licensing, R&D contracts, outsourcing - and other customer-supplier relationships) and quasi-external activity (such as strategic alliances, which is taken to include a myriad of organisational modes [Narula and Hagedoorn 1999]). Non-internal activities, apart from the obvious benefits of exploring new areas and instigating radical change, have the advantage of being a 'reversible' form of investment (Gambardella and Torrisi 1998). The capital needed is smaller, and the risks are substantially reduced, and in case of failure or organisational crisis, limited damage is inflicted on the primary operations of the firm. Nonetheless, the tacit nature of innovation, and the risks associated with loss of technological competitiveness, encourage a high level of in-house R&D activity.

External acquisition of technology is most easily done when the technology behind the product is codifiable and standardised and for which *multiple non-distinguishable* sources of these inputs are available (Narula 2001). The same argument holds true for R&D activity, since R&D output is partly tacit, externalisation of R&D means that the firm only gets the codified results, not the accumulated person-embodied skills. As has been noted elsewhere, even where firms outsource, they maintain a minimum level of in-house capacity in those technologies in order to decipher and utilise them (Veugelers 1997). Hartung and McPherson (2000) note a similar positive relationship between in-house R&D and propensity to collaborate. In other words, R&D outsourcing is only undertaken where doing so is cost-effective AND does not threaten the competitive advantages of the company. Having a single source or single buyer may prove to be most cost-effective, but it is generally accepted that low costs do not always translate to the best technology.

The manner in which firms select external vs. internal R&D acquisitions is associated with the centrality of the technological competence to the firms activities (Narula 2001). Firms will, *ceteris paribus*, prefer to undertake innovative activities in their distinctive competences through in-house R&D. Although there is considerable overlap (figure 1), broadly speaking niche and marginal competences are strategically less significant, and can be undertaken through alliances. However, the strategic importance of these technologies determines to what extent their development can be externalised. This, in turn, is determined

by the extent to which the technology is tacit, the extent to which collaboration is required to utilise it, and to what extent the partners activities need to be monitored.

Background competences are, by and large, the area where outsourcing is primarily used. In general, it would seem firms prefer to undertake research in their distinctive competencies in-house as much as possible. There is, however, considerable overlap in the use of in-house R&D and alliances for niche competences, and between outsourcing and alliances in marginal/peripheral competencies. SMEs tend to be more concerned about their loss of technological assets than large firms. SMEs tend to use non-internal means with a great deal of care, in some cases bordering on paranoia. One firm said,

> “Because we do not have the resources [ourselves, and have to outsource], we make sure none of our partners has enough of our technology to become a competitor. We provide the macro-specifications to one partner, which does the design. But we have a different company to do the manufacturing of the relevant sub-assembly. We make sure that no company is responsible for more than one sub-assembly ,and always pick companies smaller than us.”

Another manager agreed;

> "we use more than one supplier, our products are based on several boards. Each supplier produces only one board, because we don’t want any supplier to have access to our complete product. We might be able to get a lower price, but we don’t want to be in a position that the supplier is able to become a competitor. Non-disclosure agreements aren't enough."

In general, the vulnerability due to smaller size means that SMEs have to be more wary of alliances. One of the SMEs in our sample considered alliances unacceptably risky:

> "These competencies are too important to us….we have spent many years building our strength in these sectors….frankly we have world class competences……I am loathe to consider letting anyone near our technology. We only use alliances [in these areas] if we have to."

In general, however, SMEs use non-internal means to a larger extent than large firms, because they can maintain sufficiently high level of in-house competence in only a few (or even a single) technological area. This represented an advantage of the SME, according to one manager who argued,

> “we are not married to a given technology, and that is precisely why we are successful. If we did our own research, we would have a vested interest in a particular technology, even if it is not the best, and this would eventually become a problem.”

Thus, there are many more technologies which they have to acquire externally. The use of alliances in connection with niche sectors was, in general, associated with firms that had limited R&D facilities and/or considered that there was a large technological gap between their technological competencies and the market leaders. SMEs considered alliances as a way of extending their technological competences more than large firms, but only when they were unable to do so through outsourcing. For instance, one medical equipment manufacturer did not have the resources to invest in the next generation of displays. Although LCD technology has become more mature over the last 5 years, it remains capital-intensive, and proprietary technology rests with a handful of companies. It therefore sought an alliance with a US company which is a market leader in medical equipment, many times their size. The US firm did not currently compete with them in their particular product segment, and agreed to share the technology and to distribute their products in the US. As a manager pointed out,

> "It's a risk [to ally with such a large player], but the cost of developing our own display systems would use up almost our entire R&D budget for a couple of years…and our old product range was [beginning to look] old…[They]…have the technology lying around, because they have more people in their R&D facilities than we have in our entire company…[if they wanted to] they could buy us out, whether we had a partnership with them or not [so it doesn't matter whether or not we partner with them]."

The point I want to make here is that first, there is a limit to how much of a firm's R&D activities can be externally acquired particularly due to technological and strategic considerations. Second, even if costs are reduced through the use of non-internal means, they remain non-trivial, and the constraints of absolute limits of resources remains.

TABLE 2 ABOUT HERE

Both large and small firms have similar motives to undertake inter-firm R&D collaboration (Table 2). The primary motivation for both groups of firms was not considered to be the reduction of risks or costs, but the reduction of innovation time span, and the access to complementary technologies. However, larger firms are in a better position to establish partnerships, because they have more to offer. SMEs have fewer technological assets with which to barter, while the technological portfolio of large firms is larger, and besides they can offer cooperative agreements at other levels too, from either production or their marketing and sales operations. This is apparent from Table 3.

TABLE 3 ABOUT HERE

Where SMEs concentrate their activities in-house, they are still forced to consider alliances with larger firms, simply as a means of getting access to marketing and sales channels. A telecommunications equipment company explained,

> "Although we do not need anyone for technology, we are not able to offer a 'suite' [an integrated package of products]. The way of the future is systems integration, and it is the key. Customers want our equipment to work in tandem [with products of other manufacturers]. Our competitors are all large and can offer an integrated package, we can't. So we are looking for a partner who will sell our product, but we are faced with a dilemma, because the only companies who make [the other parts of the suite] are our competitors ."[2]

In general, both large and small firms show a preference to outsource applied research and product development to public research institutes and universities (as noted by Tidd and Trehwalla 1998), because of the fear of giving away their technology to a competitor, or potential competitor. Although our data is by no means conclusive, anecdotal evidence suggests that SMEs tend to engage in fewer strategic alliances with other firms, preferring to outsource wherever possible. It should be noted that there is a lower limit to the extent to which any firm (but particularly SMEs) can use non-internal sources as a substitute for internal R&D. Both alliances and outsourcing require complementary resources. Some level of in-house capacity is essential to absorb the externally acquired information. Furthermore, alliances in particular (compared to outsourcing) require considerable managerial resources, not just because of the collaborative aspect, but also because alliances tend to be used where technology is tacit. Again, limited human resources means there is a limit to what percentage of a smaller absolute size of personnel can be devoted to managing alliances.

The need for international sources of technology

However, the globalisation of markets and the growth of cross-border competition places SMEs at another disadvantage vis-à-vis large firms in another way. As economies have become interdependent, firms (of all sizes) need access to the innovation systems in other locations. Firms need to supplement their ownership advantages by seeking location-specific assets in other countries than their own. That is, they may seek to augment their home-based assets through locating some extent of their innovatory activities where there is a high level of

[2] Two months after the interview, this SME was acquired by a large competitor.

agglomeration of innovation in their industry (Kuemmerle 1999). In addition, product adaptation and development is most effectively undertaken closer to the market. Establishing R&D facilities – even of a 'listening post' variety - provides a potentially valuable opportunity to internalise spillovers from the research facilities of other players in the ICT sector in that location, both public and private.

However, in general, SMEs tend to concentrate their production and sales in their home country, much more so than large firms, and do not have the resources necessary to engage in home-base augmenting activity. Although some of the SMEs in our company have established R&D facilities abroad (Table 1) in response to increasing need to monitor the activities of competitors, and to be responsive to particular market conditions, a dispersion of R&D activities across the globe also requires extensive coordination between them – and particularly with headquarters- if they are to function in an efficient manner with regards to the collection and dissemination of information (Blanc and Sierra 1999). This acts as a centripetal force on R&D, and accounts for a tendency of firms to locate R&D (or at least the most strategically significant elements) closer to headquarters. As table 1 shows, even though almost a third of the SMEs have overseas R&D but these are very small indeed. Even in the US, which has the largest concentration of ICT firms, and which is the largest market, SMEs had less than 10 R&D employees on average compared with almost a 100 employees on average for larger firms.

Strategic alliances do provide a possible alternative to undertake such activities. Previous research has shown that firms do in fact use strategic technology alliances as a means to tap into other locations' innovation systems. Firms tend to select partners who provide the best opportunities for learning, regardless of their location (Narula and Hagedoorn 1999). However, such growing complex linkages, both of networks internal to the firm, and those between external networks and internal networks, require complex coordination if they are to provide optimal benefits (see Zanfei 2000 for a discussion). Such networks are not only difficult to manage, but also require considerable resources (both managerial and financial). It is no surprise, therefore, that external technology development is primarily the domain of larger firms with greater resources, and more experience in trans-national activity (Hagedoorn and Schakenraad 1994, Castellani and Zanfei 1998). SMEs are generally not in a position to undertake such activity. While it is true that ICTs have improved coordination, the importance of 'being there' and having direct contact remains especially important in R&D, where much of the knowledge is not only tacit and largely uncodifiable, but embodied in people.

Thus it seems reasonable to expect that large firms to undertake a higher level of R&D overseas, although in proportion this may be the same as smaller firms. Indeed, this is the conclusion made by Patel and Vega (1999), among others. Small firms are constrained by their limited resources – the expansion of R&D activities- both at home and in overseas locations requires considerable resources both in terms of capital investment, and managerial resources which these firms simply do not have. *Ceteris paribus*, large firms have more money and resources to use on overseas activity. Large firms are also more likely to have more linkages with the domestic science base, and tend to have a well developed network of supplier firms at home. But as I have highlighted earlier, SMEs are not always in a position to partner with large firms, since they have relatively little to offer in exchange, and face a strategic threat even if they were to do so. SMEs need to be able to scan overseas locations and learn from their competitors and markets no matter where they are. This is particularly important in industries where technological change is rapid.

Concluding remarks

This paper has highlighted the increasing imperative of ICT firms to expand their portfolio of technological competences, and that this applies to SMEs as much as it does to large firms. Fortunately, reduced costs of enforcing agreements, the decline in barriers to trade and investment and the improvements in communications have improved the efficacy of cooperative ventures, especially for R&D.

I have focused on electronics hardware sector within the ICT sector, where SMEs are engaged in direct competition with larger firms. Both groups of firms need roughly the same breadth of technological competences, as multi-technology products are the norm in the ICT sector. For both groups of firms, maintaining such a large portfolio of technological competences is difficult, but more so for the SME. The use of non-internal technology development through outsourcing and alliances has provided benefits for both types of firms, but particularly so for the SME.

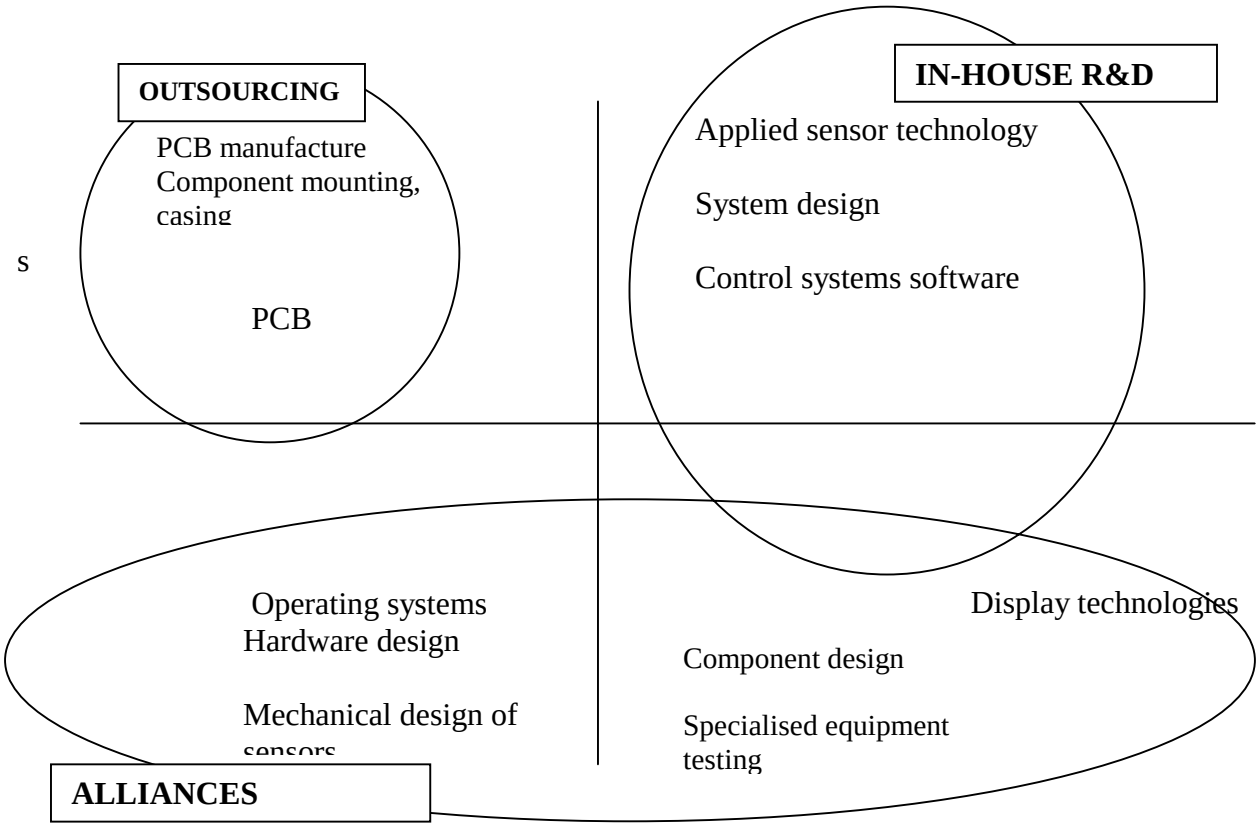
SMEs tend to maintain a smaller group of in-house technological competences, and are generally able to leverage their limited R&D resources more efficiently, as noted in the literature (Nooteboom 1994, Rothwell and Dodgson 1994). They tend to use almost twice as much of their R&D expenditures towards R&D collaboration than large firms. However, there are cognitive limits to what SMEs can do, and how much they can use non-internal R&D, as they need to maintain a minimum threshold level of in-house capacity. Nonetheless, the more

successful SMEs have been able to maintain their competitive position through a more astute use of non-internal R&D, with less in-house R&D than larger firms. In addition, even if costs are reduced through the use of non-internal means, they remain non-trivial, and the constraints of absolute limits of resources remains.

However, collaboration has its price. First, because even where non-internal means are used, some level of in-house competence must be maintained in order to understand and integrate the various technologies together. Second, most R&D alliances have a very low success rate. A failure rate of 50% was judged by firms in my sample to be “very good indeed”. For a large firm, these losses are easier to accept, who often have multiple, redundant, back-up agreements with several firms. In addition, large firms have more to offer in a partnership, and can easily find alternative sources, compared with SMEs.

SMEs tend to prefer to use outsourcing rather than alliances, perhaps because of the higher risks, and costs of managing such a partnership. When they engage in alliances, SMEs are more careful about picking partners, because they have limited opportunities to fail. There are also strategic reasons to be careful because partnering with a larger firm can lead to a loss of technological competence.

Firms in the ICT sector all have a growing need to monitor the innovation systems of other countries than their own, and to be located close to both their markets, and their competitors to maintain their competitiveness. They need to do so both through R&D facilities abroad, and through alliances. However, SMEs are again constrained by their resources. Even alliances require some level of physical presence, and the threshold level to establish such facilities is often prohibitively high for SMEs.



Note: No attempt has been made to locate technologies on a relative basis within any given quadrant.

Figure 1 Distribution of competences of a typical ICT firm, based on managers' perceptions

	SMEs	*Large firms*
Mean R&D expenditure	4.15	21.54
Mean R&D employment	42	129
% of R&D in home location	90.7	57
% of firms with overseas R&D labs	36.4	77.8
Percentage of firms with R&D facilities in the US	27.3	66.7
average size of R&D facilities in the US (employees)	8.2	96.5
% of R&D acquired externally	21.9	12.4
% of firms with < 20% external acquisition	28.6	100

Table 1 Some basic indicators

	SME		Large firms	
	mean	% major or crucial importance	mean	% major or crucial importance
reduction of costs	2.4	40	3.0	28.6
reduction of risks	2.5	30	2.9	14.3
reduction of innovation time	3.4	70	3.3	42.9
access to markets	2.4	30	2.2	33.3
access to complementary technology	3.6	60	4.6	100
setting standards	2.7	30	2.7	42.9

Table 2 The importance of different R&D motivations for ICT firms

What kind of research do you undertake with your partners?		
	SMEs	Large Firms
	% of firms that responded often' or 'most of the time'	
basic research	0	0
applied research	50	14.3
development	50	71
design	10	43
production and marketing	20	71

Table 3: Kind of R&D activities that firms prefer to undertake with partners.

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