

Nokia's strategic change by means of alliance networks. A case of adopting the open innovation paradigm?

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Abstract

In this paper, it is shown in which way Nokia used innovation networks to deal with a changing technological environment, namely the development of mobile telephony. Nokia used mainly international innovation networks in becoming a world leader in the mobile phone industry. This study is mainly theory-oriented in that it seeks to test and where possible refine theories on R&D collaboration strategies of large firms. The theoretical framework builds on the seminal work of March (1991) who distinguished exploration and exploitation for strategic change of large firms. The findings of this study can also help managers of other companies in the ICT industry to refine the collaboration strategies of their companies. The research methodology is both quantitative (alliance database analysis) and qualitative (semi-structured interviews). The most interesting result of this case study is that Nokia has been collaborating much more through joint R&D, outsourcing and standardization consortia, but has at the same managed to develop and maintain a strong brand name and corporate identity. Nokia effectively uses an open innovation strategy (Chesbrough 2003) in the development of new products and services and in setting technology standards for current and future use of mobile communication applications.

Keywords: exploration/exploitation, innovation networks, R&D alliances, open innovation

Introduction

Strategic change is often considered as a necessity for companies to survive in a turbulent environment (Hamel and Prahalad 1994). Intense international competition and rapid technological change are often mentioned as primary motives for companies to adapt their corporate strategy (Christensen 1998; Eisenhardt and Tabrizi 1995; Sadowski et al. 2003). One way of facilitating strategic change is to engage in alliances for the exploration of new capabilities and the exploitation of the existing knowledge base of the corporation (March 1991). Alliances are a means of learning from alliance partners (Kale et al. 2000; Khanna et al. 1998). The process of learning boils down to the exchange of technological knowledge or capabilities. Technological capabilities are the accumulated technical skills and know-how in an organization.

In order to come up with a more refined view on learning, I will make use of March's (1991) seminal distinction between exploitative and explorative learning. Exploitation is generally associated with the refinement and extension of existing technologies. Exploration on the other hand deals with experimentation with new alternatives and the exploration of a new (technological) field. In this paper, I argue that there are important differences between both types of learning (March, 1991; Chesbrough, 2003), which significantly affect the way in which companies make use of their external technology networks.

For firms, one way of dealing with the pressure of highly competitive environments and short-life cycle of especially high-tech products is to collaborate with other firms for the development and manufacturing of new products. By doing so, risk and rewards are spread among two or more companies. Essential for the innovation process is sharing ideas, among often 'rivalry' business firms, on the development of new products. This type of collaboration is in contrast to what was common practice in the early days of the large business firm. I will refer to these collaborate innovation processes as "innovation networks", since business firms seem to have constructed a network of firms around them with which they develop a wide variety of new products over longer periods of time.

Innovation networks are particularly important in industries where technology changes rapidly and product life cycles are short.

This research focuses on international innovation networks of firms that develop ICT technologies. The large company of today is competing in the global economy, which challenges the firm to organize its innovation network in such a way that the firm remains competitive. Since these innovation networks are by no means accidental, they will change the internal organization of large business firms, the industrial relations among business firms, and potentially industry structures. Furthermore, innovation networks will affect the way in which future innovation policy and industry policy should be designed. This research in particular focuses on international innovation networks of Nokia, which succeeded to become a world leader in the development and manufacturer of mobile telecommunications. The main research question of this study is to investigate to what extent innovation networks helped to facilitate adaptation to a changing business environment. This research question is explored by dividing it into two sub questions:

- With whom, why and on what does Nokia collaborate on product development?
- How does Nokia use networks to explore new or exploit existing capabilities for the transformation of its business?
- To what extent does the overall business strategy of Nokia fit the open innovation paradigm?

This study is mainly theory-oriented in that it combines different concepts related R&D collaboration strategies of large firms and apply these concepts to an embedded single case study of 10 R&D alliance projects undertaken by Nokia Corporation in the period 1997-2002. The findings of this study can potentially help managers of other companies in the ICT industry to refine the collaboration strategies of their companies. This paper builds on previous work of the author (Sadowski et al. 2003; Dittrich et al. 2004) and has been conducted as part of larger Ph.D. research project (Dittrich 2004).

Exploration and exploitation in innovation networks

The exploration of new possibilities and ideas is amongst others associated with search, experimentation, risk taking and innovation (March 1991). According to Granovetter (1973), new ideas and possibilities come from partners in different lines of business making different products, since these companies will give access to a different knowledge base. Thus, firms pursuing an exploration strategy for product development will establish alliances with 'weak ties' (Granovetter 1973). In this study, an indicator for 'weak ties' will be a new partner company, usually outside the core technological field in a different sub-sector of the industry (see Table 1). Exploration is characterized by opportunistic behaviour and enables a firm to bridge two distinct networks of firms, thereby benefiting from the resources of both networks (Burt 1992). As discussed in above, the strength of ties is determined by "a combination of the amount of time, the emotional intensity, the intimacy, and the reciprocal services which characterize the tie" (Granovetter 1973: 1361). Partners that are characterized as weak ties will have a lower commitment in the partnership than strong ties (Burt 1992; Williamson 1975; 181a;1981b;1985). An indicator for low commitment is a low frequency of collaboration. When companies work together on only one project. 'one-time collaboration', the commitment is presumed to be low (see Table 1). According to Koza and Lewin (1998), the level of commitment is also depending on the particular types of strategic technology alliances. Non-equity alliances, of which I will mainly consider joint development agreements and joint research pacts, are assumed to express lower commitment (see Table 1). These strategic technology alliances are non-equity relationships, meaning that the resource input is not equally spread among the partners. A joint development agreement is a collaboration agreement on the development of new technology or products. A joint research pact is joint research project with shared resources (Duysters and Hagedoorn 1993; Hagedoorn 1990; Hagedoorn and Duysters 2000). Though these are agreements with lower levels of commitment, they involve high levels of R&D input.

Exploitation of existing knowledge and capabilities on the other hand is associated with refinement, selection, production and execution (March 1991). An exploitation strategy is aimed at strengthening and broadening basic knowledge of established technologies and products. Maximizing the number of 'strong ties' (Krackhardt 1992) broadens basic knowledge of established technologies and products. An indicator of 'strong ties' in the context of this analysis is existing partners, usually in the same (core) technological field (see Table 1). The result will be a network of related and similar firms with which

longer-term relationships will be maintained. The firms in this network are highly diversified and produce a wide range of related but different products. Since the intensity and the reciprocity of the relationships of strong ties are higher than those of weak ties (Granovetter 1973: 1361), the level of commitment in exploitation strategies will presumably be higher than in exploration strategies (Krackhardt 1992). The high frequency of partnerships will be used as an indicator of high commitment (see Table 1). According to Koza and Lewin (1998), equity alliances, such as the establishment of a daughter company in which the parents have equity positions, express a high level of commitment that can be associated with exploitation (Koza and Lewin 1998: 256). As indicator for alliances with high commitment, joint ventures (JV) and research consortia (RC) are used. A joint venture combines the interest of at least two separate companies in a distinct (new) company; profits and losses are shared according to equity investment. A research corporation is a joint R&D venture with a specific research program. Again, profits and losses are shared according to equity investment.

Table 1: Four dilemmas of exploration and exploitation

Exploration	Versus	Exploitation	Indicator
Search for new technological capabilities (Burt 1992; Granovetter 1973; Khanna et al. 1998; Koza and Lewin 1998, March 1991)	Versus	Broaden existing technological capabilities (Koza and Lewin 1998; Krackhardt 1992; March 1991, Walker et al. 1997)	Partners inside versus outside core competence
Search for 'weak ties' (Granovetter 1973)	Versus	Strengthen 'strong ties' (Krackhardt 1992)	New versus existing partners
Opportunistic behaviour/low commitment (Burt 1992; Williamson 1975; 181a;1981b;1985)	Versus	Trust/high commitment (Gulati 1999; Nooteboom 1999; Uzzi 1996, 1997; Walker et al. 1997)	One-time versus reciprocal partnerships
Establishing non-equity agreements (Koza & Lewin 1998)	Versus	Establishing equity agreements (Koza & Lewin 1998)	JDA and JRP versus JV and RC

Source: Dittrich (2004)

Exploration and exploitation outside firm boundaries is used in this paper to investigate a possible paradigm shift from closed to open innovation systems. In the closed system, large companies hired the best researchers and engineers for the technologies involved. Those people discovered all application opportunities of those technologies themselves and also all subsequent new products and services were developed in-house. 'Open innovation systems' (Chesbrough, 2003) are characterized by the flexible way a firm co-ordinates a large number of innovation projects and assess their value. The system is open, because some projects come from outside and some internal projects go outside. This approach is consistent with former studies that argue that innovations are increasingly the result of a joint effort of a number of parties (innovation networks, systemic innovations). However, it adds a few perspectives to this 'co-operation approach' to innovation. First, Chesbrough (2003) argues that in dynamic markets the value of a portfolio of innovation projects is difficult to estimate and subsequently, that the value of patents – as a specific means to 'secure' an innovation's value – is very uncertain. Second, the value of patents (and inventions) depends on the specific business model a firm uses to commercialize technological innovations. Hence, there are different *modes of open innovation*, one of them is spin-offs from research. Third, co-operation is not seen as a solution to all innovation problems, but as part of the portfolio in which some if not the majority of projects is carried out by the single firm and other projects are carried out in co-operation with other firms.

Definition of strategic technology alliances and alliance networks

As suggested above, exploration and exploitation strategies are not just internal to the firm. Alliance networks are often used to support these strategies. In spite of the vast body of literature on strategic technology alliances, only very few papers focus particularly on the use of networks for exploitative or explorative learning (for exceptions see e.g. Ahuja and Lampert, 2001; Hagedoorn and Duysters,

2002; Rowley et al., 2000). There is consensus in these few contributions that firms pursuing a strategy of exploration for product development are most likely to establish alliances that are characterized by 'weak ties' (Granovetter 1973). 'Weak ties' in this context mean that companies exhibit low commitment to their alliances and team-up with non-familiar partners. When exploring a particular new technology, companies may not want to enter into inflexible forms of alliances, because they do not know whether the technology will prove to be useful to them. They want to have the opportunity to abandon the alliance at any given moment (Duysters and De Man, 2003). Strong ties, characterized by intimate, recurrent and trustful relationships, on the other hand are helpful with an exploitation strategy (Krackhardt 1992). In order to exploit knowledge and make the most of established technologies and products intensive relation with partners are a prerequisite. Exploitation requires intensive knowledge exchange and creating economies of scale. Both can be achieved in strong ties and much less so in weak ties, because only strong ties have the requisite intensity for this. Hence, exploration strategies lead to lower-commitment R&D alliances in new technological capabilities, since the focus is on learning new ideas from new partners. Exploitation strategies on the other hand will lead to high-commitment alliances in existing technological capabilities (Koza and Lewin 1998). In the literature I find some scattered empirical evidence on this matter. Hansen et al. (2001), Afuah (2000) and Rowley et al. (2000) found strong evidence that the value of strong and weak ties depends on the type of learning and the external environment. Rowley et al. (2000) showed that strong ties are particularly effective for exploitation purposes and less for effective for exploration. The need for weak ties has been shown to be particularly high under conditions of rapid technological change where the need for explorative learning is highest (Afuah, 2000).

Alliance networks as analysed in this study are made up of strategic collaboration agreements intended to share technology or technological expertise. An important part of these agreements is joint research on and development of new products. The analysis concentrates on formal agreements between firms on the research and development of new technologies. These formal agreements are constricted to strategic technology alliances. Strategic technology alliances are those forms of collaboration and agreements, for which a combined innovative activity or exchange of technological capabilities is at least part of the agreement (Duysters and Hagedoorn 1993).

Only those alliance agreements are investigated that meet the following criteria. First, these alliance agreements are of strategic importance for all partners, in that they share the risk and return of a large project with the objective to strengthen the network positions of the companies involved in the alliance vis-à-vis their competitors. Second, joint R&D and technology exchange is in the core of these alliance agreements and third, these agreements may inherit a longer commitment to the alliance partners. The four types of strategic technology alliances that fit these two criteria are joint research pacts, joint development agreements, joint ventures and research corporations. The first two are non-equity agreements, which means that the resources, risks and returns are not equally shared between the companies involved. The latter two are equity agreements, in which resource inputs, risks and returns are equally shared among all partners. These four types of alliance agreements will result in a relatively high inter-organizational dependence (Hagedoorn 1990; Hagedoorn and Duysters 2000). When discussing alliance networks, the focus is on formal strategic technology alliances; informal agreements and agreements with universities and other non-profit organizations are left out of the analysis. Though informal agreements may be essential for innovation to come about (Allen 1978), only the formalized results of the exploration and exploitation is examined by announced strategic technology agreements as the empirical base of this study.

Methods

The research methodology is a combination of a database analysis of alliance agreements and an embedded case studie. Both the nature and evolution of innovation networks are examined with an empirical analysis of patterns of strategic technology alliances over time. The data on R&D collaboration were taken from a database on strategic technology alliances. Although these forms of technological collaboration constitute only one of many possible forms of R&D partnerships, strategic technology alliances are accepted as useful indicators of collaborative behaviour of firms with regard to the development of new products and services (see for instance Hagedoorn 1995). The distinction between strategic technology alliances and other types of partnerships that the alliances in the database used for this research are primarily related to technological collaboration. Therefore, the

transfer of technology and joint undertaking of research is part of the alliance agreement (Duysters and Hagedoorn 1993).

An analysis of overall patterns alliances in the global ICT industry will reveal that innovation networks occur and evolve over time. However, such an analysis may not provide insight into how firms use innovation networks to adapt to a changing business environment, which is the main purpose of this study. For a more in-depth assessment of innovation networks the focus is limited to firms in the ICT industry only and in particular to two large, multinational corporations and their technology-sharing partners. The case study is exploratory rather than explanatory, which means that the case studies are used to build theory rather than explain historical events (Yin 2004: 138). The reason for choosing multiple case studies with a predominantly exploratory nature instead of a statistical representation of e.g. the global ICT industry is that the main research question aims at an in-depth understanding of the nature and use of innovation networks.

Case study design and case selection

This research follows an embedded single case study design. The firm is the main unit of analysis, but specific alliance projects will be studied as embedded cases to analyse exploration and exploitation in more detail. The strategic technology alliance projects serve as ‘embedded units’ within the single case design, the business firm (Yin 2004: 42-43). This means that when studying the firm, the alliances and the partner firms are studied as well as additional units of analysis for explaining firms’ behaviour.

The focal firm Nokia is a large player in the global ICT industry, which could lead to more general conclusions for other companies in this industry. Furthermore, the firm was selected as an example of a European company that has rapidly become market leader in an industry dominated by US and Asian companies.

The alliance projects are selected for their opposite positions in the matrix as depicted in Figure 1. In total, ten alliances projects have been selected, of which five can be regarded as “incremental innovation” and five as “architectural innovation”, following the definition of Abernathy and Clark (1985).

Measurement

Empirically, exploration networks differ from exploitation networks in four observable ways (see Table 2). First, exploration networks will make use of flexible legal structures, whereas exploitation alliances will use legal structures that enable long-term collaboration. Exploration networks therefore have a preference for non-equity alliances, whereas exploitation networks will have a larger proportion of equity alliances in them (Koza and Lewin 1998). Joint development agreements (JDA) and joint research pacts (JRP) are non-equity agreements with lower levels of commitment. Agreements with a high level of commitment are equity-based relations like joint ventures (JV). A measure for the extent to which a network shifts towards an exploration strategy is obtained by counting these alliance types across different time periods.

Table 2: Network characteristics for exploration and exploitation strategies

	Exploration	Exploitation
Alliance type	Non-equity alliance	Equity alliances
Type of partner	New partner	Known, familiar partner
Type of partner capabilities	Partners with non-similar technologies	Partners inside current business

Second, in exploration networks partner turnover will be higher than in exploitation alliances. Companies pursuing exploration strategies will change their partners more often. Comparing the composition of a network in period t with the network composition in t+1, will show that the proportion of new partners in an exploration network is higher than the proportion of new partners in an exploitation network. Exploration requires access to a diversity of knowledge and a continuous scanning of new technological opportunities. As these opportunities often arise outside existing partners, partner turnover will be high. Exploitation requires intense collaboration. This takes time to

build up and benefits will accrue only after long-term collaboration. Consequently, exploitation networks will have a higher proportion of the same partners over time than exploration networks. Alliance projects that are characterised as exploration will typically consist of new partners, while exploitation alliances will be set-up with familiar partners with which the company has worked before.

A third measurable characteristic of networks that differs between exploitation and exploration strategies relates to partner capabilities. In exploration alliances, companies will look for partners with capabilities outside their existing business. In exploitation alliances, companies will tend to look for companies with similar technological knowledge. Exploration strategies lead to an innovation network consisting of partners in new technological areas. Exploitation strategies on the other hand will lead to an innovation network of partners in similar technological areas.

Data sources

The CGCP database has been used for collecting data of the period 1997-2002. Similarly, the CGCP database contains information on alliances of a large number of firms. These data have been gathered from public sources, most of them available on the Internet and have been maintained continuously. Descriptions include starting date, form of the alliance and goal of the alliance. When available, financial details have been included in the description as well.

This literature-based alliance counting has some limitations. Included in the database are only publicly announced alliances and the sources are likely to be incomplete. Alliances are entered when announced. The database is a collection of data from international business magazines, journals and online news servers on collaborative agreements between firms. Only rarely is the end of an alliance made public. The maps do not depict the alliances a company has at a certain moment in time. They rather show which alliances have been announced during a certain period. However, this literature-based research will give an extensive overview of formal inter-firm collaboration, with an emphasis on international co-operation and large companies. The database has a geographical bias towards Anglo-Saxon countries, since the data have mainly been collected from sources written in English. However, the data on strategic alliances will give a clear picture of the collaborative efforts in product development over a long period in time (Duysters and Hagedoorn 1993).

As additional sources of interviews (in the case of Nokia), as will be explained in the discussion of the case studies. In order to investigate the real significance of Nokia's innovation networks in more detail interviews were held with several experts on Nokia and the Finnish ICT industry. These semi-structured interviews involved Nokia Group's management as well as Finnish researchers of the research institutes ETLA and VATT who are experts in Nokia's networking strategies and the development of the Finnish ICT industry. Preliminary open interviews were held with the head of the department of Industrial Affairs of the Confederation of Finnish Industry and Employers.

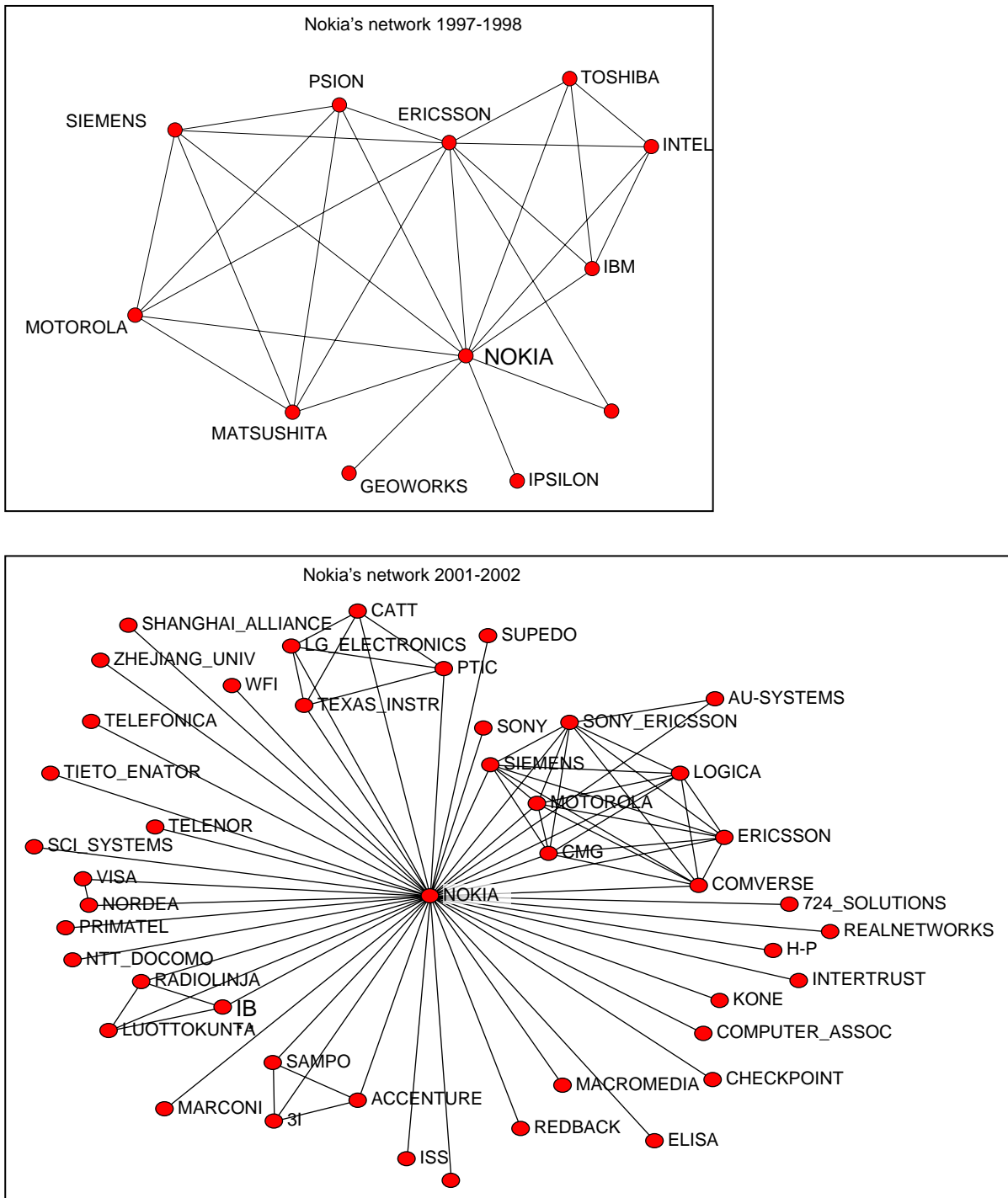
Results

Alliance networks

The period 1997-2002 marks the beginning of the third generation of mobile telecommunications, the development of UMTS technologies. In this period, Nokia had 48 strategic alliance agreements, of which 25 were joint development agreements, 16 co-production contracts, six joint ventures and one standardization consortium. Nokia has many joint R&D agreements on relatively new technological capabilities with weak ties (Granovetter 1973), i.e. with partners it did not collaborate before.

When comparing 1997-1998 with the period 2001-2002, it is evident that both the number and character of the alliance networks has changed dramatically (see Figure 1). In 2001-2002, Nokia engaged in almost twice as many alliances, namely 32 versus 60 alliance agreements (see Table 2). The partners and types of products developed in these alliances also changed in this relatively short time span, as will be explained below.

Figure 1 Nokia's alliance networks (1997-2002)



Source: CGCP database 1997-2002

With the rise of a new technology in the third trajectory, joint development of commonly accepted (open) standards is needed. For that reason the partnerships with competitors is essential. An example of a joint development agreement that involves standard setting is a strategic alliance with the Japanese NTT DoCoMo in 2001. Nokia and NTT DoCoMo will cooperate specifically in promoting open mobile architecture for WCDMA-based third-generation mobile communication services in areas such as browsing, messaging and application execution (see Figure 1).

When comparing the capabilities that are searched for in innovation networks, it becomes clear that especially software development has become more important for Nokia (see Table 3). In the period 1985-1996, more than half of all alliances were on telecommunications and almost one-sixth on both software and microelectronics (see Dittrich 2004). In the period 1997-2002, however, almost half of all

alliance agreements were on software development and more than one-third on telecommunications. In the periode 2001-2002, even half of all alliance agreements were related to software development. Following March (1991) and Koza and Lewin (1998), this indicates that exploration of new capabilities, in this case software development, has become more important in the third trajectory of mobile telecommunications.

Table 3: Search for capabilities in innovation networks

	1997-1998	2001-2002
Computers	12 (37,5%)	8 (13,3%)
Software	13 (40,6%)	30 (50,0%)
Telecommunications	4 (12,5%)	17 (28,3%)
Microelectronics	0 (0%)	1 (1,7%)
Other	3 (9,4%)	4 (6,7%)
Total	32	60

Source: CGCP (1997-2002)

Nokia engaged in many strategic alliances in both the second and third trajectory of mobile telecommunication technology, though the nature of the innovation networks in the two consecutive trajectories seems different. When comparing 1997-1998 with 2001-2002, the proportion of new partners in the third trajectory turns out to be extremely high. More than 88% of the partners in the period 2001-2002 are completely new to Nokia, and also more than 83% of the partners in 1997-1998 were completely new to the company (see Table 3). This indicates that Nokia mainly searched for weak ties (Granovetter 1973), rather than strengthened its relationships with strong ties (Krackhardt 1992). Though some of the partners are still in mobile telecommunications, like Ericsson, Matsushita, Motorola and Siemens, many new areas are being explored.

Table 4: New partners in Nokia's innovation network

	1997-1998	2001-2002
Number of partners	12	43
New partners	10	38
Proportion of new partners	83,3%	88,4%

Source: CGCP (1997-2002)

Nokia's strategy change: a case of open innovation

As has been explained above, Nokia developed as a company by a number of mergers and acquisitions (M&As) of other firms with more or less related but different business activities. M&As as well as strategic alliances are a means to obtain the necessary capabilities and are meant to improve the overall performance of the firm (Barney 1997; Wernerfelt 1984). Along with acquiring external assets, refocusing of business activities is also stressed as being important for the competitiveness of a company (Hoskisson et al. 1994; Markides and Williamson 1994). Nokia is now gradually shifting from M&As to alliances in order to strengthen their core capabilities, and divesting and refocusing its business activities instead of diversifying business activities.

Although the terms core competence and core capability are frequently used in the literature, a clear definition is not always provided (Duysters and Hagedoorn 2000). A manager at Nokia Group defines the company's core competencies to be in three fields: mobile handsets, network technology and middleware. Nokia used to produce a multitude of products, ranging from rubber boots, toilet paper to radio technology and televisions (in a company called Salora), but has refocused to mobile and radio technology only, with additional network technologies, like switches, routers and modems, and standardized software platforms. The cable division, as many other divisions, has been divested, just like Nokia has now completely left the paper and rubber industry behind (see also Ali-Yrkkö 2001: 24-29).

When decisions are made on the development and manufacturing of new products, the critical element in this rapidly changing technological environment is speed, according to a manager at Nokia Group. The decision to collaborate or not on product and software development strongly depends on two basic questions. First, will Nokia be able to produce the technology fast enough to do it alone? Second, does the company have the necessary competencies to produce it in a short time period? If

the answer to both questions is negative, the company will decide on some form of collaboration or outsourcing with a company that can produce that component fast enough.

If the new product is core to Nokia, i.e. in the domain of mobile telephony, the company will produce it internally without collaborating or outsourcing. Products within the core competence can be produced better, faster and more efficiently internally and alone than in collaboration with other companies, according to a manager at Nokia Group. In line with the concept of exploitation (March 1991), Nokia is exploiting its technological capabilities for the development or extension of existing technologies for existing markets. However, it is remarkable that the largest production volume of mobile phones is still in high-wage countries such as Finland, Germany and the USA. Nokia's production is more efficient in these high-wage countries, since mobile phones are Nokia's core technology that needs highly skilled labour for the production process. Labour costs are then of less relevance, though mobile phones are also produced in low-wage countries such as Hungary, Brazil and Korea.

Products outside the core, which Nokia refers to as "context", are usually outsourced. This is for instance the case with network elements. Nokia buys them from SCI, Flextronics Finland and Elcoteq Networks Oyj, since they can produce them much more efficiently and there are no economies of scale for Nokia in producing them internally. The structure of these agreements differs from strategic partnerships in product development, since they are mere buyer-supplier contracts. When looking for complementary products, such as integrated circuits, Nokia will simply buy them from e.g. Texas Instruments instead of producing them internally. In case after-sales services are needed, Nokia will look for a partner with a large network of local stores and a good local brand name. The company will collaborate with this local partner instead of setting up an after-sales service network.

The generic strategy decisions to determine whether new products are with the "core" or "context" competencies of the firm are subject to continuous evaluation. The core competence of Nokia may change in future, which could lead to the decision to outsource production that is now considered to be in the core competence of the firm. This has been explicitly mentioned a real possibility by the company itself as well as by researchers in the field. Ali-Yrkkö (2001: 24) notes that "Nokia has reinvented itself so many times that it seems almost impossible to forecast what kind of structure or competencies Nokia will have in five to ten years time". If a new technology in mobile telephony comes up and some other company than Nokia produces it, the firm will collaborate with them and outsource for that particular technology. For now, Nokia perceives itself still the best manufacturer in mobile telephony, so anything related to that will be produced internally without any form of collaboration. However, collaboration will become more important in the future, not only in terms of the number of collaboration but also in volume of production, according to a manager at Nokia Group. Crucial elements are speed and flexibility of production. In the current technological environment, no single company is powerful enough to define the market alone. Therefore, going alone is not the wisest thing to do.

Accessing new markets is a way of enhancing the performance potential of firms (Hamel and Prahalad 1994; Schumpeter 1942). There are several ways a firm can expand its production line. First, a firm can access a new geographical area to set up production facilities and accommodate a new client base, located a different country from the one(s) a company has other client bases. Second, a company can expand the production process by entering an entirely new product market. Above, I discussed M&As as a means of acquiring competencies that are new to the firm. However, this tool cannot be used when the new product line is new to the industry. For accessing a market that is entirely new, also to rivalry companies, M&As cannot be used. Below, these two ways of accessing new markets are discussed.

For Nokia, it used to be important to collaborate for accessing new geographical areas. Without that collaboration, local production would be impossible due to the restrictions that local governments make on market access by foreign companies. Collaboration for market access was essential for entering the mobile phone and network technology markets in China, and Brazil, but also in Australia. The local or national authorities or government required Nokia to nationalize their production facilities abroad. This nationalization process usually meant that (part of) a local manufacturer took care of the production process or that a local company sold the products in the name of Nokia. For many foreign entrants, this was the only way to sell their products to the local market. In the case of Australia it used to be so that part of the product had to be manufactured in Australia in order to sell it locally. Therefore, Nokia had to collaborate with a local manufacturer in order to enter the Australian market.

Since Nokia is a global company now, with access to almost every thinkable market, collaboration for this type of market access is not that important anymore, or at least much less important than a few years ago.

For accessing a market that is new to the company as well as to the industry, collaboration may be the only tool to achieve that. This strategy can be referred to as the exploration of new opportunities (Koza and Lewin 1998; March 1991). Nokia typically joins forces to create a new market, for instance with other mobile phone manufactures like Ericsson, Siemens and Motorola. Market creation was the main goal for entering the joint venture Symbian in 1998 (see Figure 5.3). In order to avoid market fragmentation, standardization consortia with other companies in the same line of business, the core business activities, are set up (David and Steinmueller 1995; Egyedi 1999; Hawkins 1999; Schmidt and Werle 1998). Companies in a consortium jointly create a market for a new product and set the standard for that particular technology. Once the installed base is large enough, any new entrant will have to deal with the standard technology that has been jointly agreed upon. SyncML, for instance, is the leading open industry standard for universal synchronization of remote data and personal information across multiple networks, platforms and devices. The SyncML Initiative was initiated in 2000 by Nokia and sponsored by Ericsson, IBM, Lotus, Matsushita, Motorola, Nokia, Openwave, Starfish Software and Symbian, and is supported by hundreds of leading wireless companies. Another example would be the Location Interoperability Forum (LIF), where companies from all layers of the value chain (i.e. service providers, network providers, network technology manufacturers, etc.) are involved, since all companies in the value chain will have to work with the platform. As a result of the LIF, Nokia together with CMG Wireless Data Solutions, Ericsson/Sony Ericsson, Comverse, Logica, Motorola and Siemens have collaborated on the interoperability of Multimedia Messaging Services (see Figure 1). For market creation, Nokia perceives collaboration in these standardization consortia of increasing importance.

In order to make these types of relationships work, Nokia has to be able to rely on its partners for on-time delivery. Furthermore, Nokia expects partner-companies to continuously develop and renew products to be supplied. According to a Nokia manager, the challenge is to monitor whether partner-companies do not take the relationship with Nokia for granted. Especially in relation with end-to-end types of products, Nokia needs other companies that will process partially finished products into a new, marketable end product. This marks the border between a supplier contract and a strategic alliance. The former are contracts for components that are considered commodities, the latter are (sometimes exclusive) agreements for the joint development of components or end-user products. The general trend is that Nokia shifts from pure sub-contracting in production, to manufacturing partnerships, to R&D sub-contracting and ultimately to R&D partnerships. This means that the firm boundaries between Nokia and its partner-companies are gradually fading.

The results of the above analysis of innovation networks suggest that Nokia is spinning-in technologies from competitors and suppliers. This is only one part of the open innovation paradigm formulated by Chesbrough (2003). One example of a spin-off of Nokia's R&D in the area of mobile telephony can be found in the company Benefon. Benefon was founded in late 1987, when the first managing director of Nokia-Mobira, Jorma Nieminen, decided with two colleagues to found a company of their own. The product development and manufacturing of the first products was done by a few dozen pioneers. Benefon Forte NMT 450 was the very first mobile phone of the new company. The product itself tells a lot about the company philosophy; it was radical and innovative and actually the world's first mobile phone to include an in-built answering machine. Benefon Forte had an extremely long lifetime remaining in production for the unparalleled 11 years. This is a record in the industry known for its short product life cycles. After Benefon Forte the company has introduced tens of wireless communication instruments to NMT and GSM systems in Russian, Scandinavian, European and Asian markets. A new era in product innovation began in Benefon with the European Union's MORE project (MORE = Mobile Rescue Phone). The result of the project was a new, revolutionary product concept: a mobile phone and a GPS navigator integrated in one portable product. The new product concept took shape in Benefon's GSM+GPS products, of which Benefon Esc! was launched in late 1999 and Benefon Track in 2000. Being able to precisely communicate your location and seeing where others are and to navigate there are the cornerstones of the new Benefon product generation. Especially demanding professional users appreciate Benefon's unique product concept.

Benefon continues to develop innovative instruments promoting wireless communication and improving the quality of life. The original pioneer spirit lives also among the wide Benefon partner

network. The company was established in Salo in 1988 and has currently 377 employees and total sales of 59 million Euro. One-third of the company's personnel are involved in R&D. Furthermore, R&D accounts for 17 % of net sales. The firm is internationally oriented and has been engaged in a number of strategic partnerships. Though spin-offs of Nokia may not be plentiful, Benefon seems to be a successful example of the adopting the open innovation paradigm.

Discussion and conclusions

R&D partnership with a high degree of information exchange between all partners in the R&D and production process is quite common in Silicon Valley. Small high-tech companies in Silicon Valley do not hire an entire temporary workforce in order to produce the products they want to develop. They need a few people to come up with a basic design and subsequently subcontract the entire production. This enables even the smallest companies to develop new technology fast. These small companies can be said to have a networked organization structure for their manufacturing. People work for many different companies, yet only the contractor-company is responsible for the end-result.

The challenge for such networked organizations in an open innovation regime is therefore to control the whole R&D and production process. Since the people involved are all working for different companies, they cannot be forced to work with the software or design procedures that are commonly used by the contractor. The contracted partners or people are not likely to adapt a software package or design procedure that they might not use again in future product development. Therefore, the contractor has to allow the partners to work out their initial design with their own tools. As a management process this is challenging and very different from more traditional forms of R&D and production. The benefits, yet, are flexibility, speed, innovation and the ability to produce a diverse range of products, even when the company is relatively small. Nokia is on its way to become a networked organization and Nokia's management sees this organization structure as the future of R&D and production for many high-tech large and small companies.

Both from the results of the database analysis and the experts panel research, it is clear that Nokia has extensively used networking strategies for the development of new products. In the third trajectory of mobile telecommunication, exploration strategies were more important than exploitation strategies. This was demonstrated with the shift towards alliances on new technological capabilities (March 1991; Koza and Lewin 1998), notably software development, with partners that were new to Nokia (Granovetter 1973).

The results of the experts panel analysis showed that Nokia has become a company embedded in both local and international innovation networks. The supplier-network no longer consists of simple sub-contracting or outsourcing relationships. The supplier-buyer relationship has been transformed to a networking relationship where the boundaries between Nokia and its supplier have faded away. This type of networking is the kind of embeddedness that Granovetter (1985) saw as a relationship based on trust and information sharing, rather than a formal contract. Since Nokia has many relationships of this kind and also has many R&D alliances with competitors, Nokia effectively uses an open innovation strategy in the development of new products and services and in setting technology standards for current and future use of mobile communication applications. This seems to be in line with Chesbrough's (2003) conception of firms acting under an open innovation paradigm.

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