Networking as a Means to Strategy Change: 
The Case of Open Innovation in Mobile Telephony

Koen Dittrich and Geert Duysters

The purpose of this article is to investigate how innovation networks can be used to deal with a changing technological environment. This study combines different concepts related to research and development (R&D) collaboration strategies of large firms and applies these concepts to R&D alliance projects undertaken by Nokia Corporation in the period 1985–2002. The research methodology is a combination of in-depth semistructured interviews and a large-scale quantitative analysis of alliance agreements. For the empirical analysis a distinction is made between exploration and exploitation in innovation networks in terms of three different measures. As a first measure, the difference between exploration and exploitation strategies by means of the observed capabilities of the partners of the contracting firms is investigated. The second measure is related to partner turnover. The present article argues that in exploration networks partner turnover will be higher than in exploitation networks. As a third measure, the type of alliance contract will be taken; exploration networks will make use of flexible legal organizational structures, whereas exploitation alliances are associated with legal structures that enable long-term collaboration. The case of Nokia has illustrated the importance of strategic technology networks for strategic repositioning under conditions of change. Nokia followed an exploitation strategy in the development of the first two generations of mobile telephony and an exploration strategy in the development of technologies for the third generation. Such interfirm networks seem to offer flexibility, speed, innovation, and the ability to adjust smoothly to changing market conditions and new strategic opportunities. These two different strategies have led to distinctly different international innovation networks, have helped the company in becoming a world leader in the mobile phone industry, and have enabled it to sustain that position in a radically changed technological environment. This study also illustrates that 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 article presents one of the first longitudinal studies, which describes the use of innovation networks as a means to adapt swiftly to changing market conditions and strategic change. This study contributes to the emerging, but still inconsistent, literature on explorative and exploitative learning by means of strategic technology networks.

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Introduction

For firms, one way of dealing with the pressure of highly competitive environments and short life cycles—in particular of high-technology products—is to collaborate with other firms for the development and manufacturing of new products. More and more companies have incorporated strategic technology alliances into the core of their technology strategies. The increasing use of strategic technology alliances has led to the establishment of elaborate interfirm networks in which firms team up to generate new products and technologies. In the present article these collaborative innovation processes are referred to 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 study focuses on international innovation networks of firms that develop information and communication technologies (ICT). Today’s large-scale enterprises are competing in a global economy that challenges firms to organize their 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. This study focuses in particular 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 facilitate adaptation to a changing business environment. This research question is explored by means of two subquestions: (1) With whom, why, and on what does Nokia collaborate on product development? and (2) How does Nokia use networks to explore new or exploit existing capabilities for the transformation of its business?

This study combines different concepts related to research and development (R&D) collaboration strategies of large firms and applies these concepts to R&D alliance projects undertaken by Nokia Corporation in the period 1985–2002. This study contributes to the emerging, but still inconsistent, literature on explorative and exploitative learning by means of strategic technology networks. The findings of this study can also help managers of other companies in the ICT industry to refine the collaboration strategies of their companies.

Exploration and Exploitation in Innovation Networks

The exploration of new possibilities and ideas is, among others, associated with search, experimentation, risk taking, and innovation (March, 1991). According to Granovetter (1973), new ideas and possibilities often arise from interaction with partners, or alliances, in different lines of business, since these companies will give access to a different knowledge base. Thus, firms pursuing an exploration strategy for product development will often establish alliances with partners they infrequently partner with—a so-called weak tie partnerships (Granovetter, 1973). Exploration is often characterized by opportunistic behavior and enables a firm to bridge two distinct networks of firms, thereby benefiting from the resources of both networks (Burt, 1992). In the present article, weak ties are defined as collaborative agreements with a new partner company, usually outside the core technological field in a different subsector of the industry (Table 1). Partners that are characterized as weak ties will have a lower commitment in the partnership than strong ties (Burt, 1992;
Williamson, 1975, 1981a, 1981b, 1985). An indicator for low commitment is a low frequency of collaboration. When companies work together on only one project—called a one-time partnership—the commitment is presumed to be low (Table 1). According to Koza and Lewin (1998), the level of commitment is also depending on the particular types of strategic technology alliances. Nonequity alliances, of which mainly joint development agreements and joint research pacts are considered in the present article, are assumed to express lower commitment (Table 1). These strategic technology alliances are nonequity relationships, meaning that the resource input is not equally spread among the partners.

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 will in this case enrich basic knowledge of established technologies and products (Krackhardt, 1992). An indicator of strong ties in the context of this analysis is the number of existing partners, usually in the same (i.e., core) technological field (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), the level of commitment in exploitation strategies will presumably be higher than in exploration strategies (Krackhardt, 1992). The high frequency of partnerships will therefore be used as an indicator of high commitment (Table 1).

Exploration and exploitation outside firm boundaries is used in the present article 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, and firms protected those inventions with intellectual property rights. Those people discovered all application opportunities of technologies themselves, and also all subsequent new products and services were developed in-house and served the company to enter the market first and win (Chesbrough, 2003). The open-innovation approach is complementary to the collaboration approaches discussed already (e.g., DeBresson and Amesse, 1991; Faems, Van Looy, and Debackere, 2005; Hagedoorn and Duysters, 2002; Küppers and Pyka, 2002) in the sense that Chesbrough (2003) also argues that innovations are increasingly a result of a collaboration efforts with other parties. Open innovation also means that a firm has to coordinate, in a flexible way, a large portfolio of innovation projects and to assess their value (Chesbrough, 2003; Faems, Van Looy, and Debackere, 2005). The system is referred to as open because the boundaries of the product development funnel are permeable. Some ideas from innovation projects are initiated by other parties before entering the internal funnel; other projects leave the funnel and are further developed by other parties. However, Chesbrough (2003) highlights some specific characteristics of open-innovation systems that are sometimes overlooked in other approaches. First, he argues that the value of a portfolio of innovation projects is difficult to estimate and, subsequently, that the value of patents is very uncertain (see also Faems, Van Looy, and Debackere, 2005). Second, the real value of patents or inventions does not lie in the patent itself but in the specific business model a firm employs to commercialize the associated innovations—that is, commercially viable technologies, products, and services. Third, cooperation is not seen as a solution to all innovation problems but as part of the portfolio in which some projects are carried out by the single firm and other projects are carried out in cooperation with other firms (Chesbrough, 2003). Hence, there are many different modes of innovation processes—such as outsourcing, spin-offs, and spin-ins—which may be viable in different innovation projects and

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<tr>
<th>Exploration</th>
<th>Exploitation</th>
<th>Indicator</th>
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<tr>
<td>Search for new technological capabilities</td>
<td>Broaden existing technological capabilities</td>
<td>Partners inside versus outside core competence</td>
</tr>
<tr>
<td>Search for weak ties</td>
<td>Strengthen strong ties</td>
<td>New versus existing partners</td>
</tr>
<tr>
<td>Opportunistic behavior/low commitment</td>
<td>Trust/high commitment</td>
<td>One-time versus reciprocal partnerships</td>
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<td>Establishing nonequity agreements</td>
<td>Establishing equity agreements</td>
<td>JDAs and JRP versus JVs and RC</td>
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*Adapted from Dittrich (2004). JDAs, joint development agreements; JRP, joint research pacts; JVs, joint ventures; RC, research consortia.
circumstances. Thus, an open-innovation system may result in a complex network of relationship with other organizations, serving different purposes in different periods.

As suggested already, 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 articles focus particularly on the use of networks for exploitative or explorative learning; for exceptions, see, for example, Ahuja and Lampert (2001), Hagedoorn and Duysters (2002), and Rowley, Behrens, and Krackhardt (2000). There is growing consensus in these few contributions that firms pursuing a strategy of exploration for product development are most likely to establish alliances characterized by weak ties (Granovetter, 1973). Weak ties in this context imply 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, on the other hand—characterized by intimate, recurrent, and trustful relationships—are helpful in the case of an exploitation strategy (Krackhardt, 1992). To exploit knowledge and to make the most of established technologies and products, intensive relation with partners are a pre-requisite. Exploitation requires intensive knowledge exchange and the creation of economies of scale. Both can be achieved by means of 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 some scattered empirical evidence is found on this matter. Hansen, Podolny, and Pfeffer (2001), Afuah (2000), and Rowley, Behrens, and Krackhardt (2000) found strong evidence that the value of strong and weak ties depends on the type of learning and the external environment. Rowley, Behrens, and Krackhardt (2000) show 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).

Methods and Data

In the present article, the use of innovation networks as a means to drive strategic change is investigated. In particular, the focus is on Nokia’s use of its innovation network to deal with changing environmental and strategic conditions.

Research Methodology

The research methodology is a combination of in-depth semistructured interviews and a database analysis of alliance agreements. 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 the Maastricht Economic Research Institute on Innovation Cooperative Agreements and Technology Indicators (MERIT-CATI) database on strategic technology alliances and a similar alliance database composed by the Centre for Global Corporate Positioning (CGCP). 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 behavior of firms with regard to the development of new products and services (see, e.g., 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 one large, multinational corporation and its technology-sharing partners. The case study is exploratory rather than explanatory,
which means that the case study is used to validate theory rather than to explain historical events (Yin, 2004, p. 138).

**Measurement**

For the measurement of exploration and exploitation in innovation networks, a similar methodology as discussed in Dittrich, Duysters, and De Man (2004) is applied. Empirically, a distinction is made between exploration and exploitation in innovation networks on three different measures (Table 2). As a first measure, the difference between exploration and exploitation strategies by means of the observed capabilities of the partners of the contracting firms is investigated. Companies that follow an exploration strategy will look for partners with distinctly different capabilities. On the other hand, companies pursuing an exploitation strategy will search for companies with similar technological capabilities. Exploration strategies lead to an innovation network consisting of partners in new technological areas and exploitation strategies to an innovation network of partners in similar technological areas. This is in line with findings of Benner and Tushman (2002) and Ahuja and Lampert (2001), who refer to local versus distant search—that is, searching for capabilities close or distant to the focal firm’s current skills and capabilities.

Second, in exploration networks partner turnover will be higher than in exploitation networks. 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, which takes considerable 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 (Kale, Singh, and Perlmutter, 2000; Rowley, Behrens, and Krackhardt, 2000).

Third, high partner turnover also means that exploration networks will make use of flexible legal organizational structures, whereas exploitation alliances are associated with legal structures that enable long-term collaboration. The flexibility, speed, and learning opportunities associated with nonequity agreements by far outweigh the benefits associated with stability and improved commitment, which are in turn associated with equity agreements. Equity agreements, therefore, seem to be less well equipped to deal with strategies of exploration (Duysters and Hagedoorn, 2000; Spekman and Isabella, 2000). Exploration networks are assumed to have a high proportion of nonequity alliances, whereas exploitation networks will have a larger proportion of equity alliances in them (Koza and Lewin, 1998).

In an attempt to take the discussion on exploration and exploitation to a higher level, a longitudinal development view on companies is included to show how alliance networks are used for strategic change. To find out whether companies actually use and adapt their network when entering a period of strategic change, various network measures are studied for the particular case of Nokia. In the late 1980s and 1990s Nokia was one of the forerunners in mobile telephony. During the late 1990s Nokia tried to maintain its prominent market position in the development of third-generation mobile telephony, changing from an exploitation strategy toward an exploration strategy. This makes Nokia a particularly interesting case for studying whether Nokia’s innovation network changed accordingly, using the network measures as stated in Table 2.

**Data Sources**

To investigate the significance of Nokia’s innovation networks in detail, five exploratory semistructured interviews were held in the period 1999–2001 with four experts on Nokia’s alliance strategy and the Finnish ICT industry: one interview was held in 2001 with director partnership process at Nokia Group; one interview was held in 2001 with a senior researcher at the Government Institute for Economic Research (VATT); and one interview was held with a researcher at the Research Institute of the Finnish Economy (ETLA). Two preliminary interviews were held in

| Table 2. Network Characteristics for Exploration and Exploitation Strategies |
|---------------------------------|---------------------------------|------------------|
| Partners’ capabilities          | Exploration                     | Exploitation     |
| Type of partner                 | Partners with dissimilar         | Partners inside  |
| Alliance type                   | technologies                    | current business |
|                                 | New partner                     | Known, familiar  |
|                                 | Nonequity alliance               | partner          |

K. DITTRICH AND G. DUYSTERS
1999 and 2000 with the head of Department Industrial Affairs at the Confederation of Finnish Industry and Employers (TT).

For the database analysis, two databases on strategic technology alliances were used. From the MERIT-CATI information system, all cooperative agreements on ICT-related technologies, products, software, and services from the period 1985–1996 are selected, which resulted in a sample of nearly 2,500 strategic alliance agreements. These agreements are defined as common interests between independent industrial partners, which are not connected through majority ownership. In addition, only those collaborative agreements have been collected that contain some arrangements for technology transfer or joint research (Duysters and Hagedoorn, 1993). Mere production and marketing agreements have been excluded. The focus is on technology cooperation, and a combined innovative activity or technology transfer is at least part of the agreement.

The data collected by the CGCP were collected in a similar way as the MERIT-CATI database and were collected in the period 1997–2002 (see http://www.cgcpmaps.com). The CGCP database contains information on alliances of a large number of firms, of which data were gathered from public sources, mostly available on the Internet, and maintained continuously. Data from the information technology (IT) sector were traced from 1996 onward. Telecom data was entered by Telecom Paper, a specialist company dedicated to providing information about the telecom sector. Descriptions include starting date, form of the alliance, and goal of the alliance. When available, financial details were included in the description as well.

**Results**

**The Make-or-Buy Decision at Nokia Corporation**

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 required externally available capabilities (Barney, 1997; Wernerfelt, 1984). Although M&As are still important, Nokia is gradually shifting its focus from M&As to alliances as a means to strengthen its core capabilities and is 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: (1) mobile handsets, (2) network technology, and (3) middleware. Nokia used to produce a multitude of products, ranging from rubber boots and toilet paper to radio technology and televisions, through 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, pp. 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—that is, 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 United States. Nokia’s production is more efficient in these high-wage countries, since mobile phones are Nokia’s core technology that needs highly skilled labor for the production process. Labor 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 since 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 merely buyer–supplier contracts. When looking for complementary products, such as integrated circuits, Nokia will simply buy them from, for example, 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 fall within the core or context competencies of the firm are subject to continuous evaluation. The core competence of Nokia may change over time, which could lead to the decision to outsource production of products now considered to be in the core competence of the firm. This has been implicitly mentioned as a real possibility by the company itself as well as by researchers in the field. Ali-Yrkkö (2001, p. 24) notes, “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 as the best manufacturer in mobile telephony, so anything related to this field 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 terms of the 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 it 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 to accommodate a new client base located in a different country from the ones where a company has other client bases. Second, a company can expand the production process by entering an entirely new product market. It was discussed previously how M&As can be 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 Nokia, it used to be important to collaborate for accessing new geographical areas. Without collaboration, local production would be impossible due to the restrictions that the local governments make in terms of 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. 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 is 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, such as with other mobile phone manufactures like Ericsson, Siemens, and Motorola. Market creation was the main goal for entering the joint venture Symbian in 1998. Standardization consortia are typically set up with other companies that have similar core business activities with the goal of avoiding market fragmentation (David and Steinmueller, 1995; Egyedi, 1999; Hawkins, 1999; Schmidt and Werle, 1998). Companies in such 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 on. 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), in which companies from all layers of the value chain (e.g., service providers, network providers, network technology manufacturers) 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. For market creation, Nokia perceives collaboration in these standardization consortia of increasing importance.

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 to 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 subcontracting in production to manufacturing partnerships to R&D subcontracting and ultimately to R&D partnerships. This means that the firm boundaries between Nokia and its partner companies are gradually fading.

Exploitation and Exploration in Innovation Networks at Nokia Corporation

Internationalization has been a dominant trend in the Finnish ICT industry from the late 1980s onward, and Nokia has been a trendsetter for the industry as a whole (Keil et al., 1997). In the period of the first technological trajectory in mobile telecommunications in the early 1980s, Nokia established itself as a manufacturer of mobile phones by adopting the Nordic Mobile Telephony (NMT) standard initiated by Ericsson. During the second technological trajectory, Nokia gradually caught up with Ericsson and became a dominant manufacturer of mobile phones. Based on the MERIT-CATI database, however, collaboration with Ericsson was not found in the period 1985–1996 (Figure 1). The collaboration with other mobile phone manufacturers is restricted to licensing of technology with Motorola (and Tandy) and a four-year joint venture for R&D on cellular communication with Alcatel, AEG, and Standard Elektrik Lorenz (SEL). In this 12-year period, Nokia only engaged in 25
alliances, mostly in bilateral agreements. Of those 25 agreements, 14 were joint-development agreements, 6 were licensing- and technology-sharing agreements, and 5 were joint ventures. Though there is some joint R&D subject to these strategic alliances, which may indicate an exploration strategy (Koza and Lewin, 1998), most of the agreements involve the development of mobile telecommunication technology. This indicates a tendency toward an exploitation strategy (March, 1991), since existing capabilities are used for the development or extension of existing technologies for existing markets. One cross-licensing agreement is of special interest. In 1993 Motorola and Nokia engaged in a cross-license agreement, which allowed the exchange of all future Global System for Mobile (GSM) communication contracts.

Nokia had many more alliances in the period 1997–2002 than in the previous period (Figure 2). The period 1997–2002 marks the beginning of the third trajectory of mobile telecommunications, the development of Universal Mobile Telecommunications System (UMTS) technologies. In this period, Nokia had 48 strategic alliance agreements, of which 25 were joint development agreements, 16 were coproduction contracts, 6 were joint ventures, and 1 was a standardization consortium. In contrast with the GSM trajectory, Nokia has many joint R&D agreements on relatively new technological capabilities with weak ties (Granovetter, 1973)—that is, with partners it did not collaborate with before. A good example of an exploration strategy is a joint-development agreement with Nordea Bank and Visa International. The companies started a pioneering pilot to test and verify mobile payment services based on dual-chip technology. In this case, a relatively new market is explored with an extension of existing technologies and the development of new software development. In line with Koza and Lewin (1998), this would indicate an exploration strategy.

In 1997, Nokia and Ericsson engaged in a joint-development agreement on Wideband Code Division Multiple Access (W-CDMA), the first strategic alliance that Nokia has on one of the forerunner technologies of UMTS. Another important agreement is the joint venture among Nokia, Ericsson, Motorola, Psion, Siemens, and Matsui to form a company called Symbian. This joint venture is aimed at creating a common operating system for wireless information

Figure 2. Nokia’s Innovation Network in the UMTS Trajectory (1997–2002)
appliances, for it will develop open standards. Shareholding of this joint venture is as follows: Psion has a 26.6% stake; Ericsson/Sony-Ericsson, Motorola, and Nokia each have a 20% stake; Matsushita owns 8.4%; and Siemens owns 5%. In line with the use of innovation networks (as discussed in Krackhardt, 1992; Koza and Lewin, 1998; March, 1991), Nokia exploits its existing technological capabilities through a network of strong ties, namely mobile phone manufacturers, for the development of new products for an existing market.

Thus, in the beginning of the third trajectory Nokia collaborates intensively with competing mobile phone manufacturers such as Ericsson and Siemens, whereas Nokia hardly collaborated with its competitors in the period 1985–1996. This seems to indicate that Nokia was driving the first two technological trajectories and therefore did not need the complementary competencies of other mobile phone manufacturers. With the rise of a new technology in the third trajectory, joint development of commonly accepted, or 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 company NTT DoCoMo. Nokia and NTT DoCoMo cooperate specifically in promoting open mobile architecture for W-CDMA-based third-generation mobile communication services in areas such as browsing, messaging, and application execution (Figure 2). Another example is the agreement among Nokia, CMG Wireless Data Solutions, Ericsson/Sony Ericsson, Converse, Logica, Motorola, and Siemens, with which the companies have founded the Interoperability Group for the Multimedia Messaging Services. These two large consortia demonstrate that Nokia is still in the forefront of mobile technology but needs partners to codevelop and define standards (David and Steinmueller, 1995; Egyedi, 1999; Hawkins, 1999; Schmidt and Werle, 1998).

Table 3. Search for Capabilities in Innovation Networks

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<tbody>
<tr>
<td>Computers</td>
<td>1 (4)</td>
<td>2 (4)</td>
</tr>
<tr>
<td>Software</td>
<td>4 (16)</td>
<td>22 (46)</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>13 (52)</td>
<td>17 (35)</td>
</tr>
<tr>
<td>Microelectronics</td>
<td>4 (16)</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Other</td>
<td>3 (12)</td>
<td>6 (13)</td>
</tr>
</tbody>
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*b Numbers in parentheses in percent.

Table 4. New Partners in Nokia’s Innovation Network

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<tbody>
<tr>
<td>Number of Partners</td>
<td>39</td>
<td>52</td>
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<tr>
<td>New Partners</td>
<td>n.a.</td>
<td>48</td>
</tr>
<tr>
<td>Proportion of New Partners</td>
<td>n.a.</td>
<td>92.31%</td>
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</tbody>
</table>


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

Nokia engaged in many strategic alliances in both the second and third trajectory of mobile telecommunications, though the nature of the innovation networks in the two consecutive trajectories seems different. When comparing the two periods, the proportion of new partners in the third trajectory turns out to be extremely high. More than 90% of the partners in the period 1997–2002 are new compared to the period 1985–1996 (Table 4). 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. A good example of this is the collaboration with Nordea Bank and Visa Card on secure payments over mobile phones (Figure 2). The search for new partners in new technological capabilities indicates that exploration has dominated Nokia’s networking strategies (Burt, 1992; Granovetter, 1973; Khanna, Gulati, and Nohria, 1998; Koza and Lewin, 1998; March, 1991).

A change in networking strategies can also be seen from a change in the proportion of nonequity versus equity agreements (Table 5). Comparing the second with the third trajectory reveals that nonequity agreements have become slightly more important for Nokia.
than equity agreements. According to Koza and Lewin (1998), this indicates that exploration has become more important than exploitation in the third trajectory.

The results of the previous analysis of innovation networks suggest that Nokia is predominantly embedded in international innovation networks and not so much in local innovation networks. Another interesting outcome of the analysis of innovation networks is that the formal network with other important players in the different trajectories of mobile telecommunications, like Ericsson, does not seem important. However, the history of the development of mobile telecommunications suggests that especially these networks have been crucial for the position of Nokia in today’s mobile phone market.

**Discussion and Conclusions**

The case of Nokia has illustrated the importance of strategic technology networks for strategic repositioning under conditions of change. Such interfirm networks seem to offer flexibility, speed, innovation, and the ability to adjust smoothly to changing market conditions and new strategic opportunities. Nokia’s use of exploration and exploitation strategies has led to distinctly different international innovation networks, has helped the company to become a world leader in the mobile phone industry, and has enabled it to sustain that position in a radically changed technological environment. This study also illustrates that 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. Nokia is on its way to becoming 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.

This is one of the first longitudinal studies that describes the use of innovation networks as a means to adapt swiftly to changing market conditions and strategic change. The use of a combined quantitative and qualitative approach has generated a number of internally consistent and potentially important findings. More research is needed, however, to evaluate the external validity of the current findings.

**References**


