THE ROLE OF INNOVATION NETWORKS IN A CHANGING COMPETITIVE ENVIRONMENT: THE CASE OF IBM

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ABSTRACT
Firms are increasingly embedded in innovation networks that cross border and industries. This paper explores innovation networks by investigating two strategies of acquiring technological capabilities, exploration and exploitation, by analyzing a large database on strategic technology alliances. The results indicate that innovation networks are indeed of growing importance, especially for the business transformation that has taken place at IBM. Thanks to its innovation networks, IBM has been able to transform from a computer manufacturing to a global service provider and software company.

KEY WORDS
Strategic alliances, Learning, Innovation networks, IBM.

1 INTRODUCTION
In this paper, we explore how IBM used its innovation networks to deal with a changing competitive environment. The paper is structured as follows. First, the theoretical notions underlying exploration and exploitation strategies are explained using different theoretical perspectives on capabilities of firms. Based on these theoretical notions some theoretical assumptions will be empirically investigated by exploring general trends in ICT alliances and IBM's innovation networks. The last part presents the conclusions on the significance of innovation networks in coping with the drastically changed competitive environment IBM.

2 NETWORKING STRATEGIES OF INNOVATION
The growing complexity of competition makes sure that no single firm, not even a dominant market leader as IBM, can generate all the different capabilities internally that are necessary to cope with the requirements of global competition [1]. Innovation networks can provide globally competing firms with access to information and resources, new markets and technologies. Using innovation networks, firms have the advantages from learning, scale, and scope economies allowing them to achieve strategic objectives, such as sharing risks and outsourcing.
The business environment of IBM is a mix of co-operation and competition, which embeds the firm in a network of strategically important relationships. An analysis of partner selection at the level of individual players or alliances would mean overlooking the strategic importance of the pool of relationships that an individual firm can rely on. The network becomes a source of competitive advantage complementary to the company's own competencies and resources.
Learning processes are of great importance for companies adapting to changes in their environment. In studies on *innovation*, the focus is usually on exploring new ideas needed to develop new products. The other side of the same coin is exploiting the existing knowledge that resides in a company and, where needed, expand and refine that knowledge. *Innovation networks*, on the other hand, are made up of strategic collaboration agreements intended to share technology or technological expertise. An important part of these agreements is joint development of new products. In this research, we will concentrate on the four strongest forms of strategic technology alliances, which could indicate conscious construction of innovation networks. These four types are

joint research pacts, joint development agreements, research corporations and joint ventures.

One of the motives underlying networking strategies is learning from alliance partners [2, 3]. 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 [4: 2]. These capabilities are firm specific and sometimes hard to exchange [5: 514, 6: 183]. Despite the imperfect mobility of technological capabilities, firms can acquire the necessary technological know-how by establishing learning alliances [2, 3]. Depending on the ability to assimilate and process external know-how, these learning alliances can be more or less successful in acquiring the necessary technological capabilities to innovate [7, 8]. Two strategies of learning will be distinguished: exploration and exploitation. Exploration can be associated with radical innovation and exploitation with incremental innovation [9].

2.1 EXPLORATION STRATEGY

The exploration of new possibilities and ideas is amongst others associated with search, experimentation, risk taking and innovation [9]. An exploration strategy can be extremely powerful in innovation networks, because innovation is often dependent on new combinations of knowledge. New ideas come from partners in different lines of business making different products, since these companies will give access to a different knowledge base. Firms in the same line of business making similar products may be viable partners but are not a source for learning. The companies of a different network enable a firm to learn from a different knowledge base. Firms pursuing this strategy for product development will establish alliances with 'weak ties' [10]. 'Weak ties' in this context are companies outside the core technological field in a different sub-sector of the industry.

However, the lack of trust and commitment in such partnerships can seriously hamper the information exchange between partners. It is extremely difficult to absorb externally acquired knowledge into the existing technological core, especially when knowledge from a different technological field is transferred. A firm's capacity to absorb this knowledge is largely dependent on a minimum of shared knowledge in a specific field. Although firms pursuing an exploration strategy are more likely to learn from alliances with partners of a different (segment of the) industry, some similarities between the partners are necessary to exchange information [7]. Exploration is characterized by opportunistic behavior and enables a firm to bridge two distinct networks of firms, thereby benefiting of the resources of both networks. The network will tend to be open rather than closed [11]. Exploration alliances typically do not involve joint equity relationships and can take the form of licensing and joint R&D [12: 257].

2.2 EXPLOITATION STRATEGY

Exploitation of existing knowledge and capabilities on the other hand is associated with refinement, selection, production and execution [9]. An exploitation strategy is aimed at strengthening and broadening basic knowledge of established technologies and products. This can be done through strengthening existing links and building new, direct partnerships. Maximizing the number of 'strong ties' [13] broadens basic knowledge of established technologies and products. This basis needs to be maintained as a source for (incremental) innovation. 'Strong ties' in the context of this analysis are partners in the same (core) technological field. Firms pursuing an exploitation strategy tighten their existing network and strengthen their knowledge base. 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. Forms of exploitation alliances are typically the establishment of a daughter company in which the parents have equity positions [12: 256]. Exploitation strategy is characterized by multiple agreements with the same partners and a closed network of partners that frequently collaborate over a longer periods of time.

2.3 NETWORK POSITION

The two strategies explained above may lead to different positions in the innovation network. We will argue that weak ties can be extremely powerful in innovation networks because innovation is often dependent on new combinations of knowledge. However, the lack of trust and commitment in such partnerships can seriously hamper the information exchange between partners. It seems to be extremely difficult to absorb externally acquired knowledge into the existing technological core, particularly, in the case of weak ties in which often knowledge from a different technological field is transferred. A firm's absorptive capacity is largely dependent on a minimum of shared knowledge in a specific field [7]. Firms have to have some common expertise and skills in order to be capable of information exchange on new technologies. If the core of a company's technology base is not sufficiently adapted to the new technology, then the absorption of newly acquired external technological knowledge is very difficult. Therefore, weak ties are not very successful in strengthening the existing knowledge base of firms, but can be used successfully for explorative learning.

Strong ties, on the other hand, represent relationships between similar actors that have clustered together in dense areas of the network and are more effective in consolidating and strengthening an existing knowledge base. Since similar players are linked in a network, the information flows between partners are more likely to be redundant [13, 14]. This implies that although radical innovations are more likely to arise from weak ties, strong

ties are probably more able to strengthen or broaden the existing knowledge base, which facilitates the knowledge transfer necessary for innovation. Consequently, firms should aim to develop a balance between exploration and exploitation in order to survive and prosper in a changing environment [9]. This can be done by means of establishing and maintaining both weak and strong ties.

2.4 THEORETICAL ASSUMPTIONS

The theoretical discussion above leads to some basic assumptions than can be explored empirically. It follows from the discussion of exploration and exploitation strategies that different networking strategies may lead to different levels of commitment. Exploration strategies presumably 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. This learning process involves established partnerships and the level of R&D input is presumably lower than in exploration alliances.

For the empirical analysis a distinction will thus be made between R&D alliances with lower levels of commitment and high levels of commitment. Joint development agreements (JDA) and joint research pacts (JRP) are agreements with lower levels of commitment, but involve high levels of R&D input. These strategic technology alliances are non-equity relationship, meaning that the resource input is not equally spread among the partners. These alliances are usually associated with exploration, since high levels of R&D input provide learning opportunities for alliance partners. Agreements with a high level of commitment are equity-based relations as joint ventures (JV) and research consortia (RC). These alliances are associated with exploitation and, if R&D takes place, it will make use of existing capabilities.

Along with the distinction between different levels of commitment, the proportion between the number of alliances and the number of partners will be explored. This will give a second indicator of the level of commitment in innovation networks. A lower number of alliances vis-à-vis partners may indicate a lower level of commitment towards each individual partner. A much higher number of alliances than partners indicate a higher level of commitment towards an individual partner.

Another theoretical notion that can be empirically investigated is the impact of networking strategies on the network position of companies. Exploration strategies may 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 old technological areas. The exploration and exploitation strategies will be investigated below using the MERIT-CATI database of strategic technology alliances, as discussed in more detail in [15] and [16]. In the case of IBM, the embeddedness in innovation networks is investigated from the beginning of the 1990s onwards.

3 DATA AND SAMPLE

The first theoretical assumption presented above is that different networking strategies may lead to different levels of commitment in alliance agreements. Examining the levels of commitment in networking strategies, we took a sample of nearly 2,500 alliance agreements from the MERIT-CATI database. Networking in the ICT domain is an important part of corporate strategies. Most of the firms involved in these alliances are active in the ICT industry, but companies from other sector, like e.g. the automotive or aeronautics industry, also have alliances in the ICT domain. The number of newly established alliances has remained remarkably stable over the period 1985-1996 and fluctuates around 300 alliances per year. The trend of newly established alliances shows a slight decline. In 1989, there is a sharp decrease of newly established alliances, but from the early nineties onwards the number has grown to a peak of well over 300 alliances in 1995. In 1996, the number has decreased slightly.

The types of alliance agreements can take a variety of forms, with a wide range in the level of commitment. Alliance agreements include (cross-) licensing agreements, customer-supplier contracts and standard-setting agreements. The focus of the study presented here is on alliances with a real strategic importance, hence with real commitment of the partners involved. These strategic technology alliances usually involve joint research and development or other forms of technology sharing. There is an overall trend in alliance formation is towards these strategic forms of networking. Especially joint development agreements (JDA) have shown a tremendous growth in importance. In the last period of the sample, around three-quarters of the newly established alliance agreements are joint development agreements, while in 1985 the proportion was only one-sixth. However, the number of agreements with the highest levels of commitment, joint ventures (JV) and research consortia (RC), have decreased. Overall, there is a shift towards lower-commitment agreements, but the R&D input is higher.

Companies with alliances in the ICT domain do not necessarily come from the ICT industry. However, ICT companies are most active in forming alliances in this domain. Most of the companies in our sample are computer hardware, microchip and processor manufacturers, and software producers like IBM, Hewlett-Packard, DEC and Sun Microsystems. Only two companies in the sample have telecom as the core business activity: AT&T and Ericsson. Besides those clear examples of ICT companies, the large and highly diversified electronics concerns Siemens, Philips, Matsushita, Mitsubishi and Sony show significant networking behavior as well. The companies listed here come from the Triad: USA, Japan and Europe, which is in

line with the findings presented in literature on innovation networks [15, 17]. Of all companies in the sample, 15 have established 50 or more alliance agreements in the period 1985 to 1996. Five companies have engaged in 100 or more alliances, namely Sun Microsystems, DEC, Siemens, Hewlett-Packard and IBM. The latter is by far the most active in alliance formation. The number of partners that are involved in all of those alliances can vary and does not have to be the same as the number of alliances, which potentially indicates a variance in the level of commitment as explained above.

Companies can engage in alliances with the same partner more often and an alliance can involve more than two partners. Some companies have more alliances than they have partners and others have more partners than alliances. A much higher number of alliances *vis à vis* partners may indicate the existence of strong ties [13]. In other words, companies that keep the number of partners low in comparison to the number of alliances may be demonstrating a strategy of exploitation. They collaborate more frequently with partners they already know, thereby maintaining and expanding the existing knowledge base. This could be the case with Toshiba, which has 73 newly established alliances with only 62 different companies.

On the other hand, companies that have many more partners than they have alliances may be demonstrating a search for weak ties [10]. They tend search for partners that they did not collaborate with before. This behavior could be indicative for exploration strategies. Philips, for instance, has 91 alliances with 101 different partners. Although such differences in numbers are visible in the sample, a clear indication of either of those two strategies cannot be given. What may even be more important than the numbers of alliances and partners are the technological capabilities that are searched for in the alliance formation process. This will be demonstrated with the case of IBM.

4 IBM'S INNOVATION NETWORKS

4.1 BRIEF HISTORY OF IBM

The history of IBM starts with the history of a few other companies with competencies in different mechanical fields. Computing Tabulating Machines (CTR) was formed in 1911 through a merger of International Time Recording Company, Computing Scale Company and the Tabulating Machines Company. In 1914, Thomas J. Watson Sr. joined the company to become general manager and CTR was renamed International Business Machines (IBM) in 1924. IBM's business machines consistent of a large variety of commercial products, everything from scales and cheese slicers to clocks and typewriters. Watson's patriarchal leadership and personal philosophies defined the IBM culture. Nonetheless, it was his son Tom Watson Jr., succeeding his father as CEO in 1956, who brought IBM into the digital computer age, which was a major turnaround for the company [18: 114].

Under his leadership in 1964, IBM announced its most important product to date, System/360, which was the original name of IBM's "family" of mainframe computers. System/360 in the 1960s and 1970s was as revolutionary as Windows was to Microsoft in the 1980s and 1990s. The comparison between these two companies is appropriate since both IBM and Microsoft benefited from major technological shifts and brought entirely new capabilities for customers to the market [18: 114]. For IBM the integrated circuit was the most important technology shift, though it had been invented elsewhere. This invention made computers significantly smaller, more reliable and cheaper, which made mainframe computers available for a large group of customers. Up to that moment, computers were based on proprietary technologies, but since System/360 was a family of computers – from very small to very large processors – customers could easily make upgrades when needed and software developed for one processor would run on any System/360 processor. In addition, peripheral equipment could run on any processor of the family. In short, System/360 was the ideal system for customers, but its introduction was a devastating for IBM's competitors [18: 115].

Until the early 1980s, IBM was probably the best example of a vertically integrated corporation: almost all stages of design, production and commercialization of computers remained internal to the firm [1]. This was true for semiconductors, hardware, operating systems, application software, and sales and distribution. IBM was the world leader in computer manufacturing and it seemed that the company's leadership position would remain unchallenged for many years to come. IBM was one of the pioneers in mainframe computers and still is the world's largest provider of computer hardware. The company manufactures a broad range of computers, including personal computers, notebooks, mainframe computers and network servers. IBM is also a world leader in the development of software.

Since the position of IBM had been unchallenged for so many years, the company had not developed sophisticated strategies to cope with fierce competition. In the advent of the "next big thing", which was the rise of UNIX rather than the personal computing, IBM was under serious attack. UNIX was an "open" operating system, supported by Sun and Hewlett-Packard, which offered customers the first attractive alternative to IBM's mainframe computers [18: 119]. In addition, IBM failed to see that personal computers (PCs) would be widely used by business and enterprises, so the PC market was not a high priority to IBM. PCs were not thought of as a major challenge to IBM core enterprise computing market. IBM gave control over the operating system to Microsoft and the microprocessor to Intel and in the early nineties, IBM's leadership position started to crumble. Fujitsu, Digital Equipment and Compaq were the competitors for hardware components and were catching up fast. EDS and Andersen Consulting were gaining ground in information services, while Intel and Microsoft were more profitable

in the PC market than IBM at that time [19]. The once so comfortable position of "Big Blue" was fading away at a very rapid pace. In 1994, Louis Gerstner was appointed as CEO and he had the difficult task to transform IBM in such a way that it could regain its competitive position.

4.2 STRATEGY CHANGE OF IBM: ENTERING THE INTERNET ERA

Two forces that emerged in the computer industry in the early 1990s were decisive for IBM's strategic change [18: 125]. The first force, system integration, emanated from customers. Customers increasingly valued companies that could provide solutions integrating technology into the processes of enterprises. Because of this customer-driven force, IBM saw that in time the ICT industry was service-led rather than a technology-led. The second force was the emergence of the networked model of computing that would replace the stand-alone PCs that dominated the market in the beginning of the 1990s. The PC would be one of the networking devices, but the management of free-flowing digital information would be done on large-scale systems rather than desktop computers [18: 126-127]. Thus, computing infrastructure and software would have the future. It was not more than logical that IBM had to turn its attention toward services and software, and in addition the company decided to sell and license leading-edge technology to its competitors. IBM opened its company store [18: 149], which helped Big Blue back in the saddle.

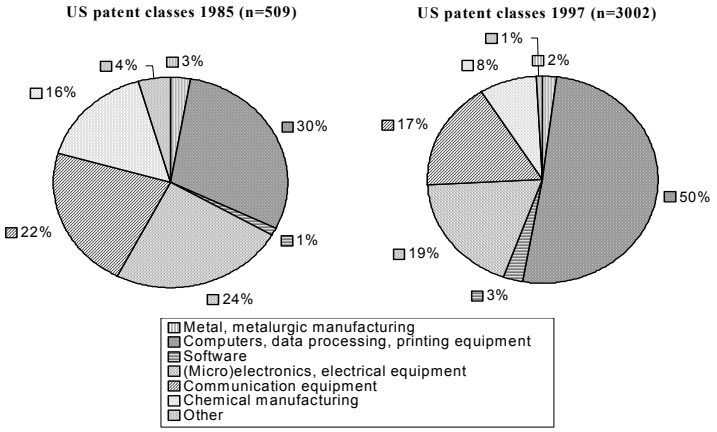
[19] provides an illustration of the strategic change that helped IBM transform from a hardware manufacturer into a dominant service provider. The major change that took place in the mid-nineties constituted in a few visionary individual IBM people who discovered the Internet as the most potential source of future revenues. This small group of believers developed an Internet strategy for the corporation as a whole.

An important initiative to help IBM catch the Internet wave was undertaken by David Grossman, a computer programmer who was one of the first to download the Mosaic browser and explore the Internet [19]. To his surprise, IBM had zero presence on the Web while competitors like Sun-Microsystems and Hewlett-Packard already had set-up websites and used it actively. IBM was the main sponsor of the Winter Olympics, but Sun used IBM-generated up-to-date scores and other data, presented on television, on their Winter Olympics website, as if Sun was the main sponsor instead of IBM. Grossman managed to convince John Patrick, an IBM strategist, and eventually IBM's CEO Gerstner, that IBM needed to "get connected" [19]. Grossman and Patrick formed an Internet group, which hired employees from division across IBM, which bundled all Web technology that people had been working on in the company. The first showcases came in 1994 with IBM's Global Network, as the world' s largest Internet Service provider, and a Web browser that preceded Netscape's Navigator and Microsoft's Explorer. For the 1996 Summer Olympics the Internet group developed a Web site with an extensive scoring database attached to it and the possibility for on-line sales tickets. The Web server software developed for the Summer Olympics evolved into a product called Websphere, which formed the basis for IBM's Web-hosting business of today [19]. The products developed by Grossman's group lead to a dramatic flight of e-business activities of IBM and have eventually transformed the company into a Global Service provider. Not surprisingly hardware had been the core business activity in the second half of the 1990s. However, in 2001 the revenue stream of Global Services has become the most important. The Global Services division had generated revenue of almost $35 billion in 2001, which was more than IBM's hardware division generated.

The growth of the Global Service division indicates that IBM is undertaking a change in the internal organization and core business activities. Figure 1 illustrates the development of core activities of IBM with a comparison of patent profiles between two moments in time.

These profiles show the technical areas in which IBM has issued patents in 1985 compared with 1997. What is evident from this comparison is that computer manufacturing is still the main manufacturing activity. The shares of patents in chemicals and (micro) electronics have clearly decreased, indicating that these activities have become less important for IBM. On the other hand, software patents have shown a sharp increase.

Figure 1: IBM patent profiles, granted patents



Source: US Patent Office

This indicates that software development has become another major activity of IBM. From the above, it is clear that IBM has undergone a drastic business transformation and is gradually changing core competencies in this process. In the next section, we will discuss to what extent networking strategies had an impact on this process of business transformation.

4.3 NETWORKING STRATEGIES AS A MEANS TO RESTRUCTURE BUSINESS ACTIVITIES

Although Gerstner does not explicitly mention networking strategies, they seem to be important in 'opening the company store' [18: 146]. In the previous section, it has been shown that the core competencies of IBM are gradually changing. In this section, we will investigate how networking strategies facilitated the business transformation of IBM initiated by Gerstner. In order to do this, the networking strategies of the early nineties, before Gerstner's arrival, are compared with the networking strategies in the mid-nineties and the beginning of the 21st century.

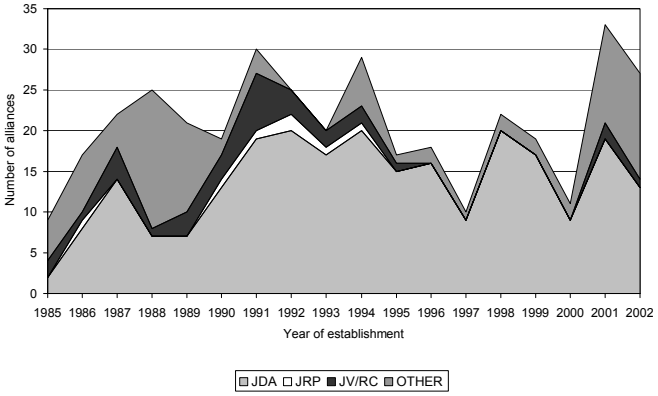
Most activities that characterized IBM in the late eighties and early nineties have been gradually farmed out to multiple layers of specialized suppliers, giving rise to rapid market segmentation and an ever finer specialization within each of the above five main value chain stages [1]. This has given rise to the co-existence of complex, globally organized product- specific value chains (e.g., for microprocessors, memories, board assembly, PCs, networking equipment, operating systems, applications software, and sales & distribution). An important initial catalyst of vertical specialization was the availability of standard components, which allowed for a change in computer design away from centralized (IBM mainframe) to decentralized architectures (PC, and PC-related networks).

IBM had more alliances than any other company in the sample: 204 alliances with 191 different partners in the period of 1985 to 1996. These numbers are by far higher than any other company in the sample, which makes IBM an interesting case for further investigation. The alliances of IBM in the sample are all within the ICT domain, which is defined in the MERIT-CATI database as computers, industrial automation, micro-electronics, software, telecom and miscellaneous other activities [20]. We will compare the patent profile of IBM (Figure 1) with strategic technology alliances, which enables us to investigate two basic alliance strategies, namely exploration and exploitation strategies.

The focus of attention in the IBM's strategic technology alliances over the years is rather volatile. Computer and microelectronics manufacturing, and the development of standard and dedicated software are subject to almost half of the total number of alliance agreements. However, computer manufacturing has become less important in the last few years, which may indicate that the profile of core competencies is gradually changing. In contrast, strategic networking in the area of telecommunications and software development has become more important.

IBM tends to be very active in developing software for third parties. Examples of these types of software development agreements are alliance with airline-companies such as a flight reservation system for American Airlines in 1992). IBM is also very active in developing communication networks, such as local area networks. The company is to a lesser extent involved in industrial automation, such as CAD/CAM applications.

Figure 2: IBM's strategic alliances



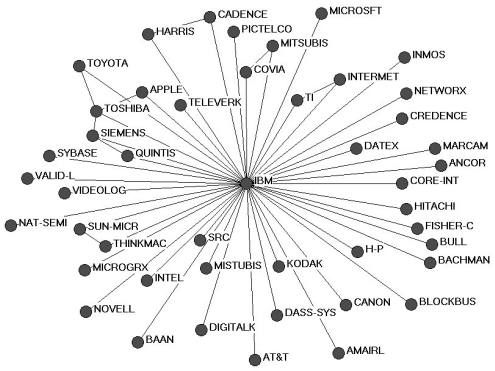
Source: MERIT-CATI; CGCP.

A change in networking strategies can also be seen from a change in the level of R&D that is involved in strategy technology alliances. The alliances of IBM are subdivided by type of agreements in Figure 2. The first category of agreements is joint development agreements (JDA) and joint research pacts (JRP). These are non-equity agreements on joint research and development and indicate exploration [12]. The second category is joint ventures (JV) and research consortia (RC). These agreements are based on equity and usually involve joint R&D, though some joint ventures are joint marketing ventures. Equity agreements are usually associated with exploitation [12]. The third category is other alliance agreements, which include standardization agreements and cross licensing. Though these agreements are of strategic important to IBM, they usually involve a lower level of R&D.

The pattern of alliances is rather volatile, both in terms of the number of agreements as in terms of the type of alliance agreement. What is clear from Figure 2 though, is that alliance agreements involving joint R&D are a substantial part of the overall alliance portfolio. However, the agreements with high commitment, joint ventures and research consortia, have become less important in IBM's networking strategies over in the last decade. This trend indicates that exploration is becoming more important than exploitation.

In order to see the significance of the overall corporate strategy change at IBM, the network embeddedness of IBM in the period before Gerstner's appointment is compared with the period after that. In the period 1991-1992 IBM engaged in 54 alliances, of which 43 were joint development agreements and joint research pacts, nine were joint ventures and research consortia and two cross-licensing agreements (see Figure 3).

Figure 3: IBM's innovation network (1991-1992)

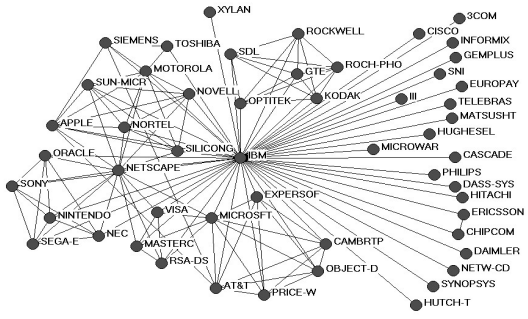


Source: MERIT-CATI

Out of those 54 strategic alliance, 23 were in the field of computer manufacturing, mainly in development of microprocessors, and 23 in the field of software development, mostly related to operating systems and software architecture. IBM had two important alliances with Microsoft and Intel. Microsoft and IBM cross-licensed Windows NT and with Intel, IBM had a long-term agreement on the development of microprocessors. This latter agreement had a time horizon of 11 years, but was terminated in 1993. The two agreements confirm IBM's choice for the so-called Windows/Intel personal computers.

IBM intensively collaborates with personal computer and software developer Apple on many fields of alliances within the ICT domain. The collaboration with Apple seems strange, since IBM and Apple support different and competing basic designs of computing [21]. However, in the period 1991-1992 IBM and Apple had ten strategic alliances, mainly related to the development of microprocessors and software architecture. Apple and IBM have had 25 alliances in the period 1991-1996. These alliances include both joint development agreements as joint ventures. The technologies developed in these alliances are mainly microprocessors for PowerPCs and mainframe computers, and the development of software, include network software, operating systems and multimedia applications. In the period 1997-2002, strategic alliances between IBM and Apple are not reported.

Figure 4 IBM's innovation network (1995-1996)



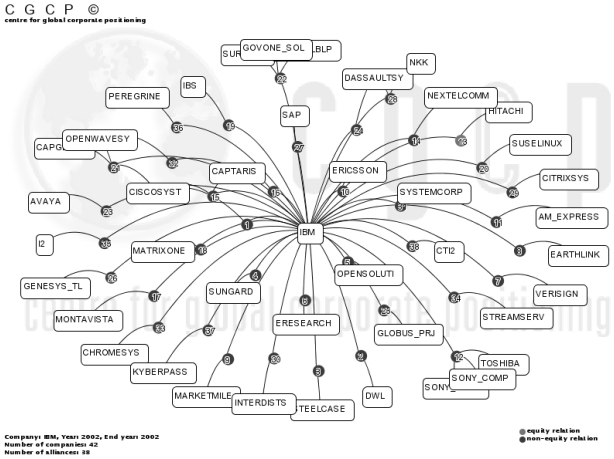
Source: MERIT-CATI

In the period 1995-1996, IBM had 40 strategic alliances, of which 32 were joint development agreements, five were joint ventures and 3 cross-licensing agreements (Figure 4).

What stands out immediately when comparing this period (Figure 4) with the previous one (Figure 3) is the collaboration with multiple partners and the increased complexity of the network configuration. In the period 1991-1992 most agreements were bilateral, but in the period 1995-1996 there are some large consortia involving many different partners. The multiple partnerships with Toshiba, Motorola and Siemens are all in developing microchips, one of IBM's core competencies.

From 1996 onwards, it becomes clear that the pioneering work of the Internet group at IBM [19], which has been discussed above, has been mutually reinforced by corporate networking strategies. Before 1996, IBM has had no alliance agreement related to the development of Internet-related products or services. In 1996 only 3 out of 18 alliance agreements deal with Internet, of which one is a joint venture with Netscape, Oracle, Sony, Nintendo, Sega Enterprise and NEC. This joint venture is set up for the development of Internet browsing software. From 1996 onwards, Internet-related products and services are becoming more and more important. IBM has gradually employed networking strategies in a variety of Internet-related products and services, based on the products developed by the Internet group like Internet browsers, ThinkPad, WebSphere and other e-business applications. IBM's core competencies are still in computer hardware and software, but the focus of attention is shifting to Internet and e-business solutions, a field unknown to the company before 1994. So, in a relatively short period of time IBM managed to change from a laggard to a leader in global (Internet) service provision. This has been achieved first through internal organizational transformation and second through a new portfolio of networking strategies.

Figure 5 IBM's innovation network (2002)



Source: CGCP 2002

When comparing the network and alliances of 1995-1996 and 2002, it seems that alliances on computer manufacturing have become less important. In 1996, hardware manufacturers as Toshiba, Motorola and Sun Microsystems were prominent partners of IBM (Figure 4), whereas there are no alliances with these companies in 2002 (Figure 5).

On the other hand, alliances on software and telecommunications have become more important. Alliances with Netscape, Oracle and Object-D in 1995-1996 (Figure 4) and with Citrix, Openwave Systems and CapGemini Ernst & Young in 2002 (Figure 5), for instance, show that IBM explored a wide variety of software development projects. In the field of telecommunications, IBM has been developing new products with leading mobile phone manufactures such as Ericsson in 2002 and aircraft manufacturer Boeing, and telecom service providers such as Nextel in 2002. These collaborations make IBM a strong partner in telecommunications in North America, Europe as well as Asia.

The data presented in Figure 3-5 show that IBM engages mainly in alliances in the fields of computer manufacturing and software development, the company's traditional core competencies, which may lead to conclude that IBM has mainly exploited existing capabilities. Frequent partners on different fields are some of IBM's most serious competitors Hewlett-Packard, Intel, Novell, Siemens, Sun Microsystems, Texas Instruments and Toshiba, and with the competitor from a different basic design of personal computers: Apple. These frequent partnerships demonstrate that IBM maintains relationships with a select group of partners on a wide variety of projects over a longer period of time. This networking strategy indicates a preference towards maintaining relationships with strong ties, instead of searching for non-redundant partners in weak ties. In 2002, however, the partners come from a different field. None of the frequent partners in hardware manufacturing can be found in Figure 5, but rather in client-based software and services. This trend indicates that IBM is becoming more of a service-led company, which reflects Gerstner's strategy of business transformation. The analysis of IBM's innovation network indicates that the company is exploring new technological capabilities. IBM has exploited existing knowledge on computer manufacturing and software development for new areas of R&D, manufacturing and service provision. IBM has, thus, actively changed its innovation network from year to year, adapting to technological, economic and market developments.

5 CONCLUSIONS

The main question addressed in this paper was how used innovation networks in order to cope with the challenges that a drastically changed competitive environment imposed upon IBM. IBM has been a dominant player in the ICT industry and has engaged in significantly more alliances than other companies in the period from the mid-eighties to the mid-nineties. The networking strategies of IBM show a clear shift towards lower-commitment R&D alliances, which points to exploration. The networking strategies have proven to be a good indicator of changes in technological capabilities, which will ultimately lead to changes in patenting behavior. The position of IBM in the innovation network also showed the exploration of new capabilities through partners outside the core competencies of the firm, along with the exploitation of old competencies with other hardware and software developers.

The case of IBM showed that the company has been capable of reorganizing its business activities and adapting its core competencies in just of few years time. It is, however, hard to determine whether the business transformation followed the development of networking strategies or vice versa, or that these developments are two sides of the same coin. Networking strategies seem to have played an important role in the process of business transformation, but the importance of networking had already been recognized before the major business transformation took place. Gerstner's role in the transformation is paramount, but a case can made that networking was decisive for putting IBM back on the map.

The business transformation initiated by Gerstner resulted in the emergence of the Internet group at IBM, which gave the company a leading position in Internet-related products and services from the mid-nineties onwards. Along side with this internal change, networking strategies and the continuous change of the innovation network have proven to be of great importance. IBM used to be a computer manufacturing company, but succeeded to become one of the most important software developers and service provider in the global economy.

In dealing with the competitive thread of new areas in the ICT industry, IBM entered telecommunications manufacturing and services. As a result, IBM has successfully established itself in the New Economy and will hold a leading position in computing, software and telecommunication services. The company used its solid base of core competencies in computer hardware and software to become a global service provider and a leader in Web-hosting and e-business. For a large, old company this has meant a rigorous change of the internal organization facilitated by actively developing strong international innovation networks.

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