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Open Innovation in Global Networks

Chapter 3

Insights from the Company Case Studies

Chapter 3 complements the "academic" analysis with insights from the 59 company case studies undertaken for this project. Their number and variety (manufacturing and services, high and low technology, MNEs and SMEs) enable an informed discussion of the diversity of open innovation in various contexts. In addition to the aggregate information drawn from the case studies, examples of how companies organise open innovation are presented.

General overview

Company case studies were undertaken in several countries to assess how open innovation is implemented in practice in different sectors and types of firms. The aim was to understand the extent to which open innovation is helping firms respond to the challenges of globalisation. A standard questionnaire was distributed to companies and followed by interviews. In selecting the companies for the case studies, attention was paid to choosing a diversity of firms across countries.

Most companies covered by the case studies implement open innovation through innovation networks as an integral part of their strategic development. By innovating in an open framework, companies co-operate with the best in their business and take advantage of the expertise that these partners have built over many years. Companies look at open innovation as close collaboration with external partners, *i.e.* customers, consumers, researchers or others that may have an impact on the future of their company.

The 59 case studies were conducted in 12 countries: Belgium, Denmark, Finland, France, Germany, Greece, Japan, the Netherlands, Norway, Spain, Switzerland and the Russian Federation. The companies are listed in Table 3.1. They include manufacturing and service companies, large firms and SMEs, high-technology and low-technology industries. They are classified according their NACE code into eight major industries: pharmaceuticals and life sciences, chemicals, electronics and telecommunications, ICT, transport equipment, materials, fast-moving consumer goods (FMCG) and services.

High-technology[1] industries are well represented: the ICT industry and the electronics and telecommunication industry each account for 11 case studies, while the pharmaceutical and life sciences industry has six (Figure 3.1). Chemicals and transport equipment (automotive, aerospace and shipbuilding industry) are also represented. Lower-technology industries include the fast-moving consumer goods (FMCG) industry (seven companies) and the materials industry, including wire drawing, textiles and glass (nine companies). Nevertheless, even in these lower-technology industries, companies often perform "high-technology" activities, including R&D. In total the manufacturing sector has 46 case studies, while the broad services sector (including some ICT and electronics and telecommunications companies) have 13.

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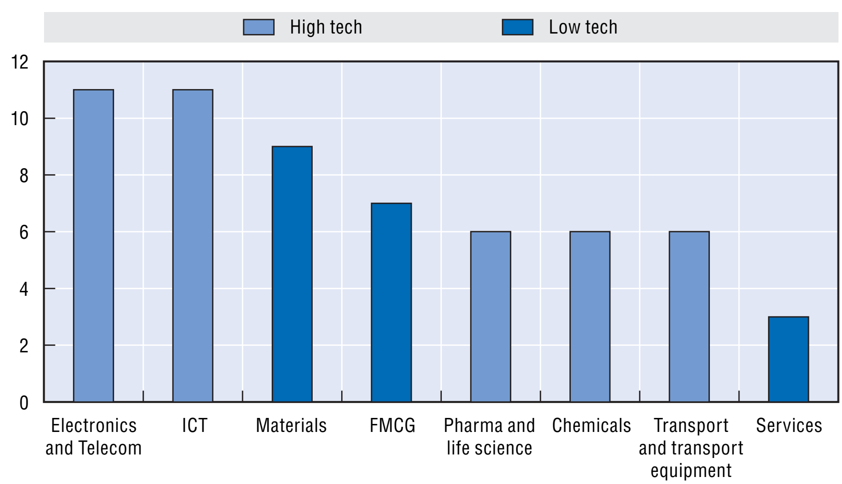
Table 3.1. **Company case studies**

Country	Companies
Belgium	Bekaert, Herstal Group, J&J, MACQ Electronique, Numeca International, P&G, TWIN Development,
Denmark	Danisco Ltd., Exiqon Ltd., Gabriel Ltd., IBM Denmark Ltd., Quilts of Denmark Ltd.
Finland	Nokia
France	Air Liquide, Alcatel Lucent, ArcelorMittal, Dassault Systèmes, Danone, Saint-Gobain SEB, SNECMA, Valeo
Germany	Siemens AG Transportation Systems, Case Germany 2, Case Germany 3
Greece	Eurobend, S&B Industrial Minerals, Velti, Case Greece 4, Case Greece 5
Japan	NEC, Omron, Toray Industries
Netherlands	Philips, Case Netherlands 2, Case Netherlands 3
Norway	Aker ASA, Ewos Innovation eZ Systems, Q-Free,
Russia	Biological Research & Systems, Biopharm, Stack Group, Case Russia 4
Spain	Case Spain 1, Case Spain 2, Case Spain 3, Case Spain 4, Case Spain 5
Switzerland	ABB, Alcan Engineered Products, Clariant, IBM Zurich Research Laboratory, Microsoft Suisse, Nestlé, Novartis, Siemens Building Technologies, Swiss Reinsurance Company, UBS

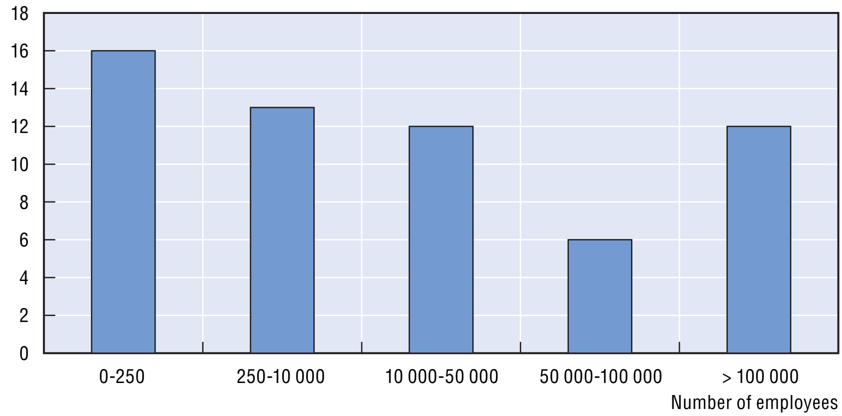
Figure 3.1. **Number of company case studies, by industry**



Source: OECD case studies.

Larger firms are over-represented in the case studies (Figure 3.2). Only 16 can be considered SMEs, *i.e.* companies with fewer than 250 employees. Within the group of larger firms, 13 have between 250 and 10 000 employees, 12 have between 10 000 and 50 000 employees, six have more than 50 000 employees and 12 very large companies report more than 100 000 employees.

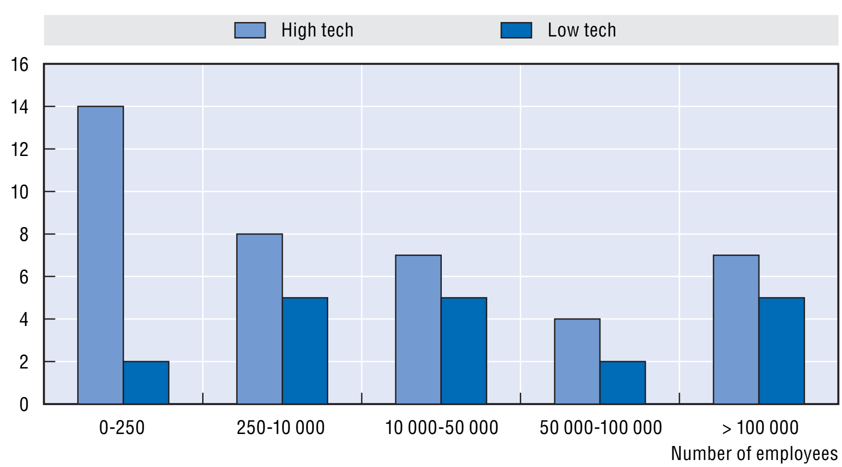
Figure 3.2. **Number of company case studies, by employment**



Source: OECD case studies.

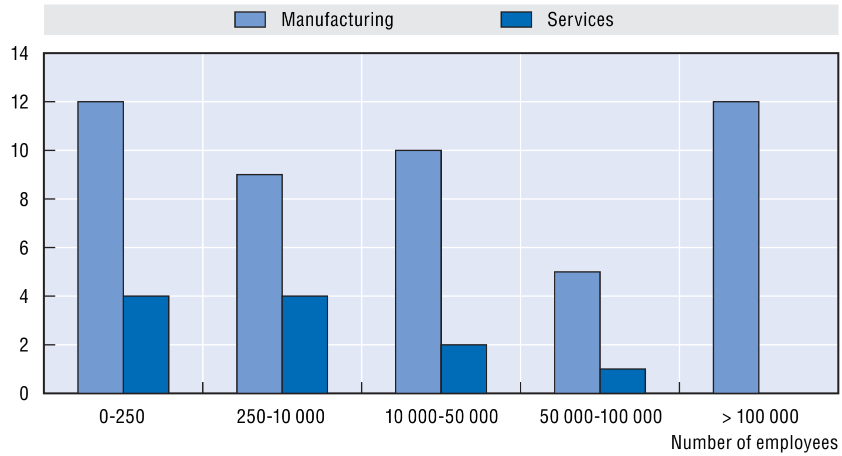
Numbers of employees are used to show the diversity of firms covered by the case studies. Most SMEs in the sample are in high-technology industries (Figure 3.3). There are also somewhat more large companies in high-technology industries (the overall sample had more case studies in high-technology than in low-technology industries). Companies in the services sector tend to be smaller; There is no service company with more than 100 000 employees, while there are 12 manufacturing firms (Figure 3.4).

Figure 3.3. **Number of company case studies, by industry and employment**



Source: OECD case studies.

Figure 3.4. **Number of company case studies, manufacturing and services, by employment**



Source: OECD case studies.

Quantitative findings on the globalisation of innovation

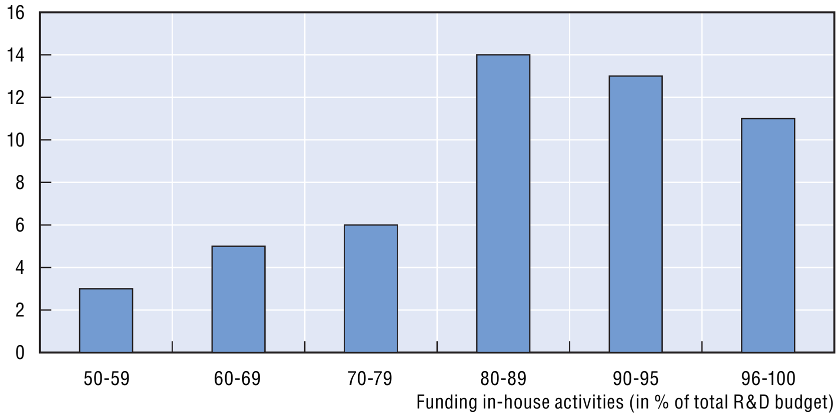
In order to structure the interview process, a standardised questionnaire was designed to collect information from innovative companies in the various countries. The quantitative part of the questionnaire focused on the globalisation of innovation, *i.e.* how companies reacted to the ongoing globalisation process, and the information presented here is based on the case studies. Some of the graphs are based on fewer case studies owing to missing values.

Basic information on innovation and R&D

The case study material shows that 67% of the companies reported R&D expenditures of between 1 and 10% of sales, while 18% of the companies reported 20% or more. The percentage remained quite stable over a five-year period, with half of the companies reporting no change, while the other half reported minor changes of 1 to 10%.

Almost three-quarters of the companies indicated that 80% or more of their R&D budget is spent on in-house R&D (Figure 3.5). Nevertheless, most are actively involved in open innovation practices: 51% of the companies allocate from 0 to 5% of their R&D budgets to research in other companies, while 31% allocate more than 10%. They fund less research in public research organisations (Figure 3.6). These percentages also remained relatively constant over a five-year period. Best practices in open innovation are therefore likely to have been in place during the last five years since their implementation typically takes some time.

Figure 3.5. **Importance of in-house innovation activities**
Number of companies



Source: OECD case studies.

In terms of the output of companies' innovation activities, 33% introduced one to ten new products or services on the market during the previous five years. Almost 55% introduced from ten to 30, and only 15% introduced more than 30. In almost 50% of the companies, sales of new products or services only represented up to 20% of total sales. However, four companies reported that more than 80% of total sales was due to new products and services.

Activities other than R&D found to be very important are research on market trends and co-ordination with customers (Figure 3.7). Other activities include working with third parties, development of new business, as well as production, manufacturing, sale and procurement.

Changing business strategies owing to globalisation

When asked to select the three most important aspects of globalisation for their company during the last five to ten years, most companies mentioned possibilities for exporting existing products to new countries/markets (Figure 3.8). Other important aspects cited were the need to introduce new products or services immediately at global scale and investing in new manufacturing facilities abroad in order to adjust products to local needs. Relocating R&D facilities to countries with relatively low wages was less important. These results concur with the findings that companies base their decisions to locate R&D on market potential and quality of R&D staff rather than on the lower costs of R&D staff in developing countries (Thursby and Thursby, 2006) (see also OECD, 2008).

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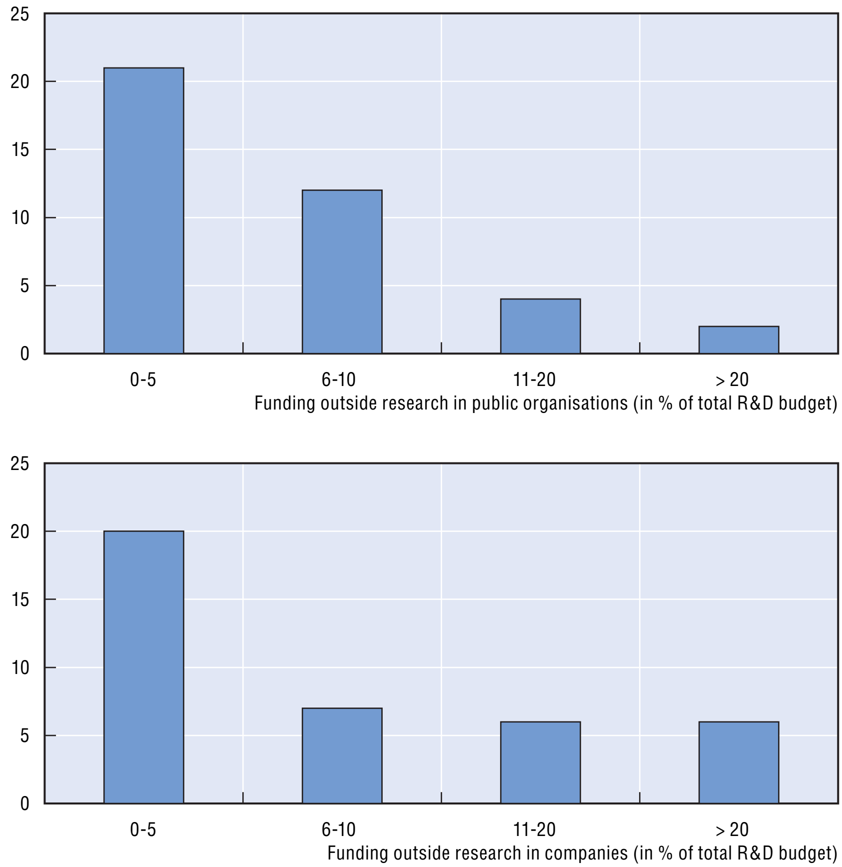
Figure 3.6. **Importance of research in public research organisations and companies**

Number of companies



Source: OECD case studies.

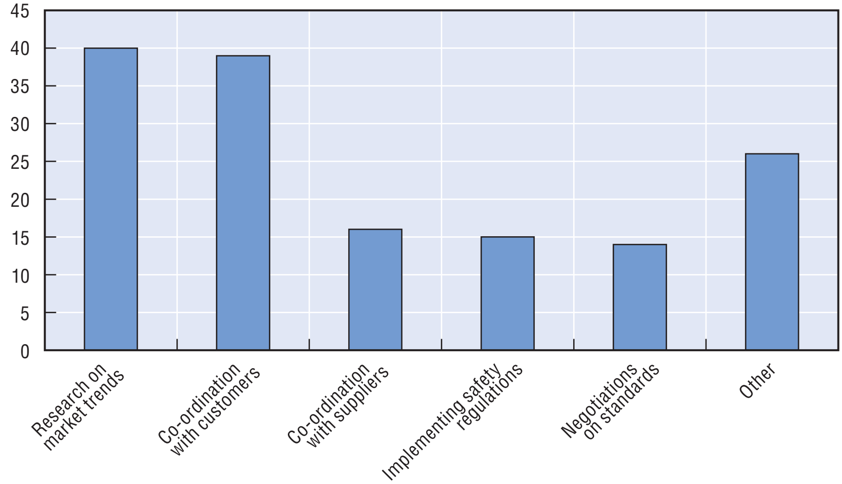
Companies pointed to the globalisation of R&D units, and the exploitation of public research results as the most important changes in their business strategy. Foreign lead users and suppliers for new product development proved to be of minor importance.

Globalisation of R&D

In analysing the geographic dispersion of R&D activities, 74% of the companies indicated having R&D facilities in one to ten countries; the most global company had R&D facilities in 26 countries. There was a clear difference between European and Japanese companies for the location of R&D abroad: European companies located most of their R&D facilities in Europe or in the United States

Figure 3.7. **Activities other than R&D that are important in innovation**

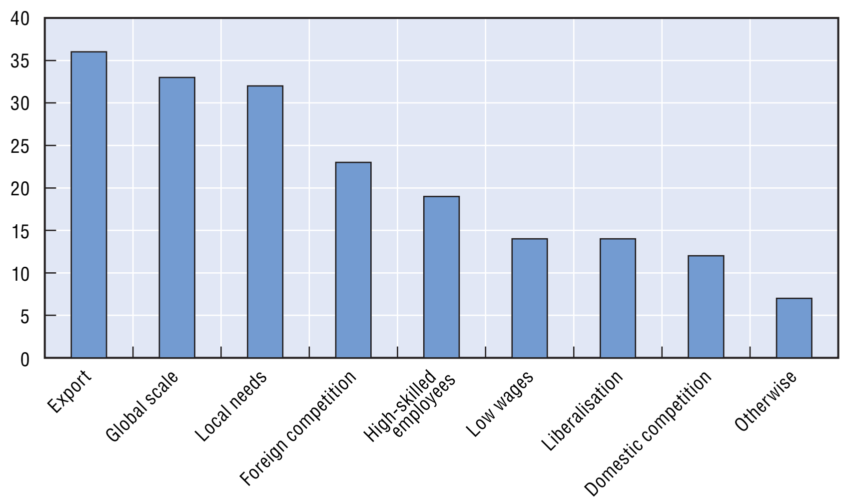
Number of companies



Source: OECD case studies.

Figure 3.8. **Importance of different aspects of globalisation**

Number of companies

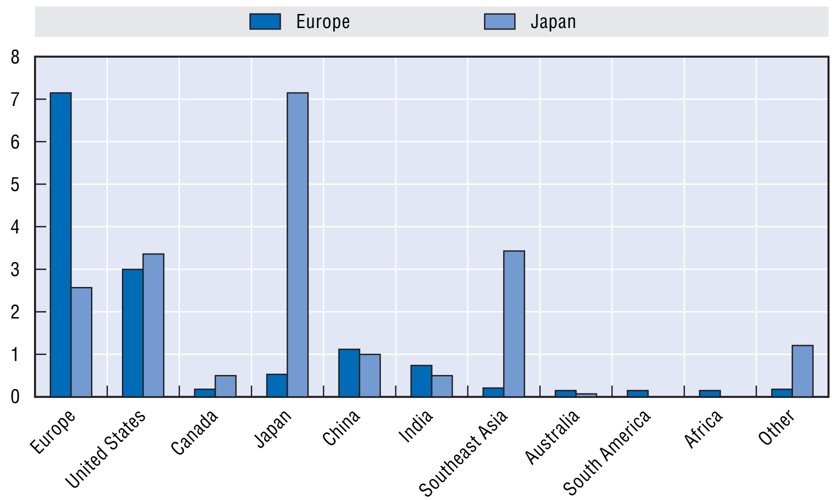


Source: OECD case studies.

(Figure 3.9). More than 70% of their total R&D investment still took place within the European Union, but China and India have become more prominent. Japanese companies have located their R&D facilities mainly in south-east Asia,

Figure 3.9. **Location of R&D facilities**

Scale from 1 (less attractive) to 10 (very attractive)



Source: OECD case studies.

although the United States and Europe are becoming more popular. Very few companies have R&D facilities in South America, Africa or Australia.

These results are largely in accordance with the 2005 EU survey on R&D investments and business trends in ten sectors which looked at the location of R&D facilities (in the survey all companies are based in the EU). It was reported that:

> "Germany, the United Kingdom and France form a group of the three most favoured countries, followed by the Netherlands, Italy and Sweden. In more than 60% of the cases, the firms stated their home country as one of the three most attractive locations. Underlying reasons for the preference of the home country may be geographic proximity to other company sites or familiarity with the national socioeconomic environment. When eliminating the home base as a possible choice, the new member states of the EU gain over-proportionally in weight but do not enter the top five. It seems that, while companies prefer to choose an R&D location within their country, this location is then subject to the same R&D strategy as any other company site outside the home country. By sector, the figure reveals that many countries are strong in all sectors. Often, the preferred choice is a country with sector-specific clusters such as Germany and France for automobiles and parts. Electronics and electrical equipment prefer the United Kingdom and Sweden. Engineering and machinery is relatively well distributed over all

> countries. However, it should be re-emphasised that the statements are related to the home country in the majority of the cases. Regarding the preferred location outside the EU, a group of three countries can be distinguished. The United States, China and India had the highest popularity index. For the United States, drivers of R&D investment are mostly a combination of technology clusters/academic institutes and markets/customers. For China, the main drivers are markets/customers and a low-cost skill base. The latter is also a main driver in India, together with the qualification of workers."

In general, companies are found to have three types of R&D facilities: local development centres, global research labs or global development centres (Sachwald, 2007). Close to 60% of companies had local development centres. Local development centres traditionally support production at the home base. Some 20% of companies had global research labs that extend the home-base R&D units and contribute to the global innovation process of multinationals by generating applications for different countries. They may be organised as part of a global network of laboratories, in which the core R&D unit in the country of origin has a less central role, or be a small specialised laboratory with a very specific research area in relation with a local university. Some companies have set up global development centres (21%). These are in charge of R&D tasks that can be separated and plugged back into the MNE's innovation process; these include back-office tasks, such as specific studies, tests or software writing.

The main reason to locate research and/or development facilities abroad is the proximity of large and growing markets. Other important factors are the availability of engineers and researchers and proximity to other activities of the company (production, sales). Factors such as proximity to suppliers, low labour costs for researchers, the low degree of regulation of product markets or the presence of lead users were viewed as unimportant. Figure 3.10 shows the number of companies stating that a particular reason was critically important for them. The 2005 EU Survey found very similar results:

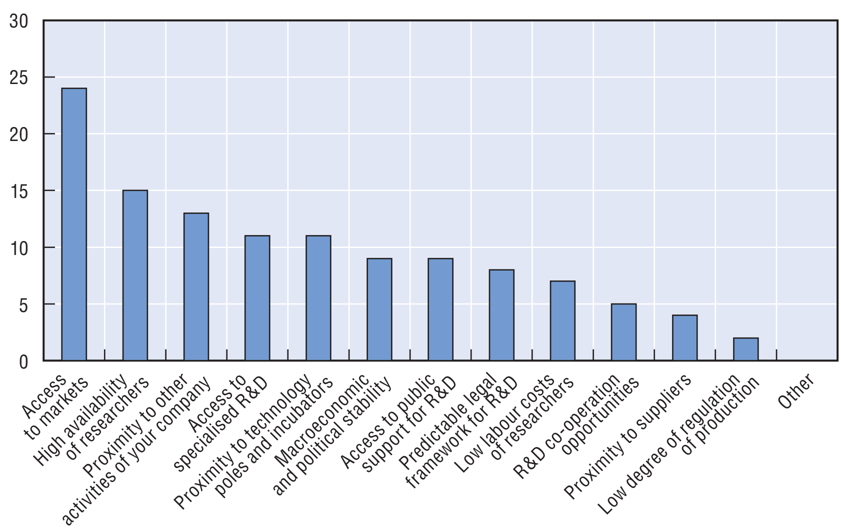
> "The respondents made statements about twelve factors for locating or increasing some of the company's R&D investment in a country other than its home country. The answers can be split into three groups. The first group consists of market access as the most important factor with more than two-thirds of the respondents rating it very or crucially important in all sectors. The second group contains seven other factors which have some importance[2] for the choice of the R&D investment location: high availability of researchers, access to specialised R&D knowledge and results, macroeconomic and political stability, R&D co-operation opportunities, proximity to other company activities, a predictable legal framework for R&D and proximity to technology poles and incubators. The factors in the

third group have less importance:[3] low labour costs of researchers, public procurement for innovative products, proximity to suppliers and a low degree of regulation of the company's product markets. It stands out that the often mentioned labour costs of researchers seem to be less significant compared to many other factors. A sector-by-sector analysis shows that market access as a location factor for R&D investment is less important for IT hardware than for the other sectors. A high availability of researchers and access to specialised R&D knowledge and results are very or crucially important for more than two-thirds of the respondents in IT hardware as well as pharmaceuticals and biotechnology, which suggests that these sectors are hungry for knowledge."

The main barrier to internationalisation of R&D was the risk of leakages of information and proprietary knowledge. Other factors inhibiting international R&D were the need for close supervision and control of R&D, and higher co-ordination and communication costs (Doz *et al.*, 2001).

Figure 3.10. **Critically important reasons for the location of R&D facilities**

Number of companies



Source: OECD case studies.

Qualitative findings: open innovation on a global scale

The second, more qualitative part of the questionnaire focused on open innovation as a strategic reaction to the ongoing globalisation process. It concentrated on certain topics in order to structure the subsequent interviews. The questions under each topic were indicative and were intended to facilitate discussion. In some countries, the qualitative part of the questionnaire was supplemented by in-depth case studies. This section brings out the main findings on these topics.

The use of external sources of innovation

The major motivation for engaging with external sources of innovation was to speed up innovation by tapping into knowledge from research institutes, companies and adjacent markets. When companies look for external sources of innovation, they tend to focus on specific technologies or products, rather than to seek to collaborate with specific companies. Other motivations were to find ideas for new projects, to attract and retain talent and to increase external funding of ideas and technology development.

External sources of innovation also present some pitfalls. Companies pay particular attention to the fact that partners' expectations, time schedules and interests in the project need to be aligned. The drivers and rewards need to be the same for all in order to achieve a fruitful, long-term collaboration.

Both MNEs and SMEs use external sources of innovation. MNEs in particular implement open innovation on two levels. First, they co-operate closely with external partners. Customers were found to be important determinants of the innovation process, especially for radical innovations. Second, they view open innovation as openness between business units *e.g.* mechanisms that make it possible for each unit to draw on knowledge available in other units. In order to establish this kind of openness, strong person-based networks and intranet sites for connecting people from different departments within the company are essential.

For SMEs, open innovation has a slightly different meaning as the type of external information mainly concerns market developments, new trends and customer requirements, in addition to scientific and technological information (new developments or techniques in relation to the technologies underlying the applications that the company develops). Lead users are an important source of information, as their needs often signal future market developments and changes in technologies and know-how.

Open innovation is reported to involve close interaction among people and to create an ecosystem within and beyond the company's boundaries. This is true of the SMEs studied and may be related to the fact that most are active in higher-technology industries. An SME's networks are often very valuable and when the SME is acquired by another company, it is crucial to

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Box 3.1. **Saint-Gobain**

Saint-Gobain reaches out internally by creating multi-sector/multi-centre programmes on technological topics of strategic interest that are shared by its different businesses. The objectives are to leverage cross-disciplinary expertise and to identify and satisfy common needs such as upstream competencies (academia, consultants) and downstream competencies (market knowledge, contacts). Saint-Gobain has set up several horizontal R&D centres *e.g.* in Northboro (United States), Aubervilliers (France), Cavaillon (France), and Shanghai (China) which are in charge of developing the company's key competencies. These R&D centres possess the critical mass necessary to carry out breakthrough projects; they also act as hubs for academic contacts and are attractive to talented young scientists. These programmes help Saint-Gobain to reach out externally by developing partnerships.

Saint-Gobain has also developed a techno-marketing team, an external venturing team and the Saint-Gobain University Network (SUN). The role of the techno-marketing team is to identify new applications for existing technologies, to assess emerging markets and technologies, and to propose new approaches for new/existing markets. The external venturing team combines ideas from innovative start-ups with the industrial strength and assets of Saint-Gobain. The Saint-Gobain University Network develops long-term interactions with the best research teams in their domains to keep an eye on technological developments. It also helps in hiring students from top universities in countries of strategic importance for Saint-Gobain.

integrate these networks. However, some of these partnerships may end if the knowledge is already available in the acquiring company. The acquiring company has advantages if it has internalised the open innovation model, since this makes it easier to manage IP. The management of IP in a true open innovation model (*i.e.* with external partners) is more difficult since it requires managing the IP interests of different partners, with different cultures and processes.

MNEs actively create ecosystems, as illustrated by the high-technology campuses and networks set up by some of the companies studied. The objective is to generate opportunities for co-operation and joint ventures, create valuable partnerships and turn ideas into business ventures. In most cases, one large company is the main investor, as this maximises the company's support and allows its researchers to be actively engaged in the

Box 3.2. **Quilts of Denmark**

Quilts of Denmark collaborated with NASA in order to optimise in-house innovation that was not entirely successful. The quilts made by Quilts of Denmark are based on knowledge provided by sleep researchers who tell Quilts of Denmark about the real needs for quilts, *e.g.* temperature regulation in relation to insomnia. Quilts of Denmark worked on a technology for regulating the temperature in quilts but it was not completely successful.

Quilts of Denmark then learned in a scientific journal that NASA had solved this problem and invented a technology called TempraKON®. NASA sells rights to some technologies that can be used for peaceful purposes. NASA receives public funding for research, but in return the technologies must be used to improve the quality of life on earth. The company Outlast had bought the rights to this technology for use in materials for house insulation. Quilts of Denmark contacted Outlast and they agreed on a joint development. Basically Outlast kept the rights for insulation materials and Quilts of Denmark received the rights for down quilts and pillows. However, NASA's technology could not be transferred directly to the company's quilts, since quilts are soft and the technology invented by NASA was very stiff. The technology was modified in a lengthy development project with Outlast. A producer of winter jackets now has a licence to use the technology owned by Quilts of Denmark.

high-technology campuses and networks. This may lead to interesting spillover effects between this company and the other companies present at the campus.

In creating an ecosystem, the company's focus is mostly not geographical but technological. However, most companies indicate that geographical proximity creates fewer problems of confidentiality. Some ecosystems are therefore local, while others have a more global focus.

External sources of innovation are used by MNEs at the corporate level and at the business unit level. Several companies have set up units to look for and identify external sources of innovation: to find interesting research at universities and other research institutes (focus on science); to seek partners (focus on potential opportunities); and to identify key technology trends and new business development. At the business unit level, companies set up business development departments for each unit, mainly with a market-oriented focus *e.g.* co-marketing or co-manufacturing.

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Box 3.3. **Philips: High-technology Campus Eindhoven**

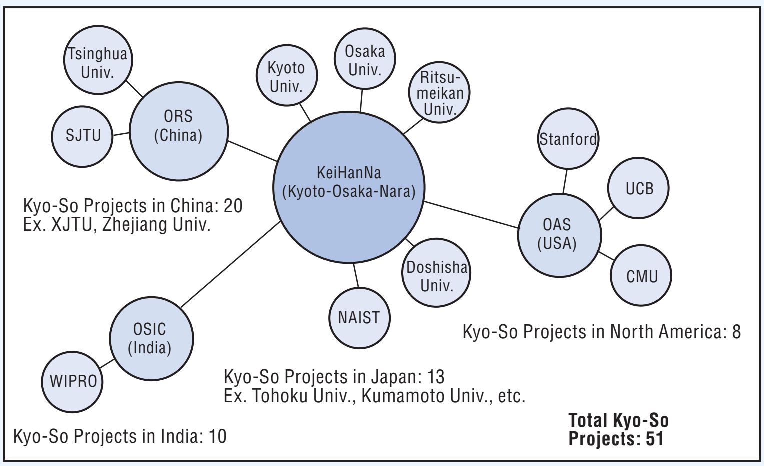
The High-technology Campus Eindhoven is a technology centre which houses thousands of engineers and advanced facilities. It focuses on crucial technological areas such as microsystems, infotainment, high-technology systems, embedded systems, life technology and nanotechnology. With "Open Innovation" as its motto, technological breakthroughs are facilitated by the emphasis on sharing equipment, services and knowledge. Technologically advanced companies, including Philips Research, IBM, Atos Origin, FluXXion, ASML, Cytocentrics, Philips Semiconductors, Handshake Solutions, and Dalsa, are already in residence. Others are nearby, such as FEI Company and TNO Industrial Technology, as is the renowned TU Eindhoven, one of Europe's leading universities in science, engineering and technology. The campus is a dynamic environment which is attracting new high-technology companies and research groups. It is a place where industry and research institutes/ universities meet to work on the future.

The Holst Centre is one of the initiatives located at the campus. It aims to be an internationally recognised and leading R&D centre in the fields of wireless autonomous transducer solutions and system-in-foil, with strong industrial participation (see also Box 4.3). The planned structure of the centre is an open one: other participants will be sought out and welcomed in a healthy balance between industry and knowledge institutions. The available research infrastructure at the campus (*i.e.* MiPlaza cleanrooms and associated facilities) is very attractive for the programme lines envisaged by the Holst Centre, which will work intensively with innovative SMEs.

External sources of innovation also differ depending on whether they are for research or for development. At the research level, companies build privileged relations with certain universities; at the development level, they build research platforms around certain technologies and group actors such as clients, suppliers and industrial partners. In some companies, each R&D centre has a university relationship. The idea is that proximity and close relations between individuals in the university and in the company lead to better results owing to similarities of language and culture. For example, in France several *pôles de compétitivité* have been created in which large companies and several research institutes work together. The sample of case studies also includes companies that have built reality centres to test their applications, *e.g.* Air Liquide.

Box 3.4. **Omron: Kyo-So**

Omron has organised its global R&D in Kyo-So (collaborative innovation) networks in Japan, China, India and the United States using its local subsidiaries as a hub. Most human resources are employed locally. The Kyo-So area is an innovation-incubating area located next to Omron's research laboratories. The partners for collaboration from outside (including from abroad) are invited to have their own pilot offices in the Kyo-So area. This facilitates an open and creative atmosphere. Special promenades are installed in the office building as cross-over/encounter/fusion zones to allow people with various functions to meet.



Some companies use IT tools, such as innovation portals or online technology intermediaries, to enhance the use of external sources of innovation. Others have developed an open source model to connect to user communities so as to tap into users' knowledge and get feedback from them. User communities help to develop the software, which is thus developed better and faster.

Companies' may engage in strategic partnerships, frequent non-strategic partnerships, and *ad hoc* partnerships. Criteria used to assess the value of partnerships are complementary skills and reputation. Other companies organise days with universities to present their competencies and long-term strategies. This helps to create valuable partnerships with universities. Most companies in the case studies collaborate with universities on particular projects.

Box 3.5. **UBS: Looking for new partners**

In engaging in open innovation practices, UBS found that too many new ideas were created internally or by consultants who were too close to the industry's existing practices. Therefore, new concepts were created:

- 13 "extreme" customers were interviewed to identify lead customer needs.
- Other customers were invited to "brown bag" lunches and UBS management meetings to share their views.
- "Best practice client-centric" service organisations were analysed for approaches and implementation, including Starbucks, Ritz Carlton, Singapore Airlines and Disneyland.
- Teams of the internal "talent development programme" analysed topics such as "client experience in other industries" and "exchange platform for innovations".

Box 3.6. **PERA: Innovation portals**

PERA is an international network of technology development and industry support centres that helps companies to develop innovative new products, improve business performance and enhance management and leadership skills. It helps its clients to become truly innovative through its ability to add value to all disciplines across the business cycle and uses it international presence to source best practice technological and business solutions across the globe. It has created a unique international infrastructure which acts as a gateway to knowledge, opportunities and partnering. It has made world-class innovation affordable for over 1 200 companies in the last five years and brought new business opportunities to thousands of companies. It has a network of over 30 offices and partners across Europe, the United States and Asia-Pacific and has created an independent pan-European association for supporting innovation – iNet – an innovation solutions network with 25 000 scientists and technologists.

Alternative ways of generating revenue with in-house innovations/ external innovations

Companies increasingly seek alternative ways to generate additional revenue from in-house innovations if the technology has future potential but is not part of their core strategy. If the technology is perceived as having only

Box 3.7. **P&G: Connect + Develop**

A well-known example of the use of external sources of innovation is P&G's Connect + Develop model. In using external sources of innovation, P&G seeks ideas that already have some degree of success in areas specified by the company. To focus its search, P&G limits itself to the following: *i)* top ten consumer needs: each business division has such a list and there is also a list for the company as a whole; *ii)* adjacencies: products or concepts that help P&G leverage its existing brand equity; *iii)* technology game boards: this is a tool that maps the evolution of different technologies and how these developments affect products in other categories.

In order to make the Connect + Develop model work, P&G needs effective networks. The company taps into closed proprietary networks and open networks of individuals and organisations available to any company. The two largest proprietary networks are "technology entrepreneurs" and suppliers. The former is a network of 70 senior P&G people who aggressively scan the market for opportunities. They map consumer needs and create so-called adjacencies maps and technology game boards. It is their task to scan the scientific literature, patent databases, local stores, etc. P&G also closely collaborates with its suppliers and has created a secure IT platform that allows P&G to post technical problems and suppliers to propose a solution.

Next to these proprietary networks, P&G also disposes of a number of open networks:

- NineSigma: a technology intermediary that helps companies solves their science and technology problems. Companies such as P&G can post their technology problem on line. If a company or research institute is able to solve the problem, NineSigma connects the parties.
- Innocentive: this technology intermediary works like NineSigma, but offers solutions to more narrowly defined problems.
- YourEncore: a network of 800 retired scientists and engineers that makes their knowledge and experience available to others.
- Yet2.com: an online market place for IP exchange.

limited potential, the technology/idea is often abandoned. In order to decide to start and finance a new business development or internal corporate venture project, companies first analyse the core business activity involved to identify the innovative potential, to determine how sustainable it will be in the market,

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the level of existing competition, etc. They then consider their complementarity with the company's existing activities: the potential economies of scale and scope, innovation potential through collaboration, exploitation of common resources, etc.

Spin-off companies are increasingly used as a way to externalise projects; the timing depends on the preferences and understanding of markets. If these appear insufficient, the spin-off may not be launched until relatively mature; however, if market-pull forces are important, the spin-off may occur rapidly because of the chances of raising external capital appear good. In creating spin-off companies, one company reported paying particular attention to the possibility of raising external capital in order to diminish the costs and risks of spinning off. Spinning-off processes are mostly supported by internal management skills and may be accompanied by venture capital financing. Some companies explicitly encourage employees to start ventures from promising research projects and technologies that are not directly suitable for core businesses.

Some case study companies have set up a corporate venture capital fund to develop new projects or companies based on ideas originating within the company; these corporate venture capital groups are often subsidiaries with a legal status. The company's main tasks are the financing of the venture and the development of managerial competencies to guide spin-offs within the company. After spinning off, the parent company usually enters the ownership structure of the spin-off, with the intention to gradually reduce its stake through a sale or initial public offering. Other companies use corporate venture capital funds to access competencies they lack.

Box 3.8. **Aker: spinning off**

Aker ASA is an active industrial company in the Norwegian petro-maritime technology cluster. Its core activities span a wide range, from fisheries (Aker Seafoods) through shipbuilding (Aker Philadelphia Shipyard in the United States) and into advanced offshore engineering and processing (Aker Kvaerner). During the past few years, Aker has developed and spun off a range of new companies such as Aker BioMarine, Aker Floating Production, Aker Oilfield Services and most recently Aker Exploration. Aker Clean Carbon was launched early in 2007 and is still wholly owned by Aker. The predominant strategy is to retain a controlling share in the spin-off companies, while using capital markets to fund and distribute the risk (Herstad, 2007).

Box 3.8. **Aker: spinning off** *(cont.)*

Aker plays a key role as a "gravitation point" in Norwegian industry and has credibility and a good track record in what is a small and highly specialised financial community. The establishment of Aker BioMarine to commercialise dietary supplements and pharmaceuticals based on certain marine fatty acids show that its gravitational pull extends beyond petro-maritime financial networks to include marine and biotechnology research and NGOs concerned with securing sustainable fisheries These external communities voluntarily contacted Aker in the wake of the announcement of the BioMarine venture. Aker BioMarine existed for almost ten years as a project internal to Aker ASA and was based on the merger between a novel technology developed in house for harvesting Antarctic shrimp "krill" and the in-house competencies necessary for immediate on-board processing of the catch. (The high quality fatty acids are destroyed within 30 minutes after the "krill" is dead, so that it must be caught and brought on board alive and processed immediately.) The company was established as a formal entity owing to the need to access complementary competencies and capital. A biotechnology actor was acquired and merged into BioMarine to provide competencies on lipid-based dietary supplements, food and feed additives. Superba™ is Aker BioMarine's name for krill oil products for the human market, and Qrill™ is the brand name for its krill meal and krill oil products for aquaculture and animal feed markets.

Other possibilities for generating revenue include postings on websites of technological brokers such as Yet2.com. These brokers bring buyers and sellers of technologies together to maximise the return on their investments. Yet2.com's principal services are to help their clients realise a return on their IP investments or to acquire IP and access technology solutions. ODIS (On Demand Innovation Services) is yet another way to generate revenues from in-house and external innovation.

Assessing the value of "external" projects or companies

In order to assess the value of external projects, companies in the case studies have developed assessment units with different objectives:

- Business development groups to screen the market.
- Financing funds, *e.g.* venture capital initiatives and corporate venture capital funds.

Box 3.9. **ODIS and Thinkplace**

With ODIS (On Demand Innovation Services) IBM has created teams of researchers and consultants to explore cutting-edge ways to increase competitive advantage and business value and provide solutions, strategies and processes for business transformation. The primary capabilities of ODIS come from the expertise and knowledge of IBM Research's industry-leading scientists and engineers combined with IBM's world-class consultant teams. To better match those capabilities with clients' needs, solutions have been organised into cross-industry interest areas. ODIS mixes research and consulting competencies, and sells innovation projects and patents to customers.

"Thinkplace" is an intranet site to which all IBM employees have access and can submit proposals for new products and processes. People can be catalysts and rate the incoming proposals in their area (as on YouTube). The product or process may then move on to the next level, and managers can sponsor an idea and take ownership of it. A team can be formed, typically of three or four people from all over the world with the right competencies. One day a week might be allocated to working on and developing this technology or business model.

- Emerging business opportunities units to identify potential business growth areas.
- Business group for scouting.
- Research centres in which other firms are invited to co-operate.

The main difficulties associated with assessing the value of external projects is that once an interesting opportunity has been identified, it is often difficult to acquire it and integrate it into the company culture. IPR and contract conditions are also reported to cause difficulties.

Several companies have created a corporate venturing programme to invest in start-ups to keep an eye on potential opportunities. The success of corporate venturing depends on the strategic fit between the (mother) company and the start-up and is often based on mutual trust. This is not without problems, however, since employees' expertise is often needed to detect useful applications of the technology developed in the start-up. Additionally, the venturing unit needs to convince other stakeholders of the added value the investment brings to the firm's portfolio.

Spinning-in activities are generally motivated by a strategic reorientation of the company towards key (technological) competencies. The spin-ins typically possess competencies that are lacking in the company. The reason for internal venture capital units to spin in companies seems to be primarily

Box 3.10. **Nestlé's venture capital fund**

Nestlé has set up a venture capital initiative for medium-term developments. The objectives are to provide Nestlé with better access to new science, technology and know-how, through acquisitions, minority stakes, licensing and joint ventures. The fund looks especially at life sciences (food and nutrition in general, health-enhancing food, agricultural biotechnology), as well as at commercial applications, such as management of consumer relations, food processing and packaging technologies. A venture board, with the head of Nestlé Nutrition as president and the Chief Technology Officer as vice-president, co-ordinates all new investments. EUR 880 million are committed for such investments; a portion has been invested in approximately 70 companies to date and investments have only been made in areas not yet covered by Nestlé units. These investments are usually based on minority stakes with rights to use results and managed on an "arm's length" basis.

technological rather than financial, with a focus on the potential market success of innovations. Most companies in the case studies are aware that the entrepreneurial structure or spirit of the spin-in can be endangered by full organisational integration. Hence, depending on the individual case, loose structural solutions may be favoured.

Box 3.11. **Novartis Venture Fund**

The Novartis Venture Fund has established itself as an "evergreen fund" with a balanced portfolio ranging from early start-ups to fully operational companies ready to go public. The Novartis Venture Fund is committed to investing in companies that develop innovative life science concepts for the benefit of patients. Since its inception, it has supported 137 businesses of which 92 are equity companies. Companies helped by this fund plan to bring new medicines to patients and because of the improving economic conditions in 2005 six of these companies went public, thereby providing substantial returns for the fund. One of these success stories is Sirtris. In May 2007, Sirtris Pharmaceuticals, Inc., made a public offering and was listed on the American NASDAQ. Sirtris focuses on discovering and developing small molecule drugs to treat diseases associated with ageing, including metabolic diseases such as Type 2 diabetes. The purpose of the fund is to stimulate outstanding innovation. In addition to funding, Novartis also provides advice and strategic input to the companies. As the companies grow, they often develop collaborations and business deals with Novartis; this further enhances the potential for discovering novel therapies. In 2007, a total investment of CHF 68 million was made.

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Box 3.12. **VCI: spinning in**

VCI (Velti Centre for Innovation) is one of the most important business initiatives of Velti. It is partly funded by the General Secretariat for Research and Technology under the "ELEFTHO" programme which aims to promote innovation and the introduction of new technologies in the Greek market. VCI's main objective is to finance and support new business ventures that operate mainly in the information, telecommunications, new media and services sectors. The incubated companies are hosted in VCI's state-of-the-art facilities and have the opportunity to take advantage of VCI's technology infrastructure, its professional staff, consultants as well as Velti's large network of investors, in order to establish and promote their innovative business idea. Services offered by VCI to the incubators include:

- Strategic guidance and network access.
- Sales and business development services.
- Legal and financial services.
- Marketing, public relations and human resources services.
- Accounting services.
- Information technology and telecommunication support.
- Software development, quality control and project management services.

All companies incubated in VCI can benefit from Velti's network of professionals and their work experience in Greece and abroad.

Companies may also use joint ventures and other forms of collaboration agreements to explore new technology domains as an alternative to spinning in. Alliances with strong partners (in technologies that may or may not be new to the company) may be an important source of information. A specific mode of collaboration applied by some companies in the case studies is open source software, which allows sharing and benefiting from software code developed by others. In some cases, commercial companies are able to develop proprietary products that are based on and complementary to open source products. Linux is the best known example of open source and has been a major competitor to proprietary products for a long period.

Examples of ways to assess the value of external projects or companies include Innovation Jam, Second Life, a virtual place to facilitate open innovation where everyone can comment, or so-called "open rooms" where people meet to exchange ideas and insights.

Box 3.13. **Nokia: open source software**

Nokia has taken steps towards greater openness with its 770 Internet Tablet based on the Linux operating system. It is the first open source (OS), Linux-based consumer handheld from Nokia, and it allows everyone to share the code. This is Nokia's first major attempt to connect a commercial company and non-commercial communities via a handset. On the market, the product is situated between cellular phones and notebooks.

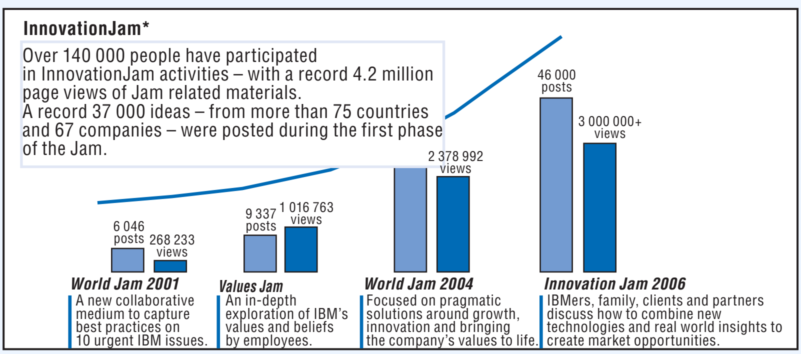
Historically, Nokia has relied on Symbian for the operating system for smartphones, and it has now used a Linux-based operating system for a browser-type device. Nokia has developed the company's main products (smartphones) in house using Symbian, because the market in smartphones is mature with strict operator and server requirements. The new Tablet is placed on new markets. By using Linux as an operating system, Nokia has chosen a flexible and mature technology that gives access to PC technologies, such as Internet Protocol. To speed the development of this open source product, Nokia published an open development platform, which is a Linux software toolset available to developers. The new development platform is targeted to open source developers and innovation houses to ensure the most effective development of a product and its applications. The idea is that developers have an opportunity to develop and share their own applications for Nokia 770 (enable application and technology development for the OS software and the commercial community). The company's goal is to work closely with technology experts and the OS community. These actions signal that Nokia is actively embracing the open source movement and the Linux operating system for future non-phone products. The 770 is not Nokia's first use of open source, but it had limited its open source efforts to its server-based networking products and internal development tools. In the handset market, this is its first major use of open source.

Human resource management

Most companies in the case studies believe that the creation of an open innovative culture is very important and that it should be present and operative at every level of the organisation; this means encouraging all employees to look for opportunities for improvement and innovation. It implies giving autonomy to employees and establishing a decentralised management structure that allows the different business units to preserve their own culture. Employees who are entrusted with more autonomy tend to become more involved. A culture of diversity is also beneficial as it leads to new views and insights. Several research departments in the case study

Box 3.14. **IBM: InnovationJam**

The largest on-line brainstorming session ever, InnovationJam 2006 brought together more than 140 000 people from 104 countries, including IBM employees, family members, universities, business partners and clients from 67 companies. Over two 72-hour sessions, participants posted more than 37 000 ideas as they explored IBM's most advanced research technologies and considered their application to real-world problems and emerging business opportunities. In July global issues were raised, such as environment, health care and traffic, and this started discussions that ran over 72 hours. People and software analysed the incoming data: What is the trend? What is especially discussed? What suggestions are made? In the second round in September ten areas were specified for identifying needs and interest. Then resources were allocated for related innovation processes with funding of approximately USD 100 million.



Source: IBM presentation.

companies employ researchers from over 20 countries to have a better view of the outside world. In addition, it allows for variety in the company's informal networks.

Trust, exchange of knowledge and clear communication are essential since innovation depends heavily on interaction among individuals: "We can accomplish everything if we are open, work as a team and share information." Companies profit from sharing knowledge, embracing ideas from outside and fighting the "not invented here" syndrome. Mobility (internal and external) of human resources is important since it increases knowledge development and exchange.

Box 3.15. **Credo of J&J**

"We are responsible to our employees, the men and women who work with us throughout the world.

Everyone must be considered as an individual.

We must respect their dignity and recognise their merit.

They must have a sense of security in their jobs.

Compensation must be fair and adequate, and working conditions clean, orderly and safe.

We must be mindful of ways to help our employees fulfil their family responsibilities.

Employees must feel free to make suggestions and complaints.

There must be equal opportunity for employment, development and advancement for those qualified.

We must provide competent management, and their actions must be just and ethical."

The creation of an innovative culture is often supported by a reward system that creates the right incentives. Few of the companies studied give financial rewards to employees who engage in open innovation practices. They are more likely to give appreciation awards to compensate extraordinary achievements, although in one case, engaging in open innovation was part of the bonus system applicable to all employees. In another case, rewards for team members in research and innovation projects are based on a specific model which includes, aside from salary and additional benefits, a stock option plan that provided researchers with the opportunity to share the risk and profits in new ventures.

To keep people motivated if new initiatives ultimately fail, some companies have a system that rewards employees for a decision to stop a particular project, which is justified by extensive documentation of the reasons so that the whole company can learn from the failure.

An important aspect of human resource management is the management of partners since the success of open innovation often depends on involving external partners in the company's innovation activities. The rewards for employees and for partners need some alignment if the collaboration is to be effective. It is important to screen potential partners' competencies and culture in view of what needs to be developed, including the alignment of mutual expectations.

Senior researchers may possess very valuable knowledge and excellent networks that may be partly lost when they move to management functions. Several companies noted difficulties in finding technical staff, which highlights the need to establish good career paths for technical staff. Companies often collaborate with universities for recruitment purposes, since university researchers often possess the expertise companies need and through collaboration they are already familiar with the company. Other companies keep more creative and complex R&D work nearer home to keep employees motivated, while outsourcing the more codified work to labs in Asia.

Intellectual property rights

Intellectual property rights have become vital in almost all industries and the number of non-disclosure agreements has grown exponentially since companies have started to engage in open innovation practices. Confidentiality and exclusivity agreements are central to partnerships: most companies sign a confidentiality agreement with partners so as to be able to work freely. Also brands, designs and models have received increasing attention.

Companies sometimes find it difficult to patent since filing a patent may allow competitors access to useful information about the new technology. They may therefore choose to maintain the secrecy of new technology in house. Patents play a key role in sectors such as pharmaceuticals, but may hinder innovation in sectors such as ICT. Some of the IT companies felt that patents hinder open innovation and particularly open source software developments. However, others are in favour of patents since they support their activities. Companies may also collaborate to create and/or exploit open standards.

Although patents are very important in the pharmaceuticals sector, most value is created at the end of the patent's lifetime. A typical pharmaceutical company applies for a patent when the potential of a drug has been established, so that the company faces huge development and testing costs to bring the drug to the market over a period of 10-15 years. Pharmaceutical companies have increasingly bought biotechnology SMEs specialised in drug discovery in recent years, as this reduces the development process and ensures a much longer period of patent protection.

Several companies from the case studies still mainly use IPR defensively, to protect the business and to prevent others from taking out a related patent. However, companies engaged in open innovation practices often organise licensing activities and strategic alliances as part of a proactive intellectual property strategy that aims at sharing technologies rather than keeping IP as a defence mechanism, *e.g.* IBM, Philips.

Box 3.16. **Alcatel-Lucent: open standards**

Alcatel-Lucent has set up a joint initiative about multimedia content delivery over DSL with Thomson multimedia. Both companies are global leaders in broadband access and entertainment and have demonstrated multimedia content delivery in the portable mobile space with a demonstration of streaming video content over a 3G cellular infrastructure. The novelty of this demonstration at the 3GSM World Congress was the use of a more efficient video compression format based on MPEG4-Part10, an open standard, which promises improved efficiency for bandwidth on cellular networks. Both companies consider that this breakthrough will unleash the potential of video delivery of entertainment over a broadband wireless network infrastructure. With their demonstration of an end-to-end delivery system, Thomson and Alcatel enable the mobile industry to deliver value-added services based on encoders and video servers from Nextream (a Thomson/Alcatel joint venture), with network infrastructure from Alcatel and end user equipment from Thomson. Both Thomson and Alcatel will be leveraging their mutual know-how in the delivery of multimedia entertainment content with differentiating features, including efficient power and bandwidth audio/video codec technology. Nextream will capitalise on vast experience in the area of digital video processing and delivery to serve this new market segment.

Box 3.17. **IBM: licensing out**

The US leader in patenting, IBM, received approximately USD 1.9 billion in royalty payments for its licensing in 2001; this represents roughly 30% of total profits. The value of licensing is even higher when cross-licensing is added. Given its licensing strategy, which includes aggressive patent licensing with increased royalties, manufacturing joint ventures, strategic joint development alliances and leverage and returns to technology, IBM also aims at leveraging its hardware and software brands in new commercial products developed by its partners.

IBM is making 500 of its software patents freely available to anyone working on open source projects, such as the popular Linux operating system, on which programmers collaborate and share code. The patents will be available to individuals as well as to small companies. IBM is hoping to begin a "patent commons", which it hopes other companies will join. The patents fall into 14 categories, including those for managing electronic commerce, storage, image processing, data handling and Internet communications. IBM will continue to hold the patents but has pledged not to seek royalties from or to place restrictions on companies, groups or individuals who use them in open source projects, as defined by the Open Source Initiative, a non-profit education and advocacy group.

IPR problems may arise in public-private partnerships because of the different objectives and characteristics of the partners, For example, companies experience difficulties when collaborating with universities, since university researchers tend to publish their technological findings, while companies usually prefer to protect their new knowledge (although universities have become more interested in patenting in recent years). Technology brokers seem to represent a very promising approach, but they have as yet no stable strategy.

Towards an integrated model of open innovation

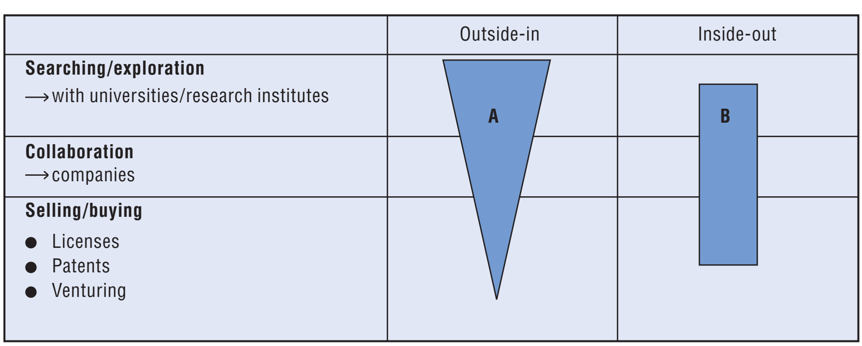
Exploration and exploitation phases in innovation

Based on insights gained from the case studies, Figure 3.11 proposes a tentative model of the dynamics of companies' innovation processes. It shows the outside-in and inside-out sides of open innovation in relation to the exploration and exploitation phases of innovation that are traditionally distinguished. Exploration in innovation involves experimenting with new alternatives while exploitation involves refining and extending existing knowledge (Beckman *et al.*, 2004).

In developing a technology, companies seem to distinguish three phases, the first of which concerns the search and exploration phase, during which companies look for new opportunities and new technologies with the potential to strengthen the company's core technology and products. Some may prove very valuable, while others may eventually be abandoned. Universities and research institutes are a valuable source in this phase, since they typically focus on research and technology that is ten to five years ahead of the market.

If the value of the technology or product becomes (more) apparent, companies tend to collaborate, mostly with other companies, to start to

Figure 3.11. **Open innovation: exploration and exploitation phases**



Source: OECD case studies.

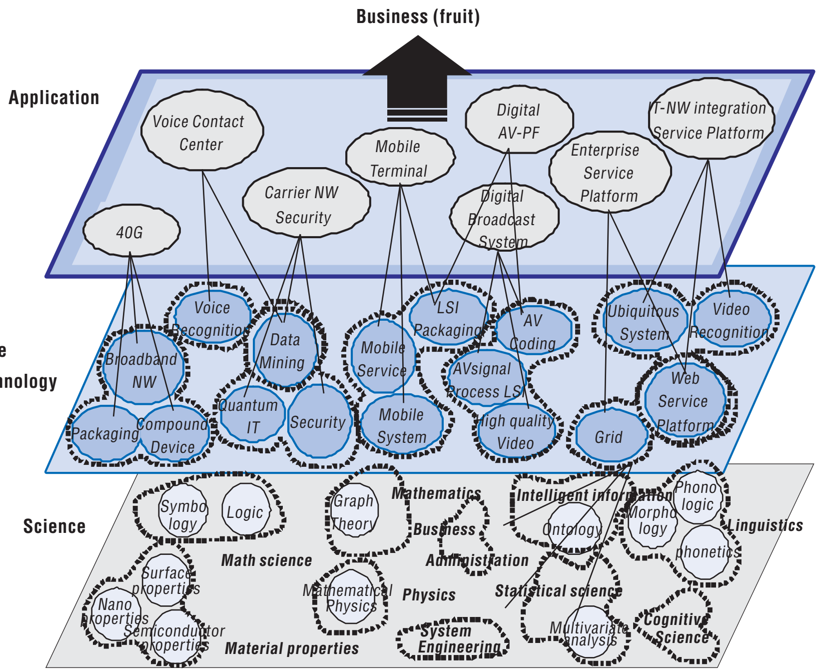
realise the commercial potential of the new technology or product. Collaboration can take place through partnerships, alliances, joint ventures, etc. Overall, the choice of mode of collaboration depends on the risk of losing control over the technology, the benefits of owning the technology or product, the implied resources, etc. In the collaboration phase, companies tend to shift from exploring technologies or products to exploiting them.

In a third phase, when the technology or product is approaching the commercialisation phase, companies need to decide if they want to commercialise the technology or product themselves or if they prefer to sell it. The sale can take several forms, *e.g.* sale to another company, sale of a licence to other companies, a spin-off, etc. To obtain complementary technologies may require buying and subsequently integrating a unit of another company that is working around the technology; it may mean buying an exclusive licence, taking a patent on the technology/product, etc. In the selling/buying phase, the company tries to exploit its technology or product commercially.

The companies covered by the case studies tend to use outside-in processes to strengthen the core technologies of the company and look for external opportunities that fit their business strategy. At NEC, open innovation for core technologies is clearly distinguished from open innovation practices for non-core technologies (Figure 3.12). Companies that engage in outside-in processes are very active in the search/exploration phase; they approach universities and research centres for interesting opportunities and screen the market for promising upcoming technologies or products. Once the value of a technology or product becomes apparent, most companies become less open and tend look for the most promising partnerships and focus on collaborating with these preferred partners. In the third phase, they become even less open as they work to achieve the competitive advantage associated with the new technology or product.

The case study companies use inside-out processes instead to search for new technologies and applications that are not part of the company's current portfolio. They use this process to look for new technologies and products with the potential to create new lines of business in new or adjacent markets. In the search/exploration phase, they seek out promising technologies or products, and in the collaboration phase they set up partnerships to explore the potential of these technologies or products. In contrast to the outside-in process, they do not become less open, since they generally do not possess all the required knowledge in house. In the selling/buying phase as well, they are likely to be quite open in order to gather all the expertise needed to bring the new technology or product to market and achieve a competitive advantage. If, for example, a company decides not to commercialise an in-house innovation itself, the inside-out process may begin by being very closed and become very

Figure 3.12. **Creating technology innovation within NEC**



Source: OECD case studies.

open in later stages. Compared to the outside-in process, the inside-out process will typically start later and end earlier.

Inside-out processes are also used to offer alternatives to researchers with an idea that does not fit the company's current strategy. In order to keep researchers motivated to look for alternative technologies, some companies have corporate venturing programmes to help these researchers create their own company and commercialise their ideas.

Most case study companies engage in outside-in processes; only a few engage in inside-out processes. The choice seems to depend on company size. Large companies are well placed to engage in outside-in processes to make collaboration agreements in order to speed up the development and commercialisation of new technologies by partnering with universities, research organisations, customers and suppliers. Few large companies engage in inside-out processes. SMEs tend to set up collaboration agreements with several actors in an attempt to speed up the development process by getting access to external knowledge. However, in general, SMEs have fewer possibilities to engage in open innovation practices owing to resource constraints.

Technological regimes and open innovation

The use of outside-in processes is also linked to companies' industry and technological environment. The literature on technological regimes (Nelson and Winter, 1982; Malerba and Orsenigo, 1993) argues that companies in an industry behave in similar ways, because they share sources of information and technology (suppliers, universities, other industries) and opportunities for innovation (Leiponen and Drejer, 2007). Their users are also likely to be the source of similar demand and ideas for innovation. Technological regimes are characterised by opportunity, appropriability and cumulativeness conditions and by the complexity of the knowledge base (Malerba and Orsenigo, 1993).

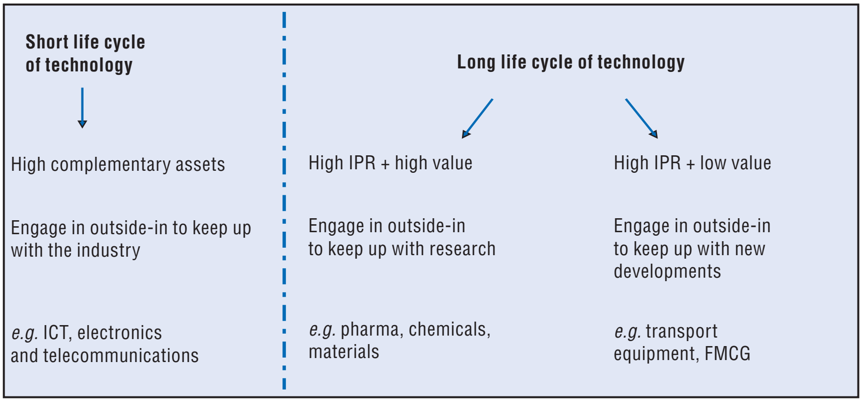
Opportunity conditions reflect the ease of innovating and depend among other things on the stage of the technology life cycle: introduction, growth or maturity (Abernathy and Utterback, 1978; Utterback, 1994). Initially, new technology makes slow progress because the technology is not well known and important bottlenecks must be overcome before it can be translated into practical and meaningful products. As work on the technology continues, the technology crosses a threshold and enters the growth stage, in which rapid progress leads to increases in sales of products based on the technology. Then, after a period of rapid improvement in performance, the technology reaches maturity and progress slows or reaches a ceiling (Utterback, 1994). Maturity occurs when there is less incentive for incumbent firms to innovate because of fears of obsolescence or cannibalisation from a rival platform (Sood and Tellis, 2005).

Appropriability conditions refer to the possibility of protecting innovations from imitation and of extracting profits from innovative activities. Companies use a variety of means to protect innovations, ranging from formal intellectual property rights such as patents, to informal mechanisms such as secrecy. If the level of appropriability is high, companies generally have time to develop their ideas and experiment to find dominant designs, while reaping the fruits of the technology's success. If not, the innovative firm must vertically integrate to build a complete solution or hope to create an enforceable contract with the suppliers of complementary products and capabilities needed to commercialise the innovation (Teece, 1986).

Cumulativeness of technological knowledge means that today's innovations form the basis and building blocks of tomorrow's innovations. Successful commercialisation of an innovation requires using it in conjunction with other capabilities or assets (Teece, 1986). Services such as marketing, manufacturing and after-sales support are almost always needed and are often obtained from specialised complementary assets.

Figure 3.13 combines the insights from the literature on technological regimes and the technology life cycle with the insights from the case studies.

Figure 3.13. **Open innovation and technological regimes**



Source: OECD case studies.

In industries characterised by rather short technology life cycles (*e.g.* ICT and electronics and telecommunications), complementary assets are increasingly important. The case study material indicates that companies in these industries engage in outside-in processes in order to keep up with new developments in and around their industry. The use of external sources of information allows them to be informed about changes within and outside the industry and to act rapidly so as not to lose their competitive advantage.

In industries characterised by longer technology life cycles, strong IPR protection may be of vital importance (*e.g.* some blockbusters in the pharmaceutical industry have reaped enormous profits). The case study material suggests a distinction between industries in which it is difficult to get around patents (strong IPR, high value) and industries in which patents are important but can be more easily circumvented (strong IPR, low value). Industries in the first category include pharmaceuticals, chemicals and materials. Companies in these industries mainly engage in outside-in processes to keep up with research and open innovation seems to be concentrated in the upstream search/exploration phase, with limited downstream collaboration in the selling/buying phase.

In the first phase of the technology life cycle, companies develop technologies that may become the next breakthrough and because these technologies are in or related to their core technology, companies prefer to develop them completely in house. However, if diverse technologies are involved (because of increasing multidisciplinarity) and if R&D expenditures are high, open innovation becomes a valuable way to get access to a broad range of technologies (Beije and Dittrich, 2008). In the pharmaceutical industry, for example, very high R&D expenditures for developing new medicines stimulate companies to collaborate with universities, research centres and biotechnology start-ups.

In some industries, patents and IPR protection are important, but competitors may develop products that circumvent the patent. Typically, they find different manufacturing methods or modify (slightly) product characteristics. In the transport equipment industry and the fast moving consumer goods industry (FMCG), companies set up outside-in collaborations to keep up with new developments. They look for technologies or products that have proven their market potential which they can improve, scale up and commercialise. If the collaboration is successful, companies tend to buy the technology or product.

Notes

1. High-technology industries are defined as high- and medium-high-technology industries, ISIC Rev.3: 24,29-35; while low-technology industries are defined as medium-low and low-technology industries, ISIC Rev.3: 15-23,25-28,36-37).
2. Some importance means that the factor is very or crucially important for more than 40% but less than 60% of the respondents.
3. Less importance means that the factor is very or crucially important for more than 20% but less than 40% of the respondents.

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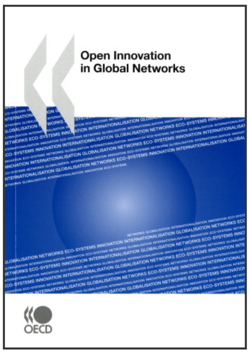

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