Towards a Theory of Open Innovation: Three Core Process Archetypes

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Open Innovation is a phenomenon that has become increasingly important for both practice and theory over the last few years. The reasons are to be found in shorter innovation cycles, industrial research and development's escalating costs as well as in the dearth of resources. Subsequently, the open source phenomenon has attracted innovation researchers and practitioners. The recent era of open innovation started when practitioners realised that companies that wished to commercialise both their own ideas as well as other firms' innovation should seek new ways to bring their in-house ideas to market. They need to deploy pathways outside their current businesses and should realise that the locus where knowledge is created does not necessarily always equal the locus of innovation - they need not both be found within the company. Experience has furthermore shown that neither the locus of innovation nor exploitation need lie within companies' own boundaries. However, emulation of the open innovation approach transforms a company's solid boundaries into a semi-permeable membrane that enables innovation to move more easily between the external environment and the company's internal innovation process. How far the open innovation approach is implemented in practice and whether there are identifiable patterns were the questions we investigated with our empirical study.

Based on our own empirical database of 124 companies, we identified three core open innovation processes: (1) The outside-in process: Enriching a company's own knowledge base through the integration of suppliers, customers, and external knowledge sourcing can increase a company's innovativeness. (2) The inside-out process: The external exploitation of ideas in different markets, selling IP and multiplying technology by channelling ideas to the external environment. (3) The coupled process: Linking outside-in and inside-out by working in alliances with complementary companies during which give and take are crucial for success. Consequent thinking along the whole value chain and new business models enable this core process.

Keywords: Open Innovation; Archetypes; Trends; Capabilities, R&D Process

A) Introduction

Shorter innovation cycles, industrial research and development's escalating costs as well as the dearth of resources are reasons why companies are searching for new innovation strategies. The phenomenon is reinforced by the increasing globalisation of research, technologies and innovation, by new information and communication technologies as well as by new organisational forms and business models' potential.

Only companies that wish to commercialise both their own ideas as well as other firms' innovation and seek ways to bring their in-house ideas to market by deploying processes outside their current businesses can start an "era of open innovation". Examples of products invented for a specific market which then became a great success in other markets are numerous: the TCP/IP protocol, which was invented for military use and lead to the world-wide web (internet), the joy stick technology in the game industry that BMW used to develop "iDrive" as a navigation aid in the new BMW 7 and 5 series, or Teflon, which was invented for space missions and became a market success as kitchenware.

However, emulation requires more than a few changes in a company's innovation paradigm. One of these changes is transforming a company's solid

boundaries into a more semi-permeable membrane to enable innovation to move more easily between the external environment and the company's internal innovation process. Another change is to fully integrate those external knowledge sources that are a prerequisite for enriching the internal knowledge base.

Creating a new, flexible innovation strategy means combining approaches that take market demands and the company's vision into account. The question remains: how can these elements of an open innovation strategy be best combined in respect of the industry speed (clock speed), the product architecture, the knowledge intensity of the research, or the form of the industry's competitiveness?

B) Open Source as Pioneer

Open Source is the most prominent example of the revolutionising of the conventional innovation process: world wide, several thousand programmers develop highly sophisticated software that competes with Microsoft's products. The Open Source approach is the phenomenon of co-operative software development by independent software programmers who, on demand, develop lines of codes to add to the initial source code to increase a program's applicability, or enable new applications.

The idea behind this approach is co-operative software creation outside firm boundaries, which is thereafter freely available. However, the source code too has to be freely available. This principle drives the evolutionary development and improvement of the software. Famous examples of the development of Open Source software are Linux, the Apache server or Freemail. The Open Source approach, which has been broadly discussed in practice and theory (see the special issues of Research Policy (2004) and Management Science (2005 forthcoming)), started the discussion on opening up the company's internal innovation process.

The core questions to be researched were: Is the Open Source innovation approach transferable and, if so, under which conditions? Enabling factors for this successful model are the short design-build-test cycles (rapid change of generations), new releases' low transaction costs, the great number of ideas that are enabled by the number of programmers involved and which, in turn, create variation and mutations as well as the selection criteria (survival of the fittest, the principle on which acceptance within the user community is based). Other success factors are a stable structure which entails an accepted system architecture and language, the communication, which is a combination of ideas and technical solutions, as well as the strong incentive: "Beat Microsoft".

Open innovation means that the company needs to open up its solid boundaries to let valuable knowledge flow in from the outside in order to create opportunities for co-operative innovation processes with partners, customers and/or suppliers. It also includes the exploitation of ideas and IP in order to bring them to market faster than competitors can. Open innovation principles therefore describe how to deal best with strategic assets in order to meet market demands and company requirements.

The open innovation approach is about gaining strategic flexibility in the strategic process and creating a critical momentum in innovation diffusion in order to generate customer acceptance and create industry standards.

2. Research Methodology and Data Sample

The database that we revisited for open innovation was originally used for an analysis of companies' activities in four areas related to the innovation process. This data had been collected during research projects over the last 10 years. Different types of data had been collected in each area, and different data collection methods had been used to ensure the quality and accuracy of the subsequent data analysis.

(1) In the area of intellectual property management we co-operated with 9 transnational companies for 8 months by means of workshops in order to identify strategies of and approaches to IP management within co-operative innovation processes. We used interviews, questionnaires and participating observation to collect data. This action research approach allowed us to develop a model of IP Management for co-operative innovation processes (see Gassmann, Bader, 2004).

(2) To investigate external knowledge sourcing, we conducted and compared case studies by means of 55 semi-structured interviews in 23 multinational companies, using listening posts in order to access innovation clusters like Silicon Valley or Singapore and to trace the technological knowledge transfer to companies' R&D centres. We were able to identify three different modes of listening posts according to their main goal: the match-maker, trend scout and technology outpost (see Gassmann, Gaso, 2004).

(3) In the area of decentralised R&D, which formed the largest data sample, we investigated 89 companies. This provided us with a comprehensive overview of the physical and geographical structure of a firm's R&D organisation and processes (see Gassmann, von Zedtwitz, 1998, 1999, 2003; von Zedtwitz, Gassmann,

2002).

(4) Based on the data analysis of the above-mentioned areas in the last phase of our data collection for the open innovation research, we collected data in two action research projects. In the area of outside-in innovation, and through a workshop structure, we collected data in 10 companies, as well as in 13 companies in the area of customer-driven innovations. Overall we collected data through twelve workshops, questionnaires, side visits and interviews over a period of 16 months with a special focus on the field of customer-driven innovations (see Gassmann, Sandmeier, Wecht, 2004).

IBM's industry solution laboratory (ISL) in Zurich Rüschlikon is exemplary of the concept of open innovation. IBM follows most of the principles of the open innovation approach, which seems to be one reason for the organisation's innovation successes.

3. A case of Open Innovation – IBM Industry Solution Lab Zurich

IBM is a successful and established enterprise in the fast growing IT market. IBM can look back on a long history of research and development activities, impressive innovation as well as good customer experience. This company was one of the first enterprises that was forced to see its competitors conquer a place in this highly dynamic industry. The increasing complexity of the IT market established new players in the hardware (e.g., Cisco and HP) and software (e.g., Microsoft, Oracle and SAP) sectors.

The information and communication technology's growing influence as well as the partial merger of traditional disciplines, e.g., biology and medicine, leads to even more dynamics and complexity. Meanwhile new media and globalisation offer new opportunities (e.g., e-business), but also lead to more technology and market uncertainty. It is therefore essential for an enterprise like IBM to not only invest in research and development, but to open up its innovation process and to focus consistently, both operatively and strategically, on market and customer demands.

In the 8 research labs (which focus on basic research and long-term development of core competencies) and the 30 development labs (oriented towards short- and middle-term projects) approximately 3400 people are employed world wide. The industry solution labs (ISL) and on demand innovation services (ODIS) initiative aim at co-ordination and co-operation between the research and development labs and at subsequently creating an essential contribution to IBM's innovative power. Since research and development activities form the most important base of IBM's success, it has invested approximately $5 billion per year, which is 5-6% of its revenue, in research and development since 1996.

This investment's success is verified by IBM's constant leading role in the number of US patents registered since 1993. Between 1993 to 2002 IBM registered 22,357 patents and generated $10 billion in licensing alone. And the number of patents is still increasing: 3,288 patents in 2002 and 3,415 in 2003. The company owns an active patent portfolio of more than 23,000 American patents and more than 40,000 world wide. "But what's more important than the statistics is the effect that these discoveries and patents are having in the marketplace – and that's what really makes something 'innovative'." (IBM 2004). Concomitantly with the increasing number of patents, IBM has explored a new business by exploiting its knowledge through licensing. It took IBM ten years, but now a huge part of its revenue is earned through patent licensing to outside partners in order to get ideas to market through its own licensing programme.

The sustained success of IBM's research is also based on the constant development of its research strategy. On analysing this development it becomes clear that IBM did not replace one strategy with another, but built on past experiences. While centrally financed research programmes and technology transfer became core in the 70s, this was supplemented in the 80s with collaborative research teams, co-ordinated agendas and joint projects with a focus on more effectiveness. "The 1990s saw an interesting shift in our industry as significant innovations began to be made by IT teams within our leading customers' technology staffs." (McQueeney, 2003).

Joint research projects with customers lead to mathematical optimisation concepts providing solutions to supply chain and customer relations problems. In the 90s, the work on customer problems as well as the research into the market place complemented the current research strategy which gives a key position to creating business advantages for customers and investing in e-business research and external partnerships (McQueeney, 2003). This new focus on research strategy was initiated by the wave of newly founded, dynamic companies and these enterprises' structural and organisational problems which did not allow entrepreneurs to develop their promising ideas within their companies. IBM learned from venture capitalist companies and introduced incubator organisations.

These changes were necessary to develop innovations outside IBM's core business, called "emerging business

opportunities" or EBOs, within IBM. This was additionally supported by the early integration of business partners and customers as well as market research and development analysts into the innovation process. This approach enabled concepts like the first-of-a-kind projects (FOAK), the on demand innovation services (ODIS), the industry solution lab (ISL) and the global technology outlook (GTO) (McQueeney, 2003 and IBM 2004). IBM successfully used their existing and potential lead customers to test new technologies, to build collaborative teams and to perform road-mapping procedures.

The IBM industry solution lab in Zurich Rüschlikon aims to establish relationships with academic and industrial partners in Europe in order to leverage their current technical knowledge and to follow those technical developments in which Europe is the leader. Today approximately 300 employees, mostly graduates in information sciences, electronics and physics, as well as 30 visiting researchers and a great number of trainees work at this research lab which has delivered 4 of IBM's 5 Nobel Prize winners.

The lab contacts the global scientific community through conferences and seminars and through scientific societies' meetings. The lab employees also participate in research programmes with the European Union and work on joint projects with European universities and their industrial partners' research institutions. More than a quarter of the researchers, engineers and programmers frequently work with important customers and give them the opportunity to get to know technological, market and industry trends.

Making the initial contact with scientific and industrial partners and customers is part the Zurich and New York industry solution labs' (ISL) main responsibilities. These two labs have a special role within IBM's research labs because of their double function of doing research and building a customer and innovation centre.

Although there is no contract-triggered pressure to integrate customers, IBM Rüschlikon strives towards external inputs without wishing to lose its leading role in driving innovation. The integration of customers and partners is supported by 350 workshops per year as well as by the 50-100 on-going research projects, product offers, integrated solutions and developing technologies. IBM's innovativeness is enriched by "innovation days" during which leading scientists, suppliers, customers and potential partners are invited to provide the company's research as a whole with external input and to stimulate discussions on mutual issues. Communication across company boundaries is seen as a way to obtain strategic alignment in research.

The customer workshops at Rüschlikon, called ISL workshops, are focused to address the current and potential IBM customers' immediate and specific need, such as value chain optimisation. The workshop can also be targeted more broadly to address long-term goals, such as increasing mind share by focusing on an array of emerging technologies. Besides exchanging methodologies and context-specific information with the circa 20 participants who mainly come from higher management positions, specific knowledge, such as technological, market and industry trends or current project outcomes, is also exchanged. Because of the delicate and strategic issues discussed at these workshops, 90% are held in-house and limited to one company. The workshops can be initiated in different ways: The customer could meet up with an ISL employee at a conference or workshop, an ISL workshop is initiated via a consulting project with an IBM business unit, or the contact is established by customers requesting it via the ODIS website. After the two-day workshop has been approved, the specific topics are discussed with all the relevant experts, researchers and stakeholders within the customer's company and IBM Rüschlikon. Thereafter the potential participants (up to 20 managers, industry experts and researchers) are invited. Not only trend and state-of-the-art information is exchanged during the workshop, but also the ISL researchers and consultants' views of company-specific problems. According to external and industry-independent perspectives, these opinions are excellent and greatly appreciated by customers.

Besides the strategic aim of identifying potential technological lead positions, relationship marketing forms the ISL mission's main focus, thus supporting IBM's business indirectly. The great success of the ISL workshop, which is evident from Rüschlikon's employees' high workload, can be summarised as being due to the following factors: experts and high-ranking decision-makers' participation, a workshop design oriented towards individual customers and the open discussions of delicate and company-specific questions in a closed community. The openness regarding the demonstration of prototypes and the presentation of IBM-specific internal methods and current research projects create the open and collaborative climate necessary to exchange knowledge. The knowledge gained through the ISL workshops in Zurich Rüschlikon forms an important basis for IBM research and especially for the site-independent research concepts like first-of-a-kind projects (FOAK), on demand innovation services (ODIS) and emerging business opportunities (EBO).

Another example of active customer integration into Rüschlikon's innovation process is the global technology outlook (GTO). The GTO aims to identify

market trends and to estimate technological development. Through the GTO process those fields that are highly important for IBM's R&D are identified. IBM's strategy is to be the first in these innovation fields. Annual expert interviews launched by the GTO owners have to answer the question: what are next year's hot topics going to be?

In a first step, the gathered information on technology and market trends that research and development labs' leaders have provided within a 6- to 9-month period, is combined with information from competence centres' R&D experts as well as with the results from surveys of those IBM employees who participated in conferences and workshops. Various other sources, like industry reports from independent research institutions and universities (e.g., the report "Future trend in the pharmaceutical industry 2010"), reports from joint research projects with partner companies (e.g., the study on successful ageing with Swiss Re), and marketing reports, complete the information search in this phase.

In a second step, the information is analysed and consolidated into approximately 20 fields, which the research departments then discuss and further group into 6-7 fields called GTO chapters. In this process the leaders of the 8 research labs and specifically the heads of the two industry solutions labs (Zurich Rüschlikon and New York) are of great importance in deciding on IBM's future innovation fields. The GTO chapters have to be linked to the previous year's chapters in order to guarantee resource allocation consistency and to safeguard the long-term development of research competencies.

The industry solution lab in Rüschlikon has a special role within the GTO procedure as it can integrate the customer's perspective through the ISL workshop results. Since his role at the forefront of research enables him to actively shape IBM's research, the leader of Rüschlikon's industry solution lab is seen as an opinion leader within IBM's GTO process. With the exception of the largest development site in Böblingen, Germany, IBM regards the ISL Zurich Rüschlikon as the major authority in R&D within Europe, the Middle East and Africa (EMEA).

Rüschlikon's innovation strategy is strongly focused on joint ventures and common research projects and reports, therefore there are manifold examples of successful partnerships. One example is provided by the study "Computer on Wheels" in which IBM developed a vision based on the input by BMW's research. IBM's vision of the car in the year 2015 is that of a computer on wheels with which IBM could create a great added value as a supplier for the automotive industry. Another example of strategic alliances for innovation is IBM's collaboration with the Conxion Dotcom incubator during which IBM Global Business Partners joined forces with Conxion, an Internet service provider and itself a start-up, to incubate start-ups. IBM is well known as a partner in strategic alliances in which the company jointly develops and exploits innovation with strategic partners in different industries. This give-and-take relationship in which IBM gains knowledge from outside as well as providing its own knowledge and technology has become a major part of IBM's business strategy.

Besides contributing to the good relationships with customers and partners, the exchange of knowledge leads to new product ideas that serve to forecast technologies and help to maintain IBM's leading market position.

IBM's success is based on its research strategy and the openness of the innovation process that allows the organisational environment to react flexibly to new market demands. IBM integrates external knowledge through its extended collaboration with customers and partners in joint research activities. IBM's patent strategy of licensing patents that cannot be used internally has become part of its business strategy. It is the combination of approaches that the organisation has attempted over the years, which makes IBM successful and worth imitating.

4. A Framework for Open Innovation: Three Core Processes in Open Innovation

What differentiates the closed innovation paradigm from the open one is basically that companies that implement the latter interact with external entities in terms of their innovation process's efficiency and effectiveness. Chesbrough (2002; 2003) describes four erosion factors that compel companies to transform their innovation strategy into a more flexible open innovation approach. Skilled workers' increasing availability and mobility as well as external suppliers' increasing capability have caused a shift in innovation paradigms. In addition, the external options available for unused ideas and the venture capital market have created new opportunities for companies.

The IBM case study demonstrates that IBM is mastering the new challenges and reacting to them with a flexible research strategy. Besides the strong focus on *integrating* customers, suppliers and partners' *knowledge* and ideas into the early stage of its innovation process, IBM has created an excellent patent strategy. This strategy allows the commercialisation through active know-how transfer projects and licensing

of those patents that cannot be realised efficiently in-house, or do not fit the innovation strategy (*exploitation of knowledge*). By tapping into innovation clusters to enhance its technological knowledge transfer through the research labs around the world and by supporting corporate new ventures through organisational strategy in which the de-coupling of innovation sub-processes is used to increase a company's innovativness? Can this approach be observed in companies other than IBM? Is the opening-up of the innovation process a new innovation paradigm?

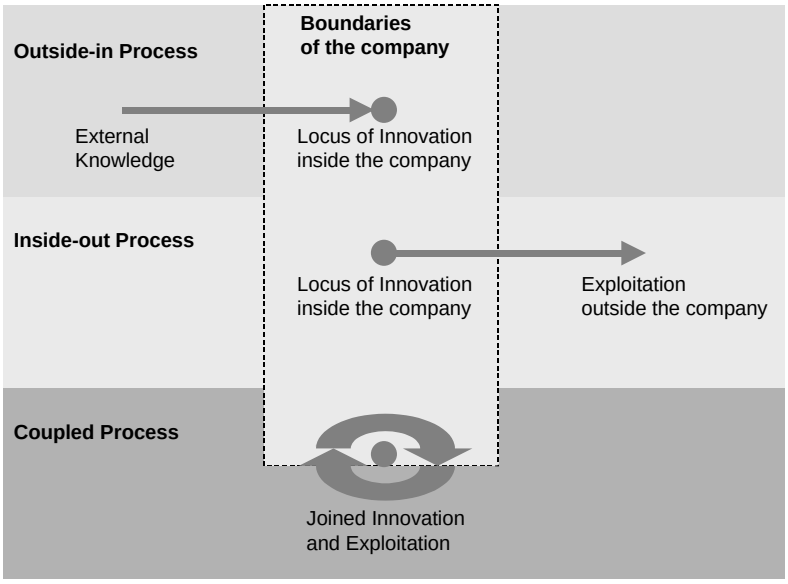

Figure 1: De-coupling the locus of innovation process

structures like incubators or spin-offs, IBM enables the realisation of ideas. This is evidenced by the high number of patents and Nobel Prize winners within the organisation. Also co-operations within strategic alliances, such as that with BMW, and an open standard strategy to increase development support (*collaborative knowledge creation*) IBM's leading market position. When analysing the case study from a process perspective, it is clear that three main processes are responsible for IBM's open innovation strategy.

Analysing the IBM case it becomes clear that IBM has de-coupled the *locus of innovation* (in terms of applying the idea and transforming it into an innovation) with the *locus of knowledge creation* (invention or research) and the *locus of commercialisation* (product development or exploitation of the innovation). Companies like IBM can integrate external knowledge by using the outside-in process in order to increase their innovativeness. Also the locus of innovation need not necessarily be the locus of exploitation. Companies can use the inside-out process in order to license knowledge and technology to exploit them outside the firm. The following figure describes this basic principle of the open innovation approach. Our research questions were: do these approaches provide evidence of a new innovation

A) Identifying three Open Innovation Process Archetypes

The results of our research can be summarised by the three core open innovation processes: (1) The *outside-in process*: Enriching the company's own knowledge base through the integration of suppliers, customers and external knowledge sourcing can increase a company's innovativeness. (2) The *inside-out process*: earning profits by bringing ideas to market, selling IP and multiplying technology by transferring ideas to the outside environment. (3) The *coupled process*: coupling the outside-in and inside-out processes by working in alliances with complementary partners in which give and take is crucial for success. All three the core processes represent an open innovation strategy, but not all are equally important for every company (see Figure 1).

Based on our revisited data in different areas of open innovation, we found that not all companies choose the same core open innovation process, or have integrated all three processes to the same degree. Each company chooses one primary process, but also integrates some elements of the others. These process archetypes are summarised in the following figure (Figure 2).

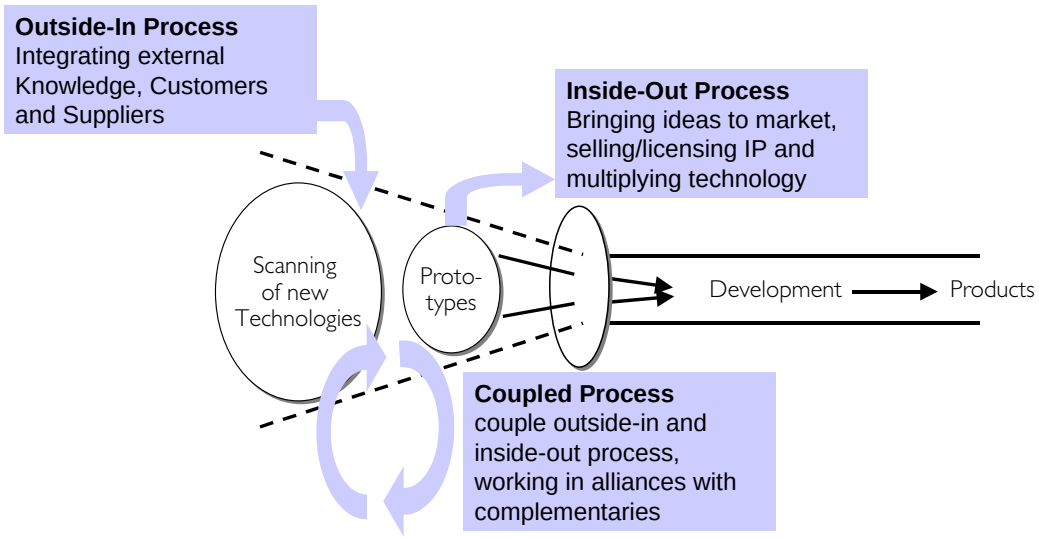

Figure 2: Three archetypes of open innovation processes

B) Outside-In Process

Deciding on the outside-in process as a company's core open innovation approach means that this company chooses to invest in co-operation with suppliers and customers and to integrate the external knowledge gained. This can be achieved by, e.g., customer and supplier integration, listening posts at innovation clusters, applying innovation across industries, buying intellectual property and investing in global knowledge creation. As seen in the IBM industry solution lab case, IBM invests heavily in contact with customers, suppliers and other external knowledge sources. One of the main functions of the solution lab in Rüschlikon is to collect and integrate external knowledge in research projects and find co-operation partners for joint ventures. Access to this valuable knowledge is one of the main assets that the lab can offer IBM research and is the reason for Rüschlikon's high status within IBM's research (see the GTO process for an example). Cisco invests in young start-up companies in order to monitor their attractiveness and innovations. Besides evaluating their acquisition potential Cisco also directs the company development towards Cisco standards and Cisco compatible products.

Opening up the internal innovation process by integrating suppliers and/or customers is not new. The literature on inter-firm collaboration in general and on supplier relationship management in particular repeatedly suggests that firms can significantly benefit if they are able to set up differentiated relationships with suppliers (Dyer et al., 1998; Boutellier, Wagner, 2002). If firms possess the necessary competence and supplier management capabilities, they could successfully integrate internal company resources with the critical resources of other supply chain members, such as customers or suppliers, by extending new product development activities across organisational boundaries (Fritsch, Lukas, 2001).

Suppliers can enhance the buyer's product and project success by contributing their capabilities to innovate and develop new products. The Austrian company Magna Steyr, one of the major suppliers to the automotive industry, is integrated into parts of the innovation process of most automotive OEMs in Europe. Whereas American automotive companies, like General Motors or Chrysler, bind their co-developing suppliers with contracts to secure exclusivity, European automotive companies, like Volkswagen, BMW or Saab, gain value from Magna Steyr's increasing competence after each new project with a competitor. In the meantime, Magna Steyr's competence has increased so significantly that it is able to develop not only parts of the car, but the whole car as proved with the development of the new Saab convertible.

Recent conceptual contributions (Wynstra et al., 2001) and benchmarking research (Ragatz et al., 1997) have begun to further explore the success factors and critical issues of successful supplier involvement in product development. Supplier involvement can provide buying firms with substantial benefits that range from

more “operational” benefits, such as the earlier identification of technical problems, fewer engineering change orders, or the availability of prototypes, to more “strategic” benefits, such as better utilisation of internal resources, access to new or supplementary product and process technologies, reduced technical and financial risks, improved product features, or shorter time-tomarket for new products (Clark, 1989; Birou, Fawcett, 1994; Handfield et al., 1999; Dröge et al., 2000; Ragatz et al., 2002). Some conceptual and empirical evidence hints at the importance of suppliers’ innovative capabilities as a major determinant for a collaborative development (Wasti, Liker, 1997; Wynstra et al., 2001; Boutellier, Wagner, 2003; McCutcheon et al., 1997; Handfield et al., 1999). DaimlerChrysler’s “Score” initiative offers suppliers incentives to reduce the company’s R&D costs through innovative ideas and improved processes. Suppliers who suggest improvements can gain a position as long-term DaimlerChrysler partners, but are also rewarded with a percentage of the costs saved.

Arguments related to early customer integration in product development are equally widely discussed in theory, but not as widely researched (Brockhoff, 2003, p. 464). Although researchers tend to be careful in promising radical innovations through customer integration, this might be seen as the ultimate aim in order to gain a competitive advantage (Brockhoff, 2003). Henkel has established “focus groups” to obtain ideas on actual needs directly from customers and to get customers to rank these needs on a strategy problem map. DuPont integrates customers and suppliers into their research and development activities on a project level. The company targets specific partners for specific projects and describes itself as an early adopter of collaborations.

Empirical studies show the relevance of an early customer integration within a company’s innovation process (Peplow, 1960; Enos, 1962; Knight, 1963; Freeman, 1968; Meadows, 1969; Utterback, 1971; Berger, 1975; Boyden, 1976; von Hippel, 1976; Lionetta, 1977; van der Werf 1982; Shaw, 1985; Voss, 1985; Biegel, 1987; Gemünden et al., 1992, 1996; Riggs, von Hippel, 1993 and Slaghter, 1994). Prahalad and Ramaswamy (2000) describe how customers moved from being passive recipients of product development in the 1970s and early 80s towards demanding to play a more active role in the 21st century. “Consumers can now initiate the dialogue; they have moved out of the audience and onto the stage” (p. 80). Consumers can now be co-creators of values because they are seen as a source of competence. Bayer Polymers, one of the main columns in Bayer’s new organisational structure, established the Creative Centre as the organisational institute responsible for the early phase of the innovation process. Besides systematising the innovation process, the Creative Centre also searches for and connects with key customers in order to integrate their knowledge and demands into future research scenarios.

Innovation methods that involve customers and enable companies to deduce their needs before customers are even aware of them are therefore widely discussed. Prahalad and Ramaswamy (2000) developed a co-creation model based on dialogue, access, risk reduction, and transparency of information between customers and company. Von Zedtwitz and Gassmann (2002) provide guidance on how to manage customer-oriented research and the interface between research scientists and development teams. Leonard and Rayport provide the concept of emphatic design (1997) in which customers are shadowed in their daily behaviour to identify their needs through their actions, while von Hippel developed the lead user method (1986) which argues that some customers are more appropriate to co-develop new products and services than others. Other authors tried to implement the latter method and analyse its success in different industries (e.g. Herstatt, von Hippel 1992; Lilien et al., 2002; Thomke, von Hippel 2002). Hilti AG, manufacturer of building equipment like drills, is famous for its intensive integration of lead users into its innovation process. But also Zumtobel Staff AG, an innovative lighting manufacturer, integrates well-known, independent architects in order to gain knowledge of design trends and combines this with modern lighting demands for mass-manufacturing.

In summary, suppliers and customers should be integrated as valuable sources of knowledge and competence that are needed for product development. Other potentially valuable sources of external knowledge in the new product development are IP-licensed patents and technological knowledge gained by linking the company to regional innovation clusters. BT Exact deploys networks with 40-50 different universities world wide simply to keep up with new developments in different regions of the world.

The internal knowledge transfer and diffusion within R&D have been recognised as a major management challenge for international companies (e.g., Chiesa, 1996; Kuemmerle, 1997; Gassmann, 1997). Recent research on international R&D reveals strong evidence of technology sourcing as a motive for foreign direct investments (e.g., von Zedtwitz, Gassmann, 2002; Kuemmerle, 1999). BMW’s Palo Alto Technology Office (PAYTO) in Silicon Valley has the mission to permanently look out for new trends, highly specialised and unique technical knowledge and technologies and to seek and establish contacts with potential external partners.

Kuemmerle (1997, 1999) distinguishes between the 'home-base-exploiting' and 'home-base-augmenting' of foreign direct investments. The former is undertaken to support manufacturing facilities in foreign countries, or to adapt standard products to the demand there, while the latter is foreign direct investment undertaken to access and tap unique knowledge and resources from regional knowledge-intensive centres of excellence. BMW's Technology Office in Tokyo, founded 1981 and comprised of 30 employees today, gathers trends and application knowledge. Japanese employees act as door openers to the Japanese scientific community and to competing as well as non-competing companies with the aim of tapping their tacit and embedded knowledge.

Patel and Vega (1999) push this conceptual model further and suggest a 'revealed technological advantage' index with four categories of international technological activity. Almeida's (1996) investigation of patent citations confirms that foreign firms make more use of sector-specific knowledge than domestic ones do. He concludes that Korean and European multinationals source knowledge from US firms in order to upgrade their technological abilities in areas in which they are weak. BASF, located in Germany and one of the major companies in the chemical industry, has realised the importance of tapping external knowledge by opening its company boundaries. Within its department of research planning and university relationships more than 800 external partnerships are maintained to identify and evaluate ideas. The company integrates partners like universities, start-ups and current as well as potential customers in order to combine their different competencies to enrich its own innovation process.

One way of tapping tacit and embedded knowledge from regional centres of excellence that many transnational companies have exploited to reduce the need for huge financial investments, is to launch technological listening posts (Patel, Vega, 1999; Weil, 2000; Gassmann, Gaso, 2004). Hitachi installed technology outposts in Dublin (Ireland) and Cambridge (UK) in 1988 to participate in leading universities' fundamental research.

The relative importance of internal and external sources is determined by a company's technological position (Hermes, 1993) and varies across different industries (Klevorick et al., 1995). Numerous authors have analysed the factors that most influence the selection of an optimal external technological sourcing mode (Roberts, Berry, 1985; Pisano, 1990; Audretsch et al., 1996; Chiesa, Manzini, 1998; Croisier, 1998; Nagarajan, Mitchell, 1998; Robertson, Gatignon, 1998; Veuglers, Cassiman, 1999) as well as the ratio between internal and external technological acquisition (Colombo, Garone, 1996; Veuglers, 1997; Lowe, Taylor, 1998). The fundamental advantages of using external innovation sources are seen in the access to new and complementary knowledge and in the access to unique resources. The German Ministry of Economics and Labour, in close collaboration with the German Chamber of Industry and Commerce (DIHK), the Frauenhofer-Gesellschaft (FhG) and the German Federation of Industrial Cooperative Research Associations (AiF) set up 18 listening posts as match-makers with local companies in 18 different world-wide innovation clusters in order to support collaboration and to gain German companies access to regional knowledge.

Some of the investigations also emphasise external sources' potential to generate radical new knowledge (Coombs, Hull, 1998). Hermes (1993) suggests using external technological sources in three cases: (a) when a company lacks internal resources, (b) when the external technology position is better, or (c) when technological knowledge can be easily transferred and market barriers are low. ABB integrates the mechatronic knowledge of spin-offs from the Technical University Zurich (ETH) in order to enrich its innovation process.

Integrating external sources of knowledge and competence, such as co-operating with suppliers and customers and/or integrating external knowledge (gained e.g. through listening posts) in an attempt to open up the innovation process, can be a company's major competence. Whereas the literature discusses the methods and key factors for integrating external knowledge sources independently, we summarise them into one archetype of open innovation processes. Our research shows which companies gain most value from focussing on the outside-in process as a main process in their open innovation approach.

The outside-in process reflects companies' experience that the locus of knowledge creation does not necessarily equal the locus of innovation. Companies that decide on the outside-in process as key are mainly from low tech industries, e.g., companies that expect spillovers from higher tech industries such as companies producing microprocessors in cars or electronic equipment like switches. Schurter AG, a small company in Lucerne, Switzerland, but one of the leaders in this business, gains external knowledge for innovation through co-operation with universities, lead customers and complementary companies. Also companies in air conditioning and automation processes focus strongly on the outside-in process. Varioprint AG, a small company in scenic Appenzell in Switzerland, is a leading supplier of printed circuit boards (PCB) with up to 24 layers that are used in almost every electronic device. With its 128 employees the company operates in a highly volatile market with an estimated value of 30 billion Swiss

Francs. The market is characterised by rapid change and driven by technological development. The company has 10 Swiss, 200 German, 500 European and about 2,000 Chinese competitors. The strongest threats come from the Asian competitors who are able to produce large volumes cheaply. A market consolidation is expected in the next few years and it is assumed that only approximately 100 companies will be left in 2005. In this market, Varioprint generates 90% of the turnover through 45 loyal customers, of which the most important ones are integrated as lead customers within Varioprint's innovation process. Relations and co-operation with customers and suppliers are very important as customers drive the technological development at Varioprint. Without their knowledge of innovation, Varioprint would not be able to stay competitive against their Asian rivals.

In the past these outside-in companies were characterised by a small or medium company size. They act as knowledge brokers or knowledge creators for bigger companies, or as the next in the value chain. Today, company size is less relevant, e.g., even DaimlerChrysler re-focussed on knowledge brokerage in 2004.

The modularity of the products that the company produces is also an important criterion. We found that companies with highly modular products, e.g., in the elevator industry like Otis or Schindler, gain advantage by choosing the outside-in process as key.

A high knowledge intensity can additionally be identified as characteristic of companies specialising in outside-in processes, because their need for knowledge cannot be satisfied by using their internal abilities only, e.g., 3M, Bosch, Proctor & Gamble and Siemens. Examples can be found in the Biotech and IT industry, but also in the consumer goods industry. In order to scan ideas outside corporation's boundaries, Henkel has linked itself to the service of the external, web-based forum "InnoCentive", which in turn connects experts from major companies world wide, and matches top scientists to relevant R&D challenges around the globe. It provides an on-line forum that enables major companies to reward scientific innovation through financial incentives. Companies ("seekers") can post challenges on the website, offering rewards of up to $200,000, and wait for other companies to offer solutions ("solvers"). The problem-solving companies then receive the rewards, whereas the seeking companies only have to pay a small fee for posting the challenges. Proctor & Gamble intensively uses its customers' knowledge for innovation. In 2002 customers already initiated 10% of the company's innovation and it aims to increase this percentage to 50% in five years' time.

To summarise the results, the next table shows the most important characteristics of companies focussing on the outside-in process as the major process in their open innovation strategy as well as providing examples of such companies.

Characteristics:	**Outside-in process:**
- low tech industry for similar technology acquisition - act as knowledge brokers and/or knowledge creators - highly modular products - high knowledge intensity	- Earlier supplier integration - Customer co-development - External knowledge sourcing and integration - In-licensing and buying patents

Table 1: Characteristics and company examples of the outside-in process

C) Inside-out Process

Companies that choose the inside-out process as a key process focus on the externalising of the company's knowledge and innovation in order to bring ideas to market faster than they can through internal development. Deciding to change the locus of exploitation to outside the company's boundaries means generating profits by licensing IP and/or multiplying technology by transferring ideas to other companies. As already mentioned in the beginning, commercialising ideas in different industries (cross industry innovation) and therefore focusing on the inside-out process in open innovation can increase a company's revenue immensely. The pharmaceutical industry (companies like Norvartis Pharma, Pfizer or Roche) is specifically well known for substances that were initially aimed at one ailment, but became better known or equally successful when used for other ailments. Three examples are Viagra, initially developed to control blood pressure, but became a great success as a sexual aid, Botox, developed as a nerve toxin, but used to reduce wrinkles in beauty therapy, and Erythropoitin (EPO), developed as a blood diluent, but became known as a doping substance in professional cycling and is currently used in cancer therapy.

Besides commercialising ideas outside the own industry or market, outsourcing can be used to channel knowledge or ideas to the external environment. Outsourcing comprises the acquisition of knowledge on a market basis (Grandstrand et al., 1992; Haour, 1992; Ulset, 1996; Mangematin, Mesta, 1999; Veuglers, Cassiman, 1999) and the licensing of technologies from

a second party (Atuahene-Gima, 1992; Leonard-Barton, 1995). The benefits of outsourcing are many, including gaining access to new areas of knowledge (complementary knowledge), managing capacity problems (more flexibility), concentration of core competencies, speed (reducing time-to-market), and the sharing of costs (Haour, 1992). DaimlerChrysler has outsourced the varnishing of their cars in Rasstadt, Germany, to the chemical company BASF. Whereas BASF was paid for the tons of varnish used in the past, the new business model is based on payment for the number of cars varnished. The outsourcing of varnishing does not only offer the advantage of DaimlerChrysler benefiting from the leading company in this sector's latest developments in varnish, but also the outsourcing to an expert in this field of all environmental demands that the German authorities set.

Intellectual property management mainly means patent management, which fits a company's innovation strategy. As illustrated in the IBM case study, both the creation of new ideas and patents as well as an effective licensing strategy can be part of this strategy. The empirical study by Ernst and Omland (2003) provides evidence of patent management's influence on a company's success. Literature on the topic of licensing is especially scarce (e.g. Arora, 1996; Freeman, 1968; Arora and Gambardella, 1996; Mansfield et al., 1977) and often focused on special industries, e.g., Arora (1997) who analyses licensing strategies in the chemical industry. He points out the benefits that can be derived from the financial advantages of making money through a license, or by providing a small financial stake.

Solvay required the licensees of its ammonia-soda process to share any improvements with it, and these improvements were in turn shared with Solvay's other licensees (Arora, 1997, p. 394). "This helped Solvay retain control, as well as enable its process to remain competitive against rivals" (Haber, 1958, p. 89; Haber, 1971; Hounshell, 1992).

Long ago Haber (1958, p. 199) pointed out that licensing can be a powerful strategy in remaining a market leader and in creating competitive advantage (for the impact of licensing on the market structure, see Arora, 1997, p. 395ff.). Hounshell and Smith (1988, p. 177) support this argument with their analysis of Du Pont's sophisticated cellophane licensing strategy (guarantees 2% of the royalty on sales up to the quota and 30% on sales above the quota), which implied that it was profitable to produce more than the agreed upon amount, as was indeed the case. Taylor and Silberton (1973) report that although most of the licensing agreements that they analysed had transfer of know-how as the major objective, most involved patents as well. A recent example of licensing patents to other industries in order to multiply technology is Schindler. The No. 2 in the elevator market world wide has developed aramid cables to replace elevators' steel cables. These cables contain carbon fibres to enable remote diagnosis and therefore support elevators' service and safety. The patents for non-elevator applications have been sold for $6 million and thus financed the whole R&D project.

The different approaches within the inside-out processes can be summarised as: leveraging a company's knowledge by opening the company's boundaries and gaining advantages by letting ideas flow to the outside. The inside-out process as a major process in an open innovation strategy, creates a substantial advantage for companies that fulfil certain criteria.

The open innovation paradigm and especially the inside-out process within this approach, support the idea that the locus of invention and innovation need not necessarily equal the locus of exploitation. Companies that decide on the inside-out process as key are mainly basic research-driven companies, like IBM, with wide applications. These companies aim at decreasing the fixed costs of R&D and sharing the risks as pharmaceutical companies like Novartis and Hoffmann LaRoche do when outsourcing parts of their development process. Also branding can be a reason to focus on the inside-out process when there are core competencies for development and commercialisation but no brand for products in the intended market. Ascom, an international provider of services for telecommunications systems, integrated voice and data communications, wireless and corded security solutions and networked revenue collection systems, joined forces with the sports utilities manufacturer Mammut in order to develop the lightest and most modern avalanche search equipment. Ascom is using Mammut distribution channels and brand in order to commercialise the product.

Wanting to set a technological standard can be a reason for outsourcing the commercialisation of a technology, or for being a supporting partner in the value chain with new technology or knowledge. Cisco successfully provides partners with its technology in order to support their technology to set a new standard. Siemens used their incubators as market-incubators for the same reason. Spillovers as positive side effects of an innovation that can be commercialise successfully in other industries as well, are a characteristic of the inside-out process as an innovation strategy.

These cross-industry innovations emerge when companies integrate, or license technology which is already established in their own industry but new to another industry. Processors which are already old technology in the IT industry can be integrated successfully into cars or elevators after some months -

all industries in which product lifecycles are longer and the demands for speed and processor capacity are less than in information technology. This becomes relevant when a 0,13 Mikron semiconductor factory costs approximately $2 billion and needs to be written off over a five-year period. Investment in the next generation processors is more valuable when a company like Intel can use cross-industry innovations to commercialise its innovation in other markets.

The following table summarises the characteristics and some examples of companies that choose the inside-out process as a key process in following an open innovation strategy.

Characteristics:	**Inside-out process**:
- (basic) research-driven company - Objectives like decreasing the fixed costs of R&D, branding, setting standards via spillovers	- Bringing ideas to market - Out-licensing and/or selling IP - Multiplying technology through different applications

Table 2: Characteristics and company examples of the inside-out Process

D) Coupled Process

Companies that decide on the coupled process as a key process, combine the outside-in process (to gain external knowledge) with the inside-out process (to bring ideas to market). In order to do both, these companies co-operate with other companies in strategic networks. At BMW's PAYTO, teams of three people have 90 days to identify, explore and develop new projects. A recent innovative example is the new BMW car control mechanism –iDrive – in their 7-series which was developed in close co-operation with different industries. It combines joystick technology developed by the local game industry with easy cockpit control of more than 700 functions. To co-operate successfully, a give and take of knowledge is necessary, therefore a coupling of the outside-in and inside-out processes is key for success. In industry innovation coupling can be a strategic option, e.g., in alliances with shared IP.

Co-operation refers to the joint development of knowledge through relationships with specific partners, such as consortia of competitors (Hagedoorn, 1993; Chiesa, Manzini, 1998; Ingham, Mothe, 1998), suppliers and customers (von Hippel, 1988; Hakanson, Johanson, 1992), joint ventures and alliances (Kogut, 1988; Hamel, 1991; Mowery et al., 1996) as well as universities and research institutes (Bailetti and Callahan, 1992; Conway, 1995; Cockburn, Henderson, 1998; Santoro, Chakrabarti, 2001). Hitachi's Cambridge Laboratory (HCL), through its co-operation with Cambridge University, discovered the "Fento-Second Ultra-Fast Quantum Device". This device will uses the "wave" nature of an electron to achieve ultra-fast switching devices for both high-end telecommunication and ultra-fast computing in the 21st century.

Co-operation is usually characterised by a profound interaction between parties over a longer period of time (Pisano, 1990; Hagedoorn, 1993; Tao, Wu, 1997; Littler et al., 1998; Fritsch, Lukas, 2001. The German MTU Aero Engines and the American engine manufacturer Pratt & Whitney mirror the structure of their organisations in order to facilitate co-operation and communication on every organisational layer. This interaction tends to result in an intensive exchange of knowledge and a process of mutual learning (Hamel, 1991; Lane and Lubatkin, 1998) that result in context-specific and implicit knowledge (Birkinshaw and Fey, 2001). The benefits of co-operation are seen in an improvement in the competitive position and in a risk minimisation, but not in a reduction of development time (Kirchmann, 1994). DaimlerChrysler's listening post in Moscow aims to establish links between the company's central research centre in Germany, where 90% of its researchers are located, and Russian scientists (especially in the field of algorithms and material sciences).

The transfer of research into knowledge through alliances and joint ventures is a relatively recent phenomenon. Kogut (1988) was the first to explicitly argue that joint ventures could be motivated by an organisational learning imperative. He proposed that a joint venture "(...) is used for the transfer of organisationally embedded knowledge which cannot be easily blueprinted or packaged through licensing or market transactions" (Kogut, 1988, p.319). More or less simultaneously, Westney (1988) and Hamel (1991) developed related perspectives on the ways in which learning can be achieved through alliances and joint ventures. Since that time there has been a proliferation of research into the knowledge transfer process across alliance and joint venture boundaries (e.g. Inkpen, Crossan, 1996; Doz, 1996; Mowery et al., 1996). The common thread in the results of these studies is that the ability to re-evaluate and learn is key for success. Biotechnology is seen as a major input for pharmaceutical R&D. World wide pharmaceutical and biotechnology firms have formed 400 to 500 new alliances every year since 1996 (Gassmann, Reepmeyer et al., 2004). Eli Lilly started the development of recombinant human insulin in co-operation with

Genentech; the resulting product Humulin became the first biotechnology product when launched in 1983. As a result of intensive co-operation between strategic alliances, it is not unusual for pharmaceutical companies to have biotechnology holdings (Novartis owns about 40% of Chiron, Roche owns about 60% of Genentech).

The objectives of most companies that focus on the coupling of the outside-in and the inside-out processes are to set standards or a dominant design for their products. A recent example can be seen in the strategic alliance of suppliers, consumer goods companies and retailers to produce RFID chips. Because the technology is new and will be relevant in future, the members of the alliance, such as Metro, Unilever and Henkel, are aiming to participate in standard setting and development.

Also companies that can achieve increasing returns by multiplying their exploitation choose the coupled process as a core one. An example is the mobile industry in which new technologies like MMS, UMTS or polyphone ring tunes can only set a standard and lead to high revenues when all or most telecom companies such as Sony, Ericson, Siemens and Nokia implement them. The technology provider needs to work with the mobile industry in a strategic alliance in order to ensure that the new technology will be implemented in the new mobile phone generation.

Alliances with complementary partners can also lead to valuable input in order for a co-operative innovation process to occur. Examples are Canon and HP, which joined forces to develop printers and EADS, the European version of NASA, which is forced to jointly develop satellites with various European partners. Boeing developed the Boeing 777 with companies in seven different countries, with hundreds of decentralised teams and managed to reduce the errors in development by 50%.

Companies working in strategic alliances or joint ventures know that one major success factor for co-operation is the right balance of give and take. A crucial precondition for working in co-operative innovation processes is the capacity to integrate foreign knowledge into a company's own knowledge and technology and to externalise it in order to enable the partner to learn. Success is based on a company's ability to find and integrate the right partner that can provide the competencies and/or knowledge needed to gain a competitive advantage in the own industry.

Characteristics:	**Coupled process**:
- standard setting (pre dominant design) - increasing returns (mobile industrythrough multiplying technology - alliance with complementary partners - complementary products with critical interfaces - relational view of the firm	- combining outside-in and inside-out processes - integrating external knowledge and competencies and externalising own knowledge and competencies

Table 3: Characteristics and company examples of the coupled process

5. The Competence Perspective: Core Competencies related to Open Innovation

Besides implementing core processes to enable integration of external knowledge, to exploit ideas outside the firm or to co-operate within joined innovation processes, the company needs certain capability to apply the open innovation approach effectively. For each of the core processes a different capability is needed. The absorptive capability has to be complemented with multiplicative and relational capability.

Absorptive Capability related to the Outside-in Process. Technology knowledge generation and application processes are increasingly sophisticated, broad and expensive. Furthermore, the "ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends is critical to its innovative capabilities" (Cohen, Levinthal 1990), since many organisations lack the ability to listen to their external world and efficiently process the signals received. The efficiency of both knowledge generation and application is contingent on the concept of "absorptive capacity".

Multiplicative Capability related to Inside-out Process. The exploitation of knowledge outside the company is related to the company's capability to multiply and transfer its knowledge to the outside environment. The capability to multiply innovation by external exploitation is strongly connected to firm's knowledge transfer capability and the selection of appropriate partners. Only if the company is able to codify and share its knowledge with the external entity, will the commercialisation of ideas be successful. But also the strategic selection of partners that are willing and able to multiply the new technology is an important element of the multiplicative capability of the firm.

Relational Capacity related to Coupled Process. The notion of "relational capacity" as a source of competitive advantage relates to Singh's idea that a company's value is strongly related to its capability to build and maintain relationships with partners in order to enable joint development in strategic alliances (Dyer, Singh, 1998; Johnson, Sohi, 2003). A company can be differentiated by the networks to which it is connected and the alliances and joint ventures that it can undertake. Therefore, the relationships with other companies, complementary companies and competitors can be a firm's major assets and a necessary precondition for the linked process within an open innovation strategy.

Further research needs to investigate the capabilities needed to conduct open innovation successfully more closely.

6. Determinants of Open Innovation

Besides keeping the processes and capabilities of open innovation in mind, the determinant perspective helps to configure the innovation system.

Open innovation can be summarised as an approach that enriches companies' innovativeness, but is also limited to companies with special products or industry characteristics. The following discussion of open innovation companies' general characteristics can help managers to decide whether this approach can improve their innovativeness and therefore gain them competitive advantage.

A high product modularity is one required characteristic with which to exploit the advantages that an open innovation approach provides. Companies in modularised types of manufacturing industries such as Kone, Thyssen and Otis can increase their innovativeness by opening up their innovation process. For companies within the chemical industry, like Novartis, with a low modularity, the advantages of an open innovation approach are limited.

Industry speed is another characteristic that can indicate whether companies can gain an advantage from open innovation. Industries such as companies providing network technology and services, e.g. Cisco, can gain a huge advantage by integrating external knowledge, or through co-operative innovation processes with partners. On the other side of the spectrum, companies with a low industry speed, like providers of building materials, e.g. YTONG, do not need to focus on faster innovation processes.

Also the tacit knowledge required to innovate and the complexity of interfaces are characteristics that are important to gain advantage by means of an open innovation strategy. Nike, as a sport clothes manufacturer, has a low demand for tacit knowledge as well as a low interface complexity, which enables the company to outsource its production to China. Companies like Bühler (grain milling process) or MTU and Pratt & Whitney (aerodynamic design of rotors in turbines) are characterised by the high degree of tacit knowledge required for their innovation, combined with a high complexity of interfaces. They can therefore use the open innovation approach to increase their innovativeness.

Companies that can use positive external effects (spillovers) by licensing their IP, as the IBM case and companies in the chemical industry (e.g., Solvay, BASF), illustrate, are predestined to determine the inside-out process as a core process within their open innovation strategy. Table 4 summarises the characteristics identified as core to gain an advantage from an open innovation approach.

Besides these core characteristics of industries and companies predestined to use an open innovation approach to increase their innovativeness, it is important to take into account whether the open innovation core process will take place in a bilateral or multilateral relationship with the chosen partner.

Open Innovation Approach	**Closed Innovation Approach**
- high product modularity	- low product modularity
- high industry speed	- low industry speed
- much explicit and tacit knowledge required	- less tacit knowledge required
- highly complex interfaces	- low complex interfaces
- creating positive externalities	- no positive external effects through licensing

Table 4: Characteristics to follow an open or closed innovation approach

Also the multiplication of innovation in order to reach increasing returns is an important characteristic of open innovation. Will the value gained through an innovation be higher by increasing the number of partners using this technology in their products and therefore increasing the number of potential customers for these products? The fax machine and the MMS technology used in mobiles are only some examples of the number of users defining the market success and the company's revenues. Without the multiplication of these technologies through co-operation with as many partners as possible (e.g., Ericson, Sony, Motorola and Siemens), the design would never have become dominant. Technologies like Bluetooth or RFID are other examples of multiplying technology as a major success factor. In order to develop

a dominant design as well as to set standards, it is crucial to multiply the linkage to partners with an open innovation approach. The security industry (e.g. KABA) where no single access control is dominant, is therefore highly fragmented and a negative example of where a closed innovation approach hinders success.

On the other hand, exclusivity can also be a major advantage and a prerequisite for a company's choice of partner. Only when companies like BMW first include new technologies and innovative features (like the sourcing of the brake-and-steer-by-wire technology from the TU Vienna where it was based on a bus safety system), can they differentiate themselves from their competitors and maintain their market position in the automotive industry. They therefore need to co-operate in bilateral partnerships with guaranteed exclusivity. In order to increase their innovativeness they are heavily dependent on focussing on including external knowledge in an outside-in process in their research. For both kinds of co-operations – bilateral or multilateral – open innovation can be a successful approach for a company meeting the required characteristics.

7. Conclusion

Our research in different areas related to the opening of the innovation process reveals the following contributions:

- We identify *three archetypes* of core processes in companies following an open innovation approach: the outside-in process, inside-out process and coupled process;
- This article revisits the open innovation approach from a *process, capability and determinant perspective*. It therefore creates a holistic picture of the open innovation approach and also helps to identify the limits of this approach.
- We highlight the importance of *the required core processes* (archetypes) to successfully follow an open innovation strategy according to companies' characteristics and capabilities;
- We analyse and present the three *capabilities* needed for the different core processes in order to be successful: *absorptive capacity* has to be complemented with *multiplicative* and *relational capacity;*
- We observe and present *requirements* for a successful emulation of the open innovation approach, but also its *limits* for companies that not possess the characteristics needed.

One of the major contributions of the open innovation approach is the perception that the *locus of knowledge* and the *locus of innovation* need not necessarily be the same (see Figure 1).

Although opening up the innovation process seems directly related to innovation success, we argue that there are significant benefits achieved by a serious discussion on when the open innovation approach should be implemented and when not.

The future of innovation is not about outsourcing *all* internal innovation activities, but about following a flexible innovation strategy to allow companies to create more and better innovation by combining various strategies, such as outsourcing ventures, reintegrating new businesses, scanning and integrating new technologies, commercialising patents, connecting external sources to the internal innovation process and launching new collaborations during the required period.

Obviously, there is a need for future research. The most important points can be summarised as following:

- a theory of the firm could be developed based on our first steps towards a framework for open innovation,
- a quantitative survey on a wider scale is needed to evaluate the empirical significance of the presented findings which are based on qualitative research, and
- transfer and relevance of these concepts (archetypes) to SMEs, which are typically managed by openness because of their lack of resources, need to be investigated.

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