

Intellectual Property Management in Inter-firm R&D collaborations

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Abstract

This paper outlines the increasing importance that intellectual property has gained in inter-firm R&D collaborations. Our research is based on an eight months duration benchmarking study with five in-depth case studies as a selection out of 221 global successful practice companies, a nine months duration workshop series with nine multinational companies from different industry sectors and furthermore, almost hundred interviews with intellectual property experts in Europe, the United States of America and Japan. We present a case study of the world's leading intellectual property champion IBM and identify general success categories and success factors for managing intellectual property in inter-firm R&D collaborations. The paper finally derives knowledge areas as basis for intellectual property rights being relevant to exploit collaboration outcomes sustainingly.

Keywords: Intellectual Property Management, Inter-firm R&D Collaborations, Trends, Open Innovation

1. Introduction

In highly industrialized countries innovations and technologies are responsible for half of the economic growth. Therefore, these are considered highly relevant from the macro-economic perspective. Empirical studies reveal that innovative companies realize more sustainable profits than imitators. On the other hand, their R&D costs explode as innovation cycles shorten and several of them experience growing numbers of imitators. The generics market of the pharmaceutical industry with 10% annual growth on average is currently amongst the fastest growing markets world wide (Gassmann, Reepmeyer, von Zedtwitz 2003). To justify high investment costs in R&D the companies have to gain competitive advantages. Only through realizing temporary monopoly profits can such companies then continue to invest in research and development on a long-term basis. Therefore these companies are searching for suitable protection strategies for their own innovations. There is an increasing empirical relevance of intellectual property which therefore has become a suitable instrument for influencing sustainability and returns-on-investments (Kortum and Lerner 1999).

There has been an increasing trend of focusing on core competencies (Hamel and Prahalad 1990, Boutellier, Gassmann and von Zedtwitz 2000). On the other hand, the demand for integrated solutions is also growing. Many companies can no longer afford to successfully develop these solutions internally (Hamel and Prahalad 1995). Therefore, they are collaborating with other parties to develop and market integrated solutions (Belz 1998). Although the number of R&D partnerships has almost tripled during the last two decades (OECD 2002), surprisingly only 45% of such collaborative arrangements and joint ventures in general are found to be successful for all parties involved (Harrigan 1988).

Evidence suggests that the issue of intellectual property has been gaining increasing importance during inter-firm R&D collaborations (Hagedoorn, van Kranenburg and Osborn 2003) and that the proportion of jointly owned patents has steadily increased during the last decades (OECD 2002). Dealing with intellectual property issues in R&D collaborations at the early stage of a collaboration is difficult as the partners may not precisely know their future situation or may not want to disclose all their expectations (Brandenburger and Nalebuff 1996). In particular, the early phase is especially delicate due to high uncertainties and risks (Doz and Hamel 1998).

2. Literature Review

The nature of intellectual property management and its impact on R&D management has been discussed by Ernst (1998a, 2002a, 2002b), Faix (1998) and as well by Ernst and Vitt (2000). A classification of prior research in a framework of patent strategy and theoretical perspectives has been done by Somaya (2002).

2.1. IP Strategy and IP Portfolio Management

Various researches have proved that there is a positive correlation between the success of the company and the strength of its patent portfolio. An intellectual property strategy should therefore aim to develop a patent portfolio with a high level of quality. Ernst and Omland (2003) have proven that young technology intensive companies, especially biotechnology enterprises, can boost their profit and growth by patent protecting their products. An alternative approach to patenting however is

secrecy (Arundel 2001) or publication (Gassmann and Bader 2004a). Trademarks also play an important role especially in cases of service innovations (Miles, Andersen, Boden et al. 2000; Klinger 2003).

According to Ernst (1995, 1996, 2001), companies within the mechanical engineering sector that have an active and systematic patent strategy are significantly more successful than companies that remain inactive and non-strategic in this area. Patent applications usually lead to revenue growth within two to three years. Shane (2001) analyzed the patent portfolio of the Massachusetts Institute of Technology and came to the conclusion that patents of high-value, i.e. with broad technical claims and a high citation index increase the probability of commercialization either by licensing contracts or by spin-offs. Lerner (1994) also proved earlier in the field of venture capital financed biotechnology enterprises, that patents with broad technical claims increase the financial rating of their companies. Austin (1993) has shown that within the biotechnology sector there is a positive influence of patent grants on the market value of the companies.

Intellectual property has reached a greater importance in many successful companies (Grindley and Teece 1997; Sullivan 1998). Especially patents are recognized as powerful instruments for innovation and technology management to overcome discontinuities, though they need to be adjusted or combined with other instruments and tools (Harmann 2003). Various strategic management literature point out that an intellectual property strategy needs to be aligned with the corporate strategy of a company (Lynn, Morone and Paulson 1996; Faix 1998; Brockhoff 1999; Hargadon and Sutton 2000; Ernst 2002a, 2002b; Smith and Hansen 2002).

An intellectual property strategy generally aims to improve the economic outcomes of investments made in innovations and should therefore address various key decisions, for example make or buy decisions, organizational association or isolation, innovation or adaptation of new technology, the protection or exploitation of knowledge; public or private research funding, safeguarding or sharing of intellectual property and pioneering advantages or disadvantages (Borg 2001; Harhoff and Reitzig 2001).

Above all, one main purpose of creating intellectual property is to protect earlier innovation investments, for example to avoid copying by third parties, and to function as an important strategic weapon against competitors (Gassmann and Bader 2004b). The latter has been demonstrated by Brockhoff, Ernst and Hundhausen (1999) for the cardiac rhythm management industry.

Increasing Relevance of R&D Collaborations

R&D collaborations are of greater importance for companies today due to increasing complexity of scientific and technological development, shortened innovation cycles and higher risks and costs for generating innovation. Due to strategic technology alliances for several decades the numbers of R&D partnerships have steadily increased (OECD 2002; Hagedoorn 2002). The growth in technology alliances was mainly driven by the high-technology industry, for example biotechnology, information and communication technology as well as aerospace. Important criteria for characterizing collaboration are motivation, structure and performance (Kale, Dyer and Singh 2001).

Aspects of motivation: A collaboration between competitors is meaningful only when a win-win situation is created and if the customer perceives the added value

(Dixi and Nalebuff 1990). Major reasons for forming such collaborations are intense competition, opening of new markets, insufficient internal resources, lack of know-how and inability to generate opportunities alone (Müller-Stewens and Lechner 2003; Gassmann and Fuchs 2001). From the strategic point of view, collaborations further strengthen a company's competitive position on a long-term basis (Kogut 1988). However, transaction costs need to be kept low in order to achieve optimized benefits (Williamson 1985; Hennart 1988).

Aspects of structure: Collaborations can be classified in different categories based upon marketing strategy (Sydow 1992): Purchase contracts and barter deals are the most market driven forms of collaborations. On the other hand, profit centre organizations are mostly driven by hierarchy. Interorganizational networks can be formed through long term supplier contracts, licensing and franchising contracts or joint ventures. Especially for R&D, collaborations can be differentiated into three categories for the background of collaborations partners (Schögel 1999): Collaborations between independent business units, suppliers and competitors as partners. Typical inter-firm collaboration partners are completion partners, suppliers, customers or competitors.

Aspects of performance: The overall performance and value creation that is achieved through collaboration is usually greater than what can be achieved by the individual efforts of its collaboration partners. Ideally, the process of cooperation should challenge each of the collaboration partners (Beamish 1987; Harrigan 1985; Merchant 1997). Gaining consensus across the individual views of the partners is a pre-requisite for a successful collaboration (Kelly, Schaan and Joncas 2002). Therefore considerable efforts need to be made by all partners to reach consensus during the early stages of forming such collaboration.

Setup and Early Phase of Collaborations

Various studies have proved that 50% to 60% of R&D collaborations fail (Spekman, Lynn, MacAvoy et al. 1996; Dacin, Hitt and Levitas 1997; Duysters, Kok and Vaandrager 1999, Kelly, Schaan and Joncas 2002). Most failures happen during the setup phase of the collaborations (Bleeke and Ernst 1993). The setup phase and the early phase of a collaboration are well known to be the crucial period for success as the quality of working relationships is established (Anderson and Weitz 1989; Sherman 1992; Doz and Hamel 1998). Trust decreases the risks based on transaction costs, enables conflict resolution and may help adapting to changes (Ring and van de Ven 1992; Parkhe 1998b). Another important aspect of the setup phase is the assessment of cultural compatibility amongst the potential partners which is often underestimated (George and Farris 1999). The selection of the right people who will finally be part of the collaboration is crucial (Yoshino and Rangan 1995). Learning already in the early phase is very important (Doz and Hamel 1998) and a communication culture has to be developed early that fits the needs of the collaboration (More and McGrath 1996).

More and more companies use external intellectual property and do not rely anymore solely on their own intellectual property (Chesbrough 2003a, 2003b). At the same time, more and more companies are willing to share their intellectual property with external third parties (Kline 2003).

While intellectual property can be acquired through internal processes, it can also be acquired by external activities, for example collaborations, acquisitions or in-licensing. Utilization of intellectual property can be internal also as external as a means for keeping other parties from selling or out-licensing also by multiplying its value through cooperating with other partners.

Joint Intellectual Property

A company's propensity to patent is significantly higher among R&D collaborators (Brouwer and Kleinknecht 1999). The exceptions seem still to be small and medium size enterprises that rarely collaborate in obtaining patents, even though collaboration has been proved to be a good way to solve their problems concerning patents (Masurel 2002).

Hicks and Narin (2000) concluded an increase of jointly owned patents with respect to a growth of collaborative R&D. In fact, there is an increasing amount and relative share of jointly owned intellectual property rights¹, especially in form of joint patents: An empirical investigation reveals that even the share of co-patent-applications in triad patent families has been increasing from almost 7% in 1980 to more than 10% in 1995 (OECD 2002). However, jointly owned patents are still seen as suboptimal due to necessary contractual and administrative regulations that remain incomplete and still leave open various legal and economic risks. Haagedoorn (2003) compared different industries concerning their joint patenting behaviour that seems to depend on the sectoral patent intensity, partnering intensity and strength of intellectual property.

Hagedoorn, van Kranenburg and Osborn (2003) observed that formal inter-firm R&D collaborations may generate valuable results for the partners but that "surprisingly" the collaboration partners recognize joint patents not really as a collaboration benefit. The general willingness of companies to share patent ownership in formal inter-firm R&D collaborations, however, depends on their experience with the joint patenting process as a such. Once the partners have learned to process joint patent ownership they continue to do so with collaboration partners.

3. Research Methodology and Data Sample

The Institute of Technology Management of the University of St. Gallen has carried out a research study on behalf of eleven transnational European companies. The global companies were of different sizes and represented various industry segments. The study was based on four major strategic technology management areas: R&D resource allocation, intelligence networks, intellectual property management and open innovation. Following intensive database research and information provided by experts and members of the consortium, 221 companies were identified as potential benchmarking partners for this subject area. 161 of these companies were contacted and asked to complete a specially designed questionnaire. 50 questionnaires were returned and evaluated. After that, thirteen successful practice companies were selected. Detailed information by means of telephone interviews were collected and finally anonymous case studies were written. In a review meeting the consortium then selected the five companies to be visited for

¹ Joint intellectual property is characterized by two or more assignees from different companies or legal bodies that share the ownership rights of the individual intellectual property right.

in-depth studies in Europe and the United States of America which were expected to provide the most innovative and interesting solutions to the issues involved.

Furthermore, our research has been enriched with information gathered during an intellectual property workshop series with a duration of more than half a year, consisting of nine multinational companies from different industry sectors. Main focus of this study was to understand how sustainable competitive advantages can be reached by applying situational adapted intellectual property strategies.

In both projects, benchmarking and workshop series, the results were discussed afterwards with the company representatives. The participants mostly focused on the relevance of intellectual property in the early stage of inter-firm R&D collaborations and on the success rate of solving intellectual property related problems and challenges.

Finally, almost hundred interviews have been conducted so far with intellectual property, innovation and R&D experts in Europe, the United States of America and Japan to deepen our insights.

4. Intellectual property in the Early Phase of R&D Collaborations

Concerning intellectual property management strategies, the benchmarking study revealed that 75% of the companies surveyed, have an intellectual property strategy that has been formulated in detail, is aligned with the corporate strategy, has been implemented company-wide and is reviewed and updated on a regular basis. It was found that the intellectual property experts develop the strategy in integrated teams with corporate stakeholders and management representatives of business units. Maximum importance was given in particular to the R&D function that was fully integrated in the intellectual property processes.

Finding solutions on the treatment of intellectual property that evolves from R&D collaborations poses a big challenge to the collaboration partners and their strategists: Before entering an R&D collaboration, companies seem to be frequently trying to save as much intellectual property on their side as possible (Markwith 2003). On the other hand, in practical terms it is a challenge to agree upon how to manage intellectual property which shall be created during the collaboration (Dillahunty 2002). However, the willingness to solve intellectual property issues and the success rate in R&D collaborations depends upon the previous experiences of the collaboration partners with the joint patenting process itself (Hagedoorn, van Kranenburg and Osborn 2003). Therefore intellectual property management in R&D collaborations plays a decisive role already in the early stages of collaborative processes. Early and explicit agreement on how intellectual property ownership and benefits are to be allocated among collaboration partners is generally important.

The benchmarking study affirmed the general interest of companies in involving external parties in their innovation processes. This includes the management of collaborations with third parties, for example customers, suppliers or even competitors. The study further revealed that about two-third of the surveyed companies are already involving external partners in their idea generation process, but that still one third of the companies has an insufficient success rate in solving intellectual property related issues in the early phase of collaborations. It turned out that one key problems seems to be the conflicts of objectives, for example between suppliers and customers. During negotiations the partners need to determine and explain the rights and duties that are expected from both parties. An important issue seems to be the level of discipline: For example, the successful parties in general

sign and stick to non-disclosure agreements even before the start of the negotiations and prepare minutes of the meeting signed by both parties.

5. The Case of IBM

IBM has been one out of five successful practice companies in intellectual property management, which have been identified in our benchmark study.

5.1. Development and Structure

Intellectual Property and its protection have always been of great importance to IBM. Former industrialists, such as John Patterson, CEO of National Cash Register (NCR), who had a great influence on later bosses of IBM, already used patents to eliminate or block competitors and aggressively sued 'infringers'. Tom Watson, Sr., also actively defended IBM's monopoly, for instance in the punch card market, by exclusively licensing the products instead of selling them (Mühlbauer 2001). Besides, like most software companies at that time, IBM hid its source codes, which allowed it to keep control over their own products. Other practices such as a functional pricing policy and the prosecuted 'tie-in'-system further supported IBM's market dominance. However, they also created a lot of resentment and dissatisfaction among competitors, customers and the public. Thus, U.S. President F.D. Roosevelt even launched an antitrust complaint against IBM (Mühlbauer 2001). However, without an appropriate protection of the punch card technology through patents, a fierce competition would probably have emerged and resulted in a price war. IBM would then probably not have become what it is today - one of the world's most famous and valuable brands and a very innovative player at the forefront of the IT development.

In the 1980's, IBM became aware of the inherent potential of commercialization practices regarding intellectual property. The company developed strategies of how best to license-out intellectual property and thereby generate returns on R&D investments. The changed philosophy turned out to be successful and within a decade the income increased by about 5,000 per cent to \$1.7 billion (Chesbrough 2001). In 2002, IBM reported an intellectual property income of \$1.1 billion in its annual report. The decrease compared to other years is said to be due to a change in the accounting policy. IBM has received more U.S. patents than any other company in the world ten times in a row. In 2002 they amounted to 3,288 patents leading to a portfolio consisting of over 37,000 active patents worldwide.

The decentralized intellectual property organization of IBM has grown with time. The corporate intellectual property department reports directly to the top management and thus, is not subordinate to the corporate legal or R&D department, as it is the case in other companies. Every division, has then its own intellectual property office. Furthermore, some regional subsidiaries of IBM also manage intellectual property internally. Germany, for instance, covers all eastern European countries, France is responsible for central Europe and some parts of Africa, and England manages the intellectual property for all northern European affiliates. IBM Switzerland has no intellectual property office of its own but uses the related services of the research centre in Rüschlikon, which is part of the corporate research organization and therefore not directly connected to IBM Switzerland. The rather complex matrix organization of IBM connects the research, market, and intellectual

property divisions and thereby guarantees the necessary influence of the R&D on the intellectual property strategy development process.

5.2. Intellectual Property Strategy and Management

IBM has a distinct corporate *intellectual property strategy* that is developed and periodically adjusted by the corporate intellectual property department. Regional and divisional intellectual property representatives can thereby give valuable advice based on their professional and local experiences, and change the course if different economic or legal situations require it. Hence, the strategies and processes of the Research Centre intellectual property and the corporate intellectual property are strongly interwoven and cannot easily be separated. However, rudimentary decisions and major guidelines, such as the general licensing policy, the targeted market, and the portfolio 'outlook,' are dictated top-down. A common ground is given by the company-wide focus on the licensing value of intellectual property. The proper valuation of intellectual property is of great importance and is performed systematically and periodically by the corporate patent portfolio management department. Thereby, mainly market criteria are applied (for example appreciation and readiness of the market, competitor's activities). Technology aspects are especially considered if the market needs to be developed first (technology-push). The patent portfolio management department is further concerned with a reasonable reduction of the patent portfolio in order to save (increasing) maintenance cost of strategically unimportant patents. The corporation's intellectual property and licensing team carefully analyzes where the industry and the market are going and manages the portfolio appropriately. The major *strategic goals* of IBM in terms of intellectual property are as follows:

- Maximizing the Return on R&D Investment (Licensing Policy).
- Worldwide "Freedom-of-Action" for marketing own technologies and products.

IBM is a pioneer and leader in licensing-out practices and generates a significant part of its annual earnings by related income. It follows a very open approach by generally and non-exclusively licensing all kinds of intellectual property, such as patents, trade secrets, know-how, and copyrights, to anyone who respects IBM's intellectual property interests. Respective initiatives are discussed and initiated within a team of business development, intellectual property, and licensing representatives. Since the company is concerned with providing complete so-called 'field-technology' licenses, i.e. the licensees can be sure that they do not need further licenses to fully exploit a specific product or service, its policy is widely received as mutually fair. Licensing-in, on the other hand, occurs relatively seldom, because IBM, with its extensive patent portfolio, usually has something to offer in return and is not dependent on other licenses to enter a field or market. In order to achieve the second and even more important goal, IBM generally aims for a broad and worldwide (uniform) intellectual property protection. The uniformity thereby facilitates the valuation of intellectual property rights for licensing purposes. Another important objective of the company is to maintain leadership in yearly U.S. patent reception. By this, IBM obviously wants to please Wall Street analysts and shareholders, as well as defend its image as a leading innovator. A comparative loss in this 'game of numbers' could send wrong signals to capital markets and other stakeholders (for example potential employees). In addition, the number of patents often helps to facilitate licensing negotiations and to settle patent fights in favour of IBM, while serving as a measure to balance the innovative capabilities of the parties involved. However, quality management as well as economic considerations is

intended to guarantee that the patent portfolio is not unnecessarily 'blown out' with costly low-quality patents. Finally, IBM prefers inter-firm settlements of patent disputes and avoids the legal enforcement alternative most of the time. This way, time and costs are saved, and future co-operation between the partners are easier and more likely to be successful.

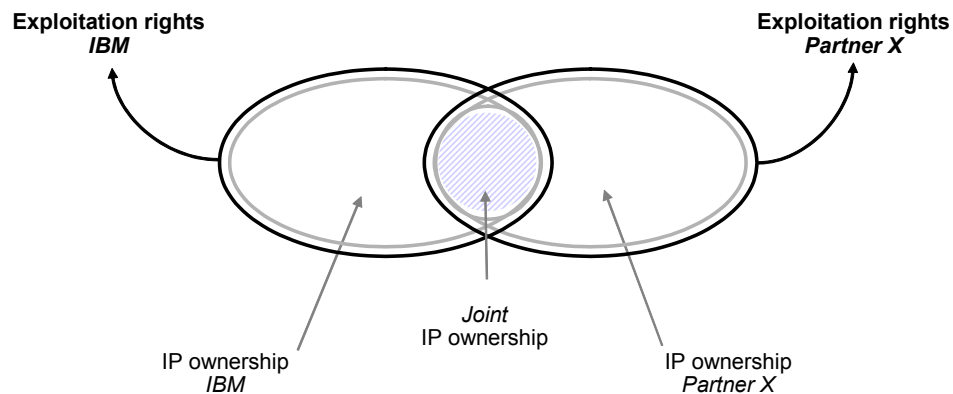
5.3. Intellectual Property within Collaborations

Intellectual property aspects have proven to be a vital part of most agreements and sometimes lead to major disputes or even prevent collaborative activities between two companies. Since the generation of intellectual property typically forms the core of any research collaboration, patent attorneys of both the research and the intellectual property organization (matrix structure) often work together in order to consider the different interests. However, in most other alliances intellectual property is neither the reason for nor a goal of the collaboration. Questions that arrive regarding the appropriate protection and allocation of rights only serve to maintain "freedom-of-action". Once an agreement is achieved, which in some cases can take years, the intellectual property is usually no longer subject to major disputes. IBM always attempts to keep the negotiated contract relatively short, clear, and practical. Like most big companies, it has its standard paragraphs that are intended to become part of the bilateral agreement. Concerning the allocation of rights, IBM has usually suggested a fairly easy solution to its partners (see Figure 1). It has proven to be very practical and has never led to serious disputes or misunderstandings among the firms involved. The rules, similar to most patent laws, simply state that whoever makes the invention also gets the ownership rights.

Joint innovations thereby establish joint patenting rights. Additionally, the counterpart typically receives complete exploitation rights. In order to avoid time consuming negotiations and intellectual property disputes, IBM sometimes does not include related paragraphs in the agreement after analyzing the potential risks or financial consequences of such an approach. This is possible because of increased harmony in national patent laws and is often appreciated by the counterparts, especially by small companies.

Altogether, IBM has had very good experiences with its "symmetric" model in joint research and development as well as regarding joint patenting. The company is convinced that any agreements which might block one partner after the collaboration are disadvantageous for learning and innovation. Therefore, IBM usually does not sign any contracts which restrict its capability to exploit potential outcomes (for example regarding certain markets, companies or regions). Of course, in some exceptional cases, appropriate concessions have been made, especially regarding joint intellectual property. Typically, then, the counterpart was a small company operating within niches of minor importance to IBM, which minimized the potential risk. Such agreements included, for instance, the allocation of ownership rights according to the technical inventions (components, systems), and exploitation rights regarding different geographical regions. Markets, on the contrary, have never been subject to related arrangements. While IBM basically considers all models possible and shows great readiness to negotiate fair and appropriate agreements, differing suggestions usually turn out to be impractical (for example definition of criteria and appropriate allocations), risky or the potential cause of future disputes. Therefore, in most cases, the "symmetric" solution applies and is intended to provide enough incentives to reach the collaborative goals. Besides, the majority of the partners perceive it as mutually fair, while some would like to gain a share of the revenues IBM generates with its licensing policy. Due to the numerous and complex

licensing contracts of IBM, however, this is not practicable and therefore refused. On the other hand, partnering companies are mostly free to license collaborative outcomes and should not benefit additionally from IBM's successful practices.



5.4. Conclusions IBM

IBM is the largest IT company in the world with a long history. Unlike many other firms, it has managed several disruptive changes and has survived in a dynamic and very competitive environment. The situation often has required major internal adjustments and flexibility. However, this process of permanent change has not stopped and challenges IBM anew every day. Decreasing margins in the hard- and software industry cause “Big Blue” to extend its range of services, whereby technology often just serves as an enabler. Like many companies in different industries, IBM tries to strategically insource and develop components in order to provide solution concepts to customers.

However, because of IBM's strategy to develop core technologies, products and services mainly in-house, together with its extensive intellectual property portfolio and long-standing experience in intellectual property management, intellectual property hardly ever causes major problems within collaborations or can be settled reasonably between the collaboration partners. Intellectual property that is generated independently belongs to the corporation and can be used and licensed by everyone. This circumstance, however, can sometimes cause problems. As mentioned before, the different business segments occasionally have conflicting interests when it comes to the allocation of rights between IBM and R&D collaboration partners. Therefore, it is essential to reconcile the involved goals and strategies in order to act on behalf of the entire company when joint innovations occurs.

6. Drivers and Problems with Intellectual Property in Inter-firm R&D Collaborations

Based on our literature research and benchmark study, we have extracted several anticipated drivers for managing intellectual property in the early phase of R&D collaborations. Motivation, structure and performance are the main success factors for interfirm intellectual property management (see Table 1).

Table 1 Success factors for managing intellectual property in R&D collaborations

Motivation related factors
• Main goal of collaboration • Former experience with collaborations • Information asymmetry • Trust and power
Structure related factors
• Strategic compatibility

6.1. Motivation related factors

(1) Main goal of collaboration: Intellectual property can be generated internally or externally (Ernst 2002a). It is therefore an important issue for a collaborating company to know whether the collaborative activities shall create intellectual property. This might depend as well on the companies' general attitude to inbound and outbound licensing. The anticipated patenting output however depends on sectoral partnering and patent intensity and finally on the sectoral strength of intellectual property as such (Haagedoorn 2003). During the early research phase of R&D collaborations it is the technologies that count the most. Acquisition of intellectual property at this stage of the innovation process often has only second priority. However, intellectual property often turns out later to become the final outcome of such collaborations. The longer a project lasts the more tangible the outputs become.

(2) Former experience with collaborations: The capability to know about the best moment to enter a collaboration select highly fitting collaboration partners, and to administer a collaboration relies strongly on former experience with inter-firm R&D collaborations (Anand and Khanna 2000). The quality of this process depends also on the capability to scan and monitor third party intellectual property in particular to find and evaluate a suitable collaboration partner (Abraham and Moitra 2001). Important experiences that influence the overall ability to manage intellectual property in collaborations depend on the skills to manage intellectual property with respect to strategy, processes, structures and culture (Gassmann and Bader 2003) and on the level of former experience with the joint patenting process as such (Hagedoorn, van Kranenburg and Osborn 2003). A large German pharmaceutical company states that 30% of their R&D budget is invested in R&D collaborations. However, the start-ups, universities and public research organizations face most of the problems. They tend to overestimate the abilities and strengths of their relatively inexperienced collaboration partners. The pharmaceutical company has gained satisfying results from its inter-firm R&D collaborations with other pharmaceutical companies so far. These partners seem to have superior levels of professional experiences and therefore can negotiate with more realistic perspectives.

(3) Information asymmetry: In general the collaborating partners have to accept that they might not know everything about the other partner. However, during the early phase it is relevant for the choice of the partners to clearly understand the level of complementarity of the shared resources (Chiesa, Manzini and Toletti 2002) and to understand the reciprocal interests of the participating partners concerning a collaboration. The number of collaboration partners has influence on the capability of the collaboration partners' knowledge of each other (Becker and Dietz 2004). Even though experts from patent departments might support the collaboration procedure by identifying open issues and recommending solutions, information asymmetry can also occur due to other influences: Difficult issues are often faced as a consequence of uncertainties resulting from anti-trust legislations, which is a major issue within the car manufacturing industry.

(4) Trust and power: Very relevant for the choice of the partners is the level of trust between them (Chiesa, Manzini and Toletti 2002). In the car manufacturing industry one has experienced that successful inter-firm R&D collaborations are mostly due to a high degree of fairness, trust and common understanding with the partners. Next to trust, however, the individual power of the collaboration partners are crucial for the setting, especially with regard to the strength of each of their intellectual property portfolios (Ernst and Omland 2003). Other factors of power are market power, skills and competences and other resources like financial resources. As a result of their purchase power the mechanical engineering sector and the car manufacturing industry sector still manages in most cases to keep the patent ownership for the inventions in collaborations with suppliers.

6.2. Structure related factors

(1) Strategic compatibility: The companies that collaborate in general do so due to a lack of resources and/or competencies that are necessary to form an autonomous standard. Chiesa, Manzini and Toletti (2002) derived from their research that the motivation for a standardization procedure in form of a development collaboration is to reduce risks and costs of standardization, to increase and complement the available skills and competencies and to increase the market power favouring the introduction of the technology on the market. Relevant for the choice of the partners is the level of complementarity of the shared resources (Noteboom 1999). Therefore the strategic fit depends highly on the level of competitiveness between the collaboration partners. In the mechanical engineering sector R&D collaborations with competitors are considered to be most critical as there is a high reciprocal influence on the collaboration partners' strategies. An important incentive that companies often realize in collaboration projects with external parties is outsourcing of their R&D activities. It is important to find mutually benefiting solutions that balance efforts, risks and opportunities for all parties involved and also to keep in mind that further investments might become necessary in future, in order to leverage the collaboration results. The way how to handle intellectual property from collaborations is still decided on a case-by-case basis, for example limited exclusivities. Collaboration partners might like to use the intellectual property beyond the scope of the collaboration business model in different markets. In those cases, the partners will need to agree to such bilateral conditions. Another reason as to why companies prefer exclusivity is that both partners want to avoid situations

where the competitors can easily get access to their collaboration results and thereby reduce their competitive advantages.

(2) Implementation capability: Inter-firm collaborations are based on joint R&D as one of the most significant reasons for forming alliances, especially in high-tech industries and the emerging technical industry sectors (Mowery 1988; Mytelka 1991; Hagedoorn 1993; Arora and Gambardella 1994; Colombo 1995). But even in other industries, for example the manufacturing industry, there may be a positive effect of R&D collaborations if there is sufficient absorptive capacity (Veugelers 1997). With respect to the information and communications technology industry, the more similar the technological portfolios of the collaboration partners, the easier it is to mutually absorb each others' capabilities (Santangelo 2000). Additionally, successful collaborating parties agree to exchange specific information about intellectual property rights before, during and even after the collaboration. Very often during finalizing the contracts, the most difficulties occur while resolving content related issues. For example one needs to answer questions, like which party should receive which rights of use.

(3) Complementary commercialization capability: Relevant for the choice of the partners is the market power of the coalition (Chiesa, Manzini and Toletti 2002). However, it is common practice to split patent ownership and rights of usages according to the business models of the collaboration partners as these might like to use the intellectual property beyond the scope of the collaboration in different markets. In those cases, the partners will need to agree to such bilateral conditions. Another reason as to why companies prefer exclusivity is that both partners want to avoid situations where the competitors can easily get access to their collaboration results and thereby reduce their competitive advantages. Another possibility is to agree to a time limited exclusivity or to declare certain market sectors as exclusive, for example the high end or low end market. However, the value of exclusivity needs to be validated with respect to product volume and the value versus cost ratio for customers.

6.3. Performance related factors

(1) Collaboration formation capability: During its formation, the capability of finding the right time schedule of involving intellectual property issues in the collaboration process is crucial, especially already during the early collaboration stage or in standardization procedures (Bekkers, Duysters and Verspagen 2002). Another issue in practical terms is, whether intellectual property issues get involved at all and not too late in the early phase of R&D collaborations.

(2) Intra-firm relation capability: Within a company, there are several factors that influence the company's capability to handle collaboration processes. A main factor is the experience of responsables to handle people and relationship issues in the early collaboration stage (Kelly, Schaan and Joncas 2002). In this context, in advance to successful collaborations, the reciprocal goals of the collaboration have been clearly supported by top-management. The intellectual property department of companies often need to deal with the inherent problem of researchers' preferences for disclosing information as soon as possible. It is further important to understand that the researchers often anticipate already in the very early collaboration formation phase who their partners are likely to be. The legal staff generally therefore often gets involved much later and is regularly only asked to fix unpleasant situations.

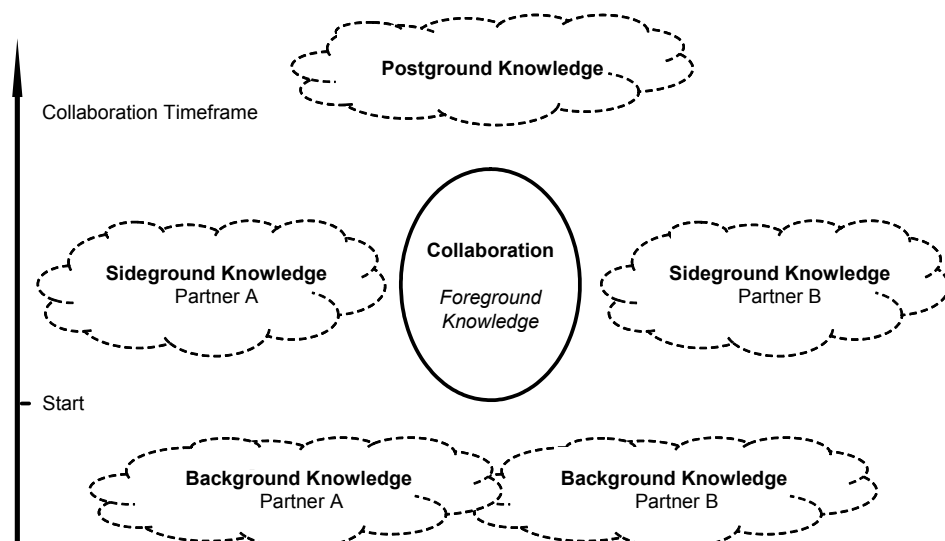
Another factor is an increase in number of new R&D collaborations towards the end of a fiscal year in order to quickly invest the remaining allocated budgets. This puts a lot of pressure on the legal staff as they need to conduct several negotiations and finalize contracts within a limited period of time. Intellectual property departments therefore consider proactively to inform and educate their R&D and marketing people about the procedures necessary to maintain an adequate level of quality and security. Those, responsible for concluding the collaboration are then able to operate in a goal-oriented manner also as have basic understandings of dos and don'ts at the same time. It has been found that internal patent awareness committees with participants from various departments and functions are key platforms for internal training and inter-communication.

6.3.3. Standardization capability: It is common practice, especially by large enterprises, to maintain a selection of standardized contract samples for various situations. It then becomes a time consuming question of power and stamina for other parties involved to change elements of the contract. However, it has shown that intellectual property handle processes in collaborations are almost not standardizable as the cases use to vary highly from case to case.

7. Managerial Implications

Collaborations are generally characterized by a high degree of mutual dependence. At the very beginning the partners need to make extra efforts to develop a common vision. The parties can substantiate this vision by formally agreeing upon subjects such as benefits, ownership, costs and resources. The purpose of conducting these negotiations is not only to establish a clear legal basis but also to maintain and support the common vision.

Due to our research we have extracted motivation, structure and performance related success factors for managing intellectual property in R&D collaborations. However, collaborating partners should not only concentrate on the collaboration phase only but as well on the prerequisites and the post collaboration era. The value



of a collaboration's outcome for each of the partners seems to depend also on the value of relevant knowledge and intellectual property rights that maybe are not directly part of the collaboration zone anymore. Especially when the collaboration partners intend to exploit collaboration results on their own, they might depend on resources of the other partner.

We have identified different knowledge areas as basis for deviated intellectual property rights which have been created before, outside or after the collaboration time frame. These areas can be classified as “background-“, “sideground-“ and “postground knowledge“ (see Figure 2). Very often a partner of a collaboration needs more rights than just those created during the collaboration to create a second source or to acquire a new customer and to derive a practical benefit from a license to use. For these reasons, relevant knowledge areas should also be considered early and should become part of the collaboration agreement.

8. Conclusions

In today's world companies are continuously under pressure to innovate. In order to cope with the internationalization of the markets, disappearing enterprises and industry borders, short product life cycles and increasing demands from customers, product and process innovations in shorter cycles must be thought about. Thus, ability to innovate has become the key driver for success of an enterprise: Only those companies are successful, which can bring innovative ideas effectively and efficiently on the market.

It is becoming increasingly evident that radical product innovations only in few cases can be achieved by companies on their own anymore. This means that the boundaries of enterprises and industry innovation processes must be opened in order to actively gain access to the knowledge and experience of customers, suppliers, research institutions and other sources. Various large enterprises have already recognized early enough that integration of external ideas and sources of knowledge into the innovation process leads to competitive advantages. The advantage of specialization and focusing as well as the attainable synergies by alignment of the R&D activities outweigh the fear of one-sided dependence.

This kind of innovation process which large companies are already actively practicing is likely to soon reach small and medium sized enterprises and especially those will be confronted with, that are dependent on external partners. The strategic positioning and the suitable innovation development are a tremendous demand for an enterprise acting alone. Projects that are solely run by a single company could even endanger its surviving in case of failure. Companies are therefore increasingly accessing sources outside their firms' boundaries and do not rely anymore on getting everything done internally. Important external sources of innovation are customers, suppliers and competitors as well as universities and research organizations.

Our research has revealed that intellectual property management in collaborations already plays an important role in the early phase of collaboration processes. It is recommended to agree upon business plans and legal issues for the anticipated exploitation of the fruits of the collaboration, including intellectual property. Important seems to be the early and explicit agreement between the partners how to share ownership and exploitation rights of resulting intellectual property. This requires a clear exit strategy: Who owns what after the co-operation has ended? A main reason for the difficulty to provide the answer is that at the start of a collaboration the partners do not definitely know the final relevant markets and competitors during or after the duration of the collaboration. At the maximum, the

partners can estimate the future situation. In other words: They talk about sharing a cake before its is baked.

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