

Collaboration in R&D: Drivers and Forms

Drafted for the SUCCESS project

All rights reserved by the author

Version April 2008

By

Line Gry Knudsen

Department of Management, Politics and Philosophy

Copenhagen Business School

lgk.lpf@cbs.dk

Table of Contents

1. Setting the Scene	3
2. R&D Collaboration as Organizational Form	5
2.1 <i>Why Collaborate on R&D?</i>	6
2.2 <i>Collaborations Come in a Variety of Forms</i>	9
2.3 <i>Open Innovation: New Ways of Organizing the Knowledge Processes of the Firm</i>	11
2.4 <i>Drivers of Collaboration in an Theoretical Perspective</i>	13
2.5 <i>The Processes of Knowledge Exploration and Exploitation</i>	15
2.6 <i>Barriers to Collaboration</i>	16
3. Collaborative R&D Capabilities	18
3.1 <i>The Role of Capabilities: a Review</i>	18
3.2 <i>The Elements of Collaborative R&D Capabilities</i>	19
3.3 <i>Absorptive Capacity</i>	21
3.4 <i>Organizational Mechanisms Leading to Collaborative Capability</i>	24
4. Managerial Implications	26

Collaboration in R&D: Drivers and Forms

1. Setting the Scene

The increasing challenges of globalization call for a more adept utilization of existing knowledge and resources through more efficient and effective collaborations between universities, research organizations and businesses. The aim of this report is to establish the drivers and forms of such integrated networks in the knowledge triangle of education, research and innovation. The empirical context of this project is the field of climate and energy research. This field is in specific need of more efficient collaborative models that can facilitate knowledge sharing and thereby ease the development of new energy technologies. The use of conventional energy sources entails perpetual problems. Oil and other fossil fuels will at some point run out. And increasing CO₂ emission is a danger to our climate. We need to think about sustainable alternatives if we are to continue to meet the world's increasing energy consumption and to stop the dramatic climate changes we are experiencing. And we need to do it with the greatest possible dispatch.

Research collaboration has a number of advantages in relation to this end. The higher speed of collaborative knowledge production, the opportunity to match complementary knowledge and an increased commercialization potential are just a few beneficial characteristics of university-industry collaboration. However, the utilization of these potential benefits is contingent on a current development of the governance models and internal structures of the integrated networks that connect universities and industry partners. Thus the aim of this report is to review the present literature on forms and drivers of R&D collaboration and hereby provide a solid ground for establishing and analyzing best practice of collaboration in the knowledge triangle within the field of climate and energy research. It is important to keep in mind that even though the field of climate and energy research has a common and very comprehensible recon d'être, i.e., to handle the grave challenges of climate change, it is a field of great diversity. The technologies of the field span a range of various disciplines. By way of example small scale terrestrial heat systems, large scale wind power systems, as well as safe nuclear energy and clean coal technology are all argued to be sustainable alternatives to existing energy sources because they do not emit greenhouse gases. Still, these energy forms vary a lot in respect to commercialization potential, safety issues and the use of other resource in the development process. A

*Collaborative
Advantages*

number of these technological sub-fields may benefit from collaborating on either basic research issues; how to utilize the distribution channels; or how to gain critical mass more generally.

The present report is drafted for the SUCCESS¹ project; a pilot project launched by the EIT with the purpose of benchmarking past and ongoing collaborations. By this benchmarking process, new and improved models of governance structures for integrated partnerships will be derived with the final goal of strengthening the link between education, research and innovation in the European Union. This report will provide a survey of the main theoretical perspectives on why and how public and private organizations engage in R&D collaboration. As organizations collaborate at an increasing rate it becomes still more important to understand how they can be instrumental in organizing and in managing the various collaborative knowledge processes, and especially how they can develop and maintain collaborative capabilities that ensure a positive outcome of their efforts. Thus, a specific purpose of this report is to enhance the understanding of why public and private organizations decide to engage in collaborative R&D projects. We will look at the range of factors that motivates organizations to engage in co-production of knowledge or to search for new knowledge through different external knowledge sources. The drivers of collaboration are argued to be founded in needs for exploitation and/or exploration of resources, and they will lead to many different forms of collaborations; from the very tight and formally organized projects to the more loose and informal relations.

The structure of the report is as follows. First, a brief introduction to the field of R&D collaboration will be provided. Second, we will outline why and how organizations collaborate. This means that we will look at the motives to collaborate and the forms these collaborative projects take. When studying the reasons and forms of collaborative projects and activities it becomes clear that some organizations seem to outperform others in the collaborative process. A third part of the report will therefore focus on the collaborative R&D capabilities that makes some organizations more capable of mitigating the potential pitfalls of collaboration. The capabilities may be either organizationally or individually held and we will throughout this report pursue a better understanding of the role they play in facilitating the collaborative activities of a given organization. In the fourth and final part we will turn towards the managerial implications that follow from working in close collaboration. The R&D manager plays a central role in ensuring the development of the

necessary capabilities, whether organizational or individual, and as argued towards the end of this report a number of strategically important activities, decisions and people management processes can be ascribed to the R&D manager of collaborating organizations. New forms of governance are asked for in this setting, as managers are repeatedly negotiating with partners and building consensus across organizational borders.

2. R&D Collaboration as Organizational Form

Inter-organizational collaboration is an organizational form that is used by an increasing number of firms to meet a wide range of organizational aims (Hagedoorn, 1996; 2002; Narula, 2004; Casson and Mol, 2006). Inter-organizational alliances are, by way of example, a preferred way of sourcing a variety of resources (Eisenhardt and Shoonhoven, 1996; Gulati, 1999; Van de Ven and Walker, 1984), and particularly a given firm's need for new knowledge has been shown to be a dominant reason for engaging in collaboration (Dyer and Nobeoka, 2000; Inkpen and Crossan, 1995; Larsson, Bengtsson, Henriksson, and Sparks, 1998; Moverly, Oxley, and Silverman, 1996). In fact knowledge intensive projects, such as technology development and R&D, are among the most often observed activities that firms collaborate on (Casson and Mol, 2006:24). Core resources are increasingly being sourced externally and core knowledge is produced in close collaboration with external partners. Thus, it is acknowledged that the critical resources of a given organization may span organizational boundaries as they are embedded in inter-organizational resources and routines. This has led Dyer and Singh (1998) to propose the idea of relational rents, which is "...a supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners" (Dyer and Singh, 1998:622). Relational rents are determined by; the degree of knowledge sharing between firms, investment in relation specific assets, the mix of complementary resources and capabilities and, finally, by effective governance. This perspective draws attention to the value that can be created in the interaction between two firms. A core point is important to derive from the relational rent perspective, namely that in the quest of gaining and sustaining competitive advantage firms does potentially benefit from having close relations to external partners.

New organizational forms

Core resources are sourced externally

Relational Rents

The benefits of tapping into the 'knowledge pool' of the partner do not only relate to the increased speed of the process of gaining new resources; also the quality of the

Speed & Quality

knowledge that is developed may be improved. This is based on the assumption that diverse knowledge is needed to produce a new product or service (Kogut and Zander, 1992). This variety is best attained when the pool of exciting resources, skills, and capabilities is bigger—which it will be when the focal firm has more non-redundant relations. This logic is parallel to the assumption behind innovation studies stating that innovation is best understood as the process of combining existing knowledge and resources (Schumpeter, 1934). And the ability to be innovative is a central component in the quest of gaining and sustaining competitive advantage (Teece, Pisano and Shuen, 1997). In sum, access to a diverse pool of knowledge and other resources is a precondition for new knowledge creation in a given innovation process.

Still, this logic may not be taken to imply that firms need to open up towards external partners without taking into consideration the downsides that may follow: The risk of losing valuable knowledge; the threat of being exposed to the opportunistic behavior of the partner; the risk of losing the freedom to act; or the need to give up control are all situations that ask for a thorough analysis of the relation to a potential partner (Suen, 2005). In fact, when studying how firms relate to each other in the innovation process, *competition* among firms has conventionally been the focus of attention (Schumpeter, 1942), while *cooperation* is viewed as a less important issue (Teece, 1992:1). This focus is, as described, now being fundamentally challenged. It is the case in studies of innovation specifically, but also in studies of firm behavior in general a prevalent position is that the relations between the firm and its external environment play an important role in shaping performance (Laursen and Salter 2006: 132). Knowledge networks and collaborative activities play an increasingly important part in innovation processes in many firms. This upsurge in both actual numbers of alliances and in the academic interest of the phenomenon has, however, not yet supplied us with an unambiguous explanation as to why firms collaborate. Still, in the following section I will seek to summarize the diverse drivers of collaboration.

*Competition versus
Co-operation*

*Knowledge
Networks*

2.1 Why Collaborate on R&D?

The reasons for firms to engage in R&D collaboration are very diverse and are often shaped by the specific characteristics of the organization. By way of example studies have shown that the size and age of a firm are some of the characteristics that may inform the motivation to collaborate (Narula, 2004); thus, smaller entrepreneurial firms or research

departments and larger corporations do tend to have different motives to engage in alliances and they may play very different roles in collaborative projects as well (Schumpeter, 1942). Where as larger firms typically have the resources for creating formal R&D laboratories and exploiting economies of scale in the R&D function (due to better access to external finances and benefits from complementarities between R&D and other activities), they might lack the adaptability that often characterizes smaller firms. Smaller firms for their part often benefit from being more flexible due to a lower degree of bureaucratization in research and innovation activities, yet they are motivated to collaborate because they need access to the resources that the larger firm holds. Numerous empirical studies have sustained this finding for example by showing that innovation output appears to be less proportional to size, meaning that R&D productivity declines with size and that larger firms therefore need the creative inputs that smaller and more innovative firms can provide (Cohen and Levin, 1989; Hagedoorn, 2002).

Size and age of firms as drivers of collaboration

R&D collaborations are in most cases based on a variety of motives that can intervene and might change over time as the partners develop their knowledge base or as the projects undergo changes (Hagedoorn, 2002). In addition to size and age of the firm other idiosyncratic factors, such as the character of the specific knowledge needed by an organization, may foster a wish for collaboration as well, and thus the disciplinary background of the firm or research group may also spur collaboration.

The decision on whether to collaborate or not has traditionally been framed as a trade-off between using internally produced knowledge or sourcing externally the knowledge needed (e.g. collaborating with R&D partners) in the innovation processes. Thus the question of whether to collaborate with an external partner for the purpose of accessing the assets needed or to integrate the activities has been illustrated by help of a flow chart guiding the focal firm through to the end decision (Teece, 1986). Following this perspective, the decision relies first of all on whether or not complementary assets are necessary for commercial success of the firms R&D activities. If the answer to this fundamental question is positive a row of questions will follow, which relates to whether the assets that are needed are specialized? Whether the appropriability regime is weak? To what extend the specialized assets are critical to the firm? And whether or not the cash position is satisfactory? And finally whether the imitators/competitors are better positioned and thus can become a threat to the focal firm (Teece, 1986). If the answers to these

Internally produced or externally sourced knowledge

questions are negative then collaboration/contracting is said to be the most profitable solution, and as such answering the questions will guide the focal firm towards the right decision on whether or not to collaborate.

Other scholars have, in a similar manner, examined the factors that affect the trade-off between in-house generated and externally acquired knowledge, and they have found that the antecedents fall into two main groups; either technical or organizational in nature (Tidd and Trewhella, 1997). Organizational factors that may spur collaboration comprise, first, the corporate strategy and how it dictates for example a policy of technological differentiation attainable through collaboration. A second organizational issue affecting the aspiration to collaborate is the level of competencies; if these are weak the firm may be more motivated to source new competencies externally, as also mentioned above in regards to the discussion of small firms' motivation to collaborate. Third, the company culture may affect the decision to collaborate as the underlying values and beliefs have a strong impact on the employees (and managers) attitude towards external knowledge (Sveiby and Simons, 2002). A culture signaling that 'we are the best in the world' may contribute to a rather myopic view of external technologies, whereas firms that consistently reinforce a philosophy that important technological developments can occur almost everywhere are more keen on searching for and applying external knowledge (Tidd and Trewhella, 1997:370). Another cluster of influencing factors is related to the technology of the focal firm. These factors are described as, first of all, the manager's comfort with a given technology or in other words how the company culture affects the single manager's view on collaboration. Next the competitive impact is important in influencing the decision to collaborate—or not; in fact, the wish to retain the core technologies as a distinctive source of competitive advantage is shown to be the most important reason for refraining from collaborating. Other issues affecting the trade-off are the complexity and 'codifiability' of the technology and finally the credibility given to the firm by a technology, which means that a firm may want to collaborate with a given partner on a specific technology because they believe this alliance to influence the credibility of the products in the market.

Technical or organizational factors spur collaboration

Competencies

Organizational culture

Codifiability

Additionally, timing is potentially a very important determinant for the decision to collaborate. One main characteristic of R&D opportunities is that they are often temporary which means that an innovator needs to exploit the opportunity quickly before the information leaks to competitors, or before the opportunity is replaced with a

Timing

technologically more advanced alternative, that is; before the window of opportunity closes (Katila and Mang, 2003). A situation where the innovator due to competition does not have sufficient time to build the knowledge or complementary assets needed, the time issue can force the firm to collaborate to access the required assets. This is particularly true when imitation is easy (Teece, 1986). In fact prior research has shown that discoverers of technological opportunities can access resources for exploitation most effectively through collaboration (Mitchell and Singh, 1996). The reason for engaging in collaborative projects is also stressed to be caused by overall strategic considerations such as the wish for market expansion or extending product portfolios (Atuahene-Gima and Patterson, 1993). The strategic perspective recognizes that sourcing knowledge externally is driven by long term competitive considerations and not only by minimization of transaction costs (Tidd and Trehwella, 1997). Often the acquisition of external knowledge or technology complements internal R&D rather than being a substitute for it (Tidd and Trehwella, 1997). Hence, the decision to collaborate can have a number of antecedents and we will return to a more theoretical description in the next section, but first we need to recognize that the growing acknowledgement of the importance of external knowledge sources to enhance internal R&D activities give rise to a variety of collaborative activities, such as joint ventures, partnerships, research consortia, ad hoc network relations, etc. (Ring and Van de Ven, 1994).

Strategic considerations

2.2 Collaborations Come in a Variety of Forms

Collaborative R&D projects come in a myriad of forms and this is yet another reason to why it is difficult to arrive at a general definition of collaborative R&D. R&D collaboration is a fraction of a large and diverse group of inter-firm relationships between firms, situated on the continuum between markets and hierarchies (see figure 2.1), and it is said that there is as many definitions of what an alliance is as there are alliances (Suen, 2005). Anyhow, the collaborative R&D projects can vary from the establishment of joint ventures at the one end to more loosely knitted networks at the other (Hagedoorn, 2002). The specific aim of R&D collaboration range from a narrow focus on developing new products based on existing technology, to very broad and indefinable projects where firms seek to develop the 'next generation' of a particular technology or product in collaboration (Sampson, 2007).

Between Market and Hierarchy

INSERT Figure 1 here (Contractor and Ra)

The many hybrid forms that belong in the middle of the continuum vary in degree of formalization and interaction between the partners. Even though different in governance form, etc., the various kinds of inter-organizational R&D collaborations have some common features. R&D collaboration is defined as a set of different inter-organizational R&D activities between two or more independent firms engaging in a process of ongoing resource contribution to create value (Hagedoorn, 2002; Bamford *et al*, 2003). The contributions can include knowledge, technology, staff, customers, brands, capital, and equipment (Hagedoorn 2002; Bamford *et al*, 2003: 12). The activities often take place in contexts involving uncertainty over outcomes (Ariño *et al*, 2001). The R&D alliance is strategic when it is the means by which a firm seeks to implement, in part or in whole, elements of management's strategic intent (Hamel and Prahalad, 1989). Additionally, these alliances are almost always managed by an incomplete contract, as the terms can not be completely specified and agreed upon at the outset of the relationship. This is so due the unforeseen nature of R&D. As a consequence these inter-organizational projects are dependent on joint decision making and a committed management team (Bamford *et al*, 2003).

Incomplete contracts

In continuation it must be highlighted that R&D collaboration is a means, not an end in itself. A specific R&D project is thus best described by the goals it is set to fulfill (Ariño, 2003), yet the measurement of the outcome of inter-organizational alliances can be very hard to define (Yan and Zeng, 1999). This suggests the need for clear alignment between the goals of R&D collaborations and the organizational design of the collaborative project. R&D activities differs remarkably from other business processes that firms may collaborate on, as for example marketing alliance, due to a high degree of uncertainty and risk connected to R&D activities. In fact various types of collaborations are being managed and organized in different ways according to how close the relation to the partners is. For example an equity-based alliance, such as a joint venture, may be harder to negotiate and organize than a non-equity alliance, which then on the other hand may be more flexible (Ariño, 2003). A non equity alliances may be more challenging to manage and organize as there is no formal 'alliance organization' and that all activities depend on acceptance from

Collaboration as means not ends

cross firm teams and committees. This inquires a new way of perceiving the mode in which R&D projects and related innovation activities are organized.

2.3 Open Innovation: New Ways of Organizing the Knowledge Processes of the Firm

A scholar that has been especially vocal in calling for a new paradigm in innovation studies is Henry Chesbrough (2003). Inspired by the work of his supervisor, David Teece, Chesbrough emphasizes the importance of external sources of knowledge in the innovation process, and he proposes the *open innovation paradigm* to accentuates the idea that ‘firms can and should use external as well as internal ideas and internal and external paths to markets as the firms look to advance their technology’ (Chesbrough, 2003:xxiv). A cornerstone in open innovation idea is the purposive use of inflows and outflows of knowledge that can be used to accelerate internal innovation, and expand the markets for external use of innovation (Chesbrough, 2006b). Open innovation scholars state that open innovation means systematically encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources and broadly exploiting those opportunities through multiple channels (West and Gallagher, 2006: 320). Thus, openness in the innovation process can be understood as a firm’s *willingness* to make use of a wide range of external sources (e.g., other firms, universities, research labs or small start up firms) in order to enhance the innovation capacity. In addition to defining openness as a firm’s willingness to make use of external sources it is also said that openness ‘reflects an ability to profitably access external sources of innovation’ (West, 2006: 109). This *ability* to profitably access external knowledge is closely connected to the protection of the returns from the knowledge at stake, which again depends on the intellectual property rights. Thus, openness can be understood as both the willingness and the ability of a firm to make use of external sources of knowledge in the innovation process.

*Open Innovation
Models*

The open innovation paradigm is asserted to be highly novel and to contrast with previous closed innovation paradigms, being models that focus on vertically integrated innovation processes and are highly inward-looking (Chesbrough, 2003; 2006b). Still, as numerous innovation scholars have countered, relying on external sources of knowledge and externally produced assets is not as such a new venture (Christensen, Olsen and Kjær, 2005; Frederiksen, 2007). As I have stated previously scholarly attention has been drawn to

the importance of (externally produced) complementary assets for decades. Teece, for example, argues that 'in almost all cases, the successful commercialization of an innovation requires that the know-how in question be utilized in conjunction with other capabilities and assets' (Teece, 1986: 288). Further, studies have, since the 1970s, called attention to the value of specific external sources of knowledge such as customers and lead users (von Hippel, 1977; 1978).

In order to understand why we nevertheless, witness an upsurge in articles based on the open innovation perspective and the general recognition of a more positive attitude towards externally produced knowledge, we must look at a number of developmental changes in the society in general. Introducing a special issue of R&D Management on open innovation, Oliver Gassmann (2006) underscores five developmental trends that seem to be consistent with the open innovation paradigm. He notes that the more an industry's idiosyncrasies relate to the five trends the more appropriate the open innovation model seems to be to firms of this industry. The first of the five trends is the *wave of globalization*: many global firms favor open innovation models because they can achieve economies of scale more swiftly. A second factor is the *intensity of technology*: most firms lack the capabilities to cope with all upcoming technologies and lack the financial capacity to exploit these technologies alone. This leads them towards other firms. Third, *technology fusion* seems to invite openness: the morphing of technologies into new interdisciplinary research fields makes a single firm incapable of doing innovation alone. A fourth trend is the rise of *new business models*. For the purpose of risk sharing, pooling of complementary competences and the realization of synergies, many firms tend to form strategic alliances or corporate partnerships, and thus many new business models are created due to shifting industrial or technological boundaries. The final trend is the focus on *knowledge resources*. The fact that knowledge is seen as one of the most important resources of the firm turns employees into knowledge brokers, trying to relate to relevant persons and knowledge sources outside the firm (Gassmann, 2006: 224).

*Positive Attitude
towards External
Knowledge*

The open innovation perspective is more far reaching than earlier work on strategic alliances, as this perspective deals with more than one-off partnerships or sporadic relations to external partners; it delineates a new way of perceiving the firm and its relation to external partners. In acknowledging that the trend of openness is diffusing to more parts of the firm Chesbrough has argued for the formation of open business models, namely

business models that create value by leveraging different ideas, due to inclusion of a variety of external ideas and knowledge in many parts of the firm (Chesbrough, 2006a:2). This idea contrast with the classical understanding of collaboration as an organization form which is chosen on an ad hoc basis when collaboration fits the purpose of a given need for knowledge. Collaborative R&D projects are not to be treated as single instances designed on an ad hoc basis in accordance with specific goals. Rather we ought to study collaborative activities as a bundle of activities that has a number of specific advantages, which challenge the way firms are organized and capabilities are developed. And therefore we might have to develop new business models that incorporate a more open perspective.

2.4 Drivers of Collaboration in an Theoretical Perspective

A central idea in strategic management research is that firms are somewhat self-sufficient entities that have a preference for doing business alone (Contractor and Lorange, 1988; Gomes-Casseres, 1996), and that their main motive to engage in partnership is to overcome constraints shaped either by the market or the specific industry (Heimeriks, 2004:30), or, as pointed to by Grandori and Soda (1995), collaboration may be chosen as a consequence of bureaucratic failure. The argumentations about the causes of inter-organizational collaboration are often formed by the theoretical lens put upon collaboration. Studies of strategic alliances is often founded either in a transaction cost logic (TCE) (Williamson, 1985, 1991; Hennart, 1988, 91), emphasizing transaction cost efficiency as the motivation for collaboration, or they have their out spring in a resource based logic (RBV) assuming firms to be bundles of capabilities and resources heterogeneously distributed across firms (Penrose, 1959; Wernerfelt, 1984).

The first perspective, TCE, explains why firms engage in alliances by referring to the opportunity to minimize production or transaction cost (Williamson 1991; Hennart, 1988, 1991). Further Williamson (1991) notes that alliances provides incentives that are intermediate to the high-powered incentives implied by the market and the low-powered incentives provided by the more flexible set of administrative control systems available in firms. Internalizing the activities is the best way to control transaction costs (such as writing and enforcing a contract) effectively, and therefore this will be preferred if transaction cost of a given exchange is high. It is thus argued that collaboration will be preferred “when the transaction costs associated with an exchange are intermediate and not high enough to justify vertical integrating” (Gulati, 1995: 87). The TCE perspective, focusing on either the

*Transaction Costs
Economics*

conditions that lead the firm to produce resources in house rather than buying them externally (Coase, 1937;Williamson, 1985) or allying with external partners to get what is needed (Dyer, 1996; Williamson, 1999), takes a micro-analytical perspective, looking at ‘one transaction at a time’ (Jacobides and Billinger, 2006). Even though the transaction cost perspective is and has been very influential, its focus on alliance formation as being dependent on a wish for cost minimization in relation to single projects may prevent us from seen the bigger picture of inter-organizational collaboration.

Scholars adhering to the resource based view on the other hand state that firms ally when they 1) find themselves in a strategically vulnerable situation and need the resources that collaboration can bring them, or 2) are in a strong position that make it possible to capitalize on their assets through alliances (Eisenhardt and Schoonhoven, 1996). Closely related to the resource based view scholars of the knowledge based view (KBV), argue that collaboration can be beneficial because it will link a focal firm to knowledge that the external partners possesses (Hamel, Doz and Prahalad, 1989), and accordingly collaboration is a vehicle for organizational learning, giving partner firms access to each other’s knowledge (Kogut, 1988; Hamel, 1991; Grant, 1996;). The learning motivation for engaging in alliances has been a growing theme in recent literature and the interest in how organizations develop new competencies and learn from their partners takes centre stage in many studies (e.g. Inkpen, 1998; Larsson *et al.*, 1998; Kale et al., 2000; Muthusamy and White, 2005). For example scholars of evolutionary economics have pointed to the fact that organizations change and adapt their technologies both by internal processes and by interaction with partners (Nelson and Winter, 1982). The ability to adapt organizational routines which are building blocks of a firm’s capability is what explains a firm success and survival. We will return to how these different perspectives perceive capability development, but first lest summarize how scholars have pointed to the differences in reasons for collaboration between these different perspectives:

Resource Based View

Knowledge based View

Evolutionary Economics

Insert table 1 here

To summarize, strategic alliances scholars have suggested that inter-firm collaboration is a

mechanism by which a firm can leverage its skills, acquire new competencies, and learn (e.g. Kogut, 1989; Hamel, Doz, and Prahalad, 1989; Huber, 1991; Larsson, Bengtsson, Henriksson, and Sparks, 1998; Lyles, 1988; Powell and Brantley, 1992). For the partnering firm, alliances represent interfaces with its environment that provide access to valuable external information and knowledge (Powell, Koput and Smith-Doerr, 1996; Teece, 1992). As such, these arrangements can provide opportunities for firms to assimilate information, internalize skills, and develop new capabilities. Moreover, research has suggested that social networks, competencies, and the relative configuration of skills and organizational practices of the partnering firms can influence the level of learning through alliances (e.g. Hamel, 1991; Lane and Lubatkin, 1998; Mowery, Oxley and Silverman, 1996; Shan, Walker and Kogut, 1994). As knowledge creation and innovation are becoming increasingly multidisciplinary, an amount and combination of scientific skills and intellectual capabilities that normally exceed the capabilities of a single firm is often needed to generate research breakthroughs (Powel, Koput and Smith-Doerr, 1996). This provides a given firm with a number of good reasons to approach external partners. In general, the motives for engaging in R&D collaboration can be divided into two main groups; the first comprises the need for new knowledge and can be classified as *exploratory* activities and the second type is associated with the wish for making better use of the knowledge and resources already at hand, namely *exploitation* of existing knowledge.

Multi-disciplinarity

2.5 The Processes of Knowledge Exploration and Exploitation

In order to describe the proper balance between creating new knowledge and exploiting already existing capital and assets James March (1991) has advanced the dual concept of exploration and exploitation (March 1991:71, Koza and Lewin 1998:256). The concept of knowledge *exploration* comprises activities such as search, variation, risk taking, experimentation, play, flexibility, discovery and innovation. The core activity of exploration is experimentation with new alternatives. The results of these processes are often uncertain, distant, and thus sometimes even negative. The distance in time and space between the locus of learning and the time for the realization of returns is generally greater in the case of knowledge exploration than in the case of knowledge exploitation. Additionally a collaborative project aiming at exploring of new knowledge will be characterized by a high degree of uncertainty, due to the fact that future knowledge cannot be perfectly predicted—if it could, it would be held already (Popper, 1956).

Exploration

Knowledge *exploitation*, on the other hand, includes refinement, choice, production, efficiency, selection, implementation and execution. Exploitation is about refining and extending the existing competencies, technologies, and paradigms. The returns of knowledge exploitation are, in the word of March; ‘positive, proximate, and predictable’ (March, 1991:85). Applying the trade-off between exploration and exploitation to collaborative activities it becomes clear that the ability to create synergies in the collaborative knowledge-processes is affected by the intent of each partner and the presence of appropriate integrative resources (Nielsen, 2005: 1201). In particular, the issue of mutual learning involves conflicts between short run and long run concerns and between gains to individual knowledge and gains to collective knowledge (March, 1991:74). The need for exploration of new and complex knowledge is often the cause of a decision to source knowledge externally as collaboration may ease the process of learning this new knowledge that the partner may hold (Teece, 1986; Pisano, 1990). In times of ‘creative destruction’ (Schumpeter, 1975), that is; periods of big change in technology regimes, firms may not be able to cope internally with the fast changes in the underlying knowledge and technologies, and are thus forced to turn towards external knowledge source to supplement their internal R&D (Pisano, 1990). In fact the high complexity of knowledge and technologies in many research disciplines is often used to explain the need for collaboration, as it is done for example by Teece, who states that, “It is well to recognize that the variety of assets and competences which need to be accessed is likely to be quite large, even for only modestly complex technologies. No company can keep pace in all [...] areas by itself” (Teece, 1986:293). Both exploitation and exploration, on this view, are essential activities for firms; still, they are activities that fight for scarce resources. Thus, it is important to understand the implicit or explicit choices that are made in organizations related to activities of development and use of knowledge.

Exploitation

*Creative
Destruction*

*Complexity of
Knowledge and
Technologies*

2.6 Barriers to Collaboration

We have now reviewed a number of good reasons for firms to collaborate on R&D activities, but as indicated throughout this chapter the valuation of whether or not to ally does not always redound to the advantage of collaboration. Knowledge production and knowledge utilization are among the most important activities in R&D intensive firm (Dierickx and Cool, 1889; Leonard-Barton 19992; Conner and Prahalad, 1996; Grant 1996). Through these and related knowledge processes the most vital assets of the R&D intensive firm is gained or

created. Thus in order to keep control of these processes it is argued that knowledge intensive firms are most likely to wish for an in-house organization of R&D processes in order to be able to protect the valuable assets (Lewin and Massini, 2004). Based on this argument it is expected that firms will acquire only niche and marginal resources which are less strategically important, through collaborations (Narula, 2004) and will leave the creation of the most central knowledge to the internal R&D department. Limits to the degree of collaboration are not only created out of a wish to protect core knowledge. Empirical studies have shown that even though firms that utilize external knowledge are more innovative there is a certain point where searching for external knowledge becomes unproductive (Katila and Ahuja, 2002; Laursen and Salter, 2005). This finding goes both for the process of searching for new knowledge through a number of different sources, i.e., the search breadth, and for repeating the search from a specific source (partner) numerous times, i.e., the search depth. It is shown that both external search depth and breadth has an inverted curvilinear relation to innovation performance (Laursen and Salter, 2005). These studies illustrate that in connection to collaboration with external partners in the R&D processes the more is not always the better. This finding accentuates the importance of studying the reasons firms have to collaborate on R&D projects as we might expect that it is necessary to limit the extent of collaborative activities and choose only the most valuable partnerships in accordance with the findings just presented.

Protecting Core Knowledge

More is not always better

Another reason as to why it is important to identify a firm's motives for collaboration is that the aim of the collaboration will have an effect of which capabilities that need to be developed. If capabilities are what closes the gap between an intention to collaborate and a positive outcome of the collaboration (Dosi, Nelson and Winter, 2000), we need to know exactly what spurred the intention in order to say something about the capabilities. By way of example, let us imagine a focal firm looking for knowledge that can help them in the process of venturing into a new field of research. Due to fierce competition etc., they do not have the time to hire new employees or develop the knowledge internally; they need to source the knowledge externally. But the kind of scientific knowledge they require is not easy to integrate; it is complex and highly codified, and thus they need to build a close relation the partner firm who holds parts of the knowledge needed. This new collaborative relation necessitate the employment of a wide range of capabilities in the focal firm first of all the abilities to search for and find the right partner, and following to be able to

understand and internalize the complex new knowledge that the partner may hold. Adding both disciplinary skills and communication skills does not even make a full picture, but still it give us a sense of how complex the range of necessary capabilities are. In the coming section we will look into how these various collaborative R&D capabilities can be conceptualized and what their antecedents look like.

3. Collaborative R&D Capabilities

An empirical tendency has motivated numerous strategic alliances scholars to study the role of collaborative capabilities in shaping firm performance. They are motivated by the fact that while some firms witness failures in relation to their collaborative projects, in only around 10 % of the alliances others face a failure rate of over 70% (Harbison and Pekar, 1998). This variation in performance has caused a wish to study the determinants of successful in alliances, and the studies are centered on the specific abilities that seem to be present in successful firms. A range of scholars have contributed to this field of study by examining collaborative capabilities albeit under slightly different labels, such as 'relational capability' (Dyer and Singh, 1998), 'alliance capabilities' (Kale, Dyer and Singh, 2002; Heimeriks and Duysters, 2007) and 'collaborative know-how' (Simonin, 1997). I will return to these slightly different types of capabilities, yet to get an understanding of the concept of capabilities we must begin with understanding the concept of capabilities as such.

Success Rate

3.1. The Role of Capabilities: a Review

We commence from the advanced definition of capabilities as bundles of routines, as originally defined by scholars belonging to the field of evolutionary economics (Nelson and Winter, 1982). This work was based on the logic that a firm experience superior survival and growth rates because of the existence of superior capabilities which enable them to consistently sustain innovation, new knowledge creation, recombining existing capabilities and reinventing and updating their underlying routines (Nelson and Winter, 1982). Building on the behavioral theory of the firm (Cyert and March, 1963) evolutionary economics is founded on principles concerning behavior in situations of uncertainty. It is argued that people only possess a limited cognitive ability and therefore they can exercise only bounded rationality when making decisions in complex, uncertain situations (Simon, 1976). Thus individuals tend to 'satisfice', that is, they attempt to attain realistic goals, rather than maximizing a utility or profit function. Further it is argued that the firm cannot be regarded

Collaborative Capabilities

as a monolith, because different individuals and groups within it have their own aspirations and conflicting interests, and that firm behavior is the weighted outcome of these conflicts (Cyert and March, 1963).

In general alliance capabilities will, if possessed, act as means to gain competitive advantage (de Man, 2004). Examining how firms achieve and sustain competitive advantage is a fundamental activity in strategic management studies (Rumelt, Schendel and Teece, 1991), and as described previously the resource based view (RBV) assumes firms to be bundles of capabilities and resources heterogeneously distributed across firms (Penrose, 1959; Wernerfelt, 1984), creating competitive advantage by being rare, valuable, inimitable, and non-substitutable (Barney, 1991). Thus, in contrast to more classical strategic management scholars who explain discrepancy in firm performances as caused by the structure of the industry (for example its barriers to entry and rivalry among industry incumbents) that a given firm belong to (Porter, 1980), scholars adhering to the resources based views see firm heterogeneity as created by the existence of superior capabilities and resources inside the firm. Although theoretically useful the RBV neglects to account for the mechanisms by which resources actually contribute to competitive advantage. Recent extensions of the RBV seek to explain how this may happen in dynamic and rapidly changing markets via application of the dynamic capabilities perspective (e.g. Teece, *et al.*, 1997; Eisenhardt and Martin, 2000). The literature provides somewhat different classification s of dynamic capability (Zahra *et al* , 2006), still the most often cited definition is that: "Dynamic capabilities [...] are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide split, evolve, and die" (Teece *et al.*, 1997). Most important to acknowledge is that dynamic capabilities are especially associated with change (Eisenhardt and Martin, 2000). Especially in a setting like the present where the aim is to study the nature of the capabilities that can help a firm attain new knowledge in collaboration with external firms, dynamic capabilities may be an especially helpful construct. Dynamic capabilities are thus said to differ from ordinary organizational capabilities as they enable the firm to innovate outside their current routines. I thus perceive collaborative R&D capabilities to be a sub-group of dynamic capabilities.

*Dynamic
Capabilities*

3.2 The Elements of Collaborative R&D Capabilities

In the context of the present study it is especially important to recognize that firms change and adapt their technologies, both internally and as an outcome of interaction with external partners (Nelson and Winter, 1982; Lewin and Massioni, 2004). In a collaborative situation these higher level routines will guide the interaction with partner firms and new technologies, and processes or business methods will be internalized in the focal firm through the variation, selection and replication processes of the firm. According to evolutionary economics configurations of routines and capabilities are context specific and reflect firm differences. For example, capabilities for absorbing new knowledge from external partners consists of more elaborated boundless of routines in R&D intensive firms (industries) compared to firms characterized with low R&D intensity (Massini *et al*, 2002). This is so because superior firms (innovating firms) hold combinative capabilities being routines for decomposing internal, external and old knowledge and recombining it. And this dynamic capability respond to the rapidly changing environment by effectively adapting, integrating, coordinating and reconfiguring internal and external organizational skills, resources and functional competencies is exactly what is what determine superior performance (Tecce *et al*, 1997). A firm's ability to dynamically transform current knowledge into new knowledge (exploitation activities) and generate new applications from existing knowledge (explorative activities) is exactly what makes them innovative (Kogut and Zander, 1992). This combinative capability, being the ability to synthesize and apply current and new knowledge is a central capability of the innovating firm. Collaboration in this context is seen as 'options on new markets distantly related to current knowledge by providing a vehicle by which firms transfer and combine their organizationally embedded learning' (Kogut and Zander, 1992:395).

*Innovative
Capabilities*

The capabilities construct has been applied to the field of collaboration by many researchers as the following list will illustrate. These scholars have a shared mission in trying to explain alliance performance heterogeneity as a consequence of differences in capabilities of the firms. Whether talking about 'collaborative capability' (Schreiner *et al*, 2005) or 'alliance competences' (Spekman *et al*, 2000), 'alliance capabilities' (Heimeriks, 2004), 'relational capabilities' (Dyer and Singh, 2004), 'relational assets' (Dunning, 2002) or 'collaborative know-how' (Simonin, 1997; 2002); they all argue that a connection exist between the collaborative capability and alliance performance.

Schreiner (2000) and Schreiner *et al* (2005) has elaborated on the collaborative

capability construct by showing that it can be conceptualized as being a multi-dimensional construct consisting of three sub-capabilities, namely; 'coordination capabilities', 'communicative capabilities, and 'bonding capabilities'. This study is interesting due to the acknowledgement of the various kinds of capabilities that, in conjunction, form collaborative capabilities. Alliance capabilities are furthermore described as being "partly a function of individual skills and capabilities and firm-level attributes that enhance, encourage, and support alliance-like thinking and behavior throughout the firm" (Spekman *et al*, 2000: viii). This perception of the capabilities as being developed in a consonant process including both individual level and organizational level attributes is, however, not very salient in the capability literature; in general, the attention is concentrated on organizational level factors.

Individual and Organizational Capabilities

A few exceptions from this organizational level focus deal with the role of the individual in forming the alliance as they focus on e.g. interpersonal trust as a core factor in supporting the successful alliance (Kale *et al*, 2000;). Kale *et al* define the construct 'relational capital' which they suggest to be "the level of mutual trust, respect, and friendship that arises out of close interaction at the individual level between alliance partners" (Kale *et al.*, 2000:218). Relational capital creates a basis for learning and transfer of know-how across organizational boundaries but it also helps the focal firm to protect itself from the potential opportunistic behavior of their partner (Kale *et al*, 2000:217). Thus relational capital is seen to mitigate the natural tension between learning on the one hand, and protecting on the other hand. Another study makes a related point in saying that the relational capability of a firm, i.e., its capability to interact with other firms, can increase its access to knowledge and knowledge transfer (Lorenzoni and Lipparini, 1999). Both transaction and production costs can be lowered through multiple, repeated, trust-based relationships, and collaboration offer the focal firm with access to complementary capabilities and specialized knowledge resulting in positive effects for the firm (Lorenzoni and Lipparini, 1999). In fact the notion of organizational learning has grown in importance during the last decade and plays a central role in many R&D collaborations today.

Relational Capital

3.3 Absorptive Capacity

What becomes especially important in the fallout of the discussion of learning through collaboration is to analyze how a firm can internalize the knowledge that they are presented to in a given collaboration. This is comprised by the construct of absorptive capacity. A

firm's ability to prosper from external knowledge is related to firm specific absorptive capacity; that is; the ability to recognize the value of new external knowledge, assimilate it and apply it to commercial ends in the firm (Cohen and Levinthal, 1989; 1990). Absorptive capacity is the ability to connect existing internal practice of a given firm to new external knowledge in a process where the overall innovation capacity is affected.

Absorptive Capacity

Cohen and Levinthal (1989, 1990, 1994) have suggested that firms differ in their ability to recognize, assimilate and utilize external information. The absorptive capacity depends on the cumulative experience within the firm and the extent to which its knowledge is related to external information. Focusing on the process of absorption it is important to bear in mind that some kind of shared knowledge and expertise is a necessary condition to make communication happen between the members of a focal firm and external partners (Cohen and Levinthal, 1990; Borgatti and Cross, 2003). This could be both a basic level of shared language and symbols and of more technical forms of knowledge. Different kinds of knowledge are associated with different kinds of absorptive capacity (Cohen and Levinthal 1989), and when it comes to absorbing scientific knowledge a firm is better off if it has a high number of academic staff employed and has a high R&D intensity. Absorptive capacity is especially important in the setting of this study as it is shown that innovation firms are better at developing both internal and external absorptive capacity for innovation and creation of new knowledge while non innovation firms (imitators) is limited to adopt codified and mature knowledge (Lewin and Massini, 2004). This type of knowledge does not hold the potential to create innovation in R&D intensive firms.

A firm's ability to learn from another firm is determined by the relative characteristics of the firms (Lane and Lubatkin, 1998). Describing the one firm as a teacher firm and the other as the student firm Lane and Lubatkin (1998) state that three characteristics determine the relative absorptive capacity of a firm: a), the specific type of new knowledge offered by the teacher firm; b), the similarity between the student and the teacher firm's compensation practices, being the similarity of two firms' compensation policies, serves as one proxy for the similarity of their knowledge-processing systems and norms and organizational structures (structures are important to how firms processes knowledge because organizational members interact not only as individuals, but also as actors performing organizational roles; and c), the student firm's familiarity with the teacher firm's

set of organizational problems.

The way a firm deals with organizational problems is said to be a function of the dominant logic of that firm, or the 'common thread' running through all the objectives of the firm (Lane and Lubatkin, 1998:465). As Lane and Lubatkin state: "Even if the students understands the know-what (scientific knowledge) and the know-how that shaped it (the knowledge processing systems) its ability to commercially apply the new knowledge will largely depend on the degree to which its know-why (dominant logic) overlaps with the teacher's... the more familiar the student is with the types of problems or projects that the teacher prefers, the more readily it will be able to commercially apply new knowledge from that teacher" (Lane and Lubatkin, 1998:466).

Absorbing intra-industry knowledge is shown to be supported by more in-formal contacts between employees. This knowledge can easily be spread between people as this knowledge is easily understood due to the homogeneity of the knowledge from one's own industry. Inter-industry knowledge on the contrary is best shared through formal channels and the employees will need some more general skills in structuring problems and gathering information on previously unknown subjects. An organization's absorptive capacity will depend on the absorptive capacity of its individual members, but it is argued that an organization's absorptive capacity is not simply the sum of the absorptive capacity of its employees; some aspects are distinctly organizational (Cohen and Levinthal, 1990). The organizational level capability relates to the ability of the organization as a whole to stimulate and organize the transfer of knowledge across departments, functions and individuals and even between firms. As absorptive capacity is said to be incremental in nature, a firm's ability to appropriate new external knowledge will depend largely on prior experience with collaboration and of whether the employees hold related knowledge (Cohen and Levinthal, 1990: 128). Various studies have shown that firms benefit more from collaboration when they have some (but not all) technological capabilities in common with their partners (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998; Sampson, 2007). When firms choose to utilize external knowledge sources in their R&D process it often serves the purpose of accessing complementary knowledge, i.e. knowledge that add to and match the knowledge already at hand. A potential useful resource for the accumulation of knowledge via R&D is pre-existing know-how within the firm. This kind of complementary knowledge can produce economies of scope, which 'arises from inputs that are shared or utilized jointly

without complete congestion' (Willig, 1979, in Helfat, 1997:340). A firm's exposure to knowledge within its environment will influence the development of future capabilities (McGrath, MacMillian and Venkataraman, 1995), yet this knowledge needs to complement the knowledge already held to ensure learning (defined as the extent to which knowledge is related to and at the same time different from the knowledge in their networks) (Lofstrom, 2000).

If all researchers in a group share the same specialized knowledge, coding scheme or specific expertise they will be good at communicating with each other, but will have a hard time linking up with an external knowledge source (Burt, 2002) as they may not understand the new external knowledge or can not integrate it with the knowledge they already possess. In fact, the process of knowledge sharing often meets certain barriers that make it difficult to attain the objectives. These barriers should not be ignored, but studied and handled in a deliberate manner, and it is well known that failures and difficulties in collaborative projects are vital sources of insight that need not be concealed (Kanter, 1994).

Shared Capabilities

3.4 Organizational Mechanisms Leading to Collaborative Capability

In sum I argue, based on the above discussions that collaborative R&D capability is a dynamic capability consisting of the interplay between strategic (organizational) and structural (physical) resources at the organizational level and (human) competences at the individual level. As such, the value of collaborative capability lies in its ability to integrate and leverage the organizational and individual mechanisms that govern inter-firm relationships.

*Intra-firm
Mechanisms*

However, in spite of the increasing interest in the phenomenon of inter-organizational collaboration, and the capabilities needed to facilitate collaboration among firms, we still know little about these central organizational mechanisms that facilitate collaborative R&D processes and the collaborative competences that they may give rise to (Heimeriks and Duyster, 2007). The lack of understanding of these organizational mechanisms and the role they play is what motivates the analysis of the next sections. As stated in chapter 1 one of the main weaknesses with the studies of collaborative capabilities is that they neglect to empirically account for the *individual* level attributes that ensure the effective embeddedness of collaborative capability. Thus we need to develop a comprehensive understanding of the organizational mechanisms that foster collaborative

Alliance Experience

capabilities in general and specifically we need to focus at the individual level attributes that lead to the development of these capabilities.

An alliance capability can, according to Kale, *et al* (2002), be defined as a mechanism or routine that is purposefully designed to accumulate, store, integrate, and diffuse relevant organizational knowledge about alliance management. It is stated that different organizational mechanisms can be developed to enhance the ability to facilitate knowledge acquisition and knowledge conversion (Nambisan, Agarwal, and Tanniru, 1999). In the context of R&D collaboration, such organizational mechanisms are for example performance incentives, alliance functions, or alliance managers, which are initiatives that can facilitate the sourcing, creation, sharing and deployment of knowledge.

Reluctance to Share Knowledge

One recent large scale empirical study of 193 firms aimed at enhancing our understanding of these mechanisms. The firms studied had a total alliance portfolio of approximately 2973 alliances and the study showed that a specific kind of organizational mechanism, namely alliance mechanisms, can play an important role in shaping alliance performance (Heimeriks, 2004). The study provides a categorization of alliance mechanisms that can be instrumental in developing alliance capabilities. The first of the four categories are 'functions', which refers to an organizational unit in which a number of critical alliance tasks are managed. We also find mechanisms that can help to structurally coordinate alliance knowledge in the firm or functions that support alliance management in a number of ways, such as accumulating and assembling experiences in such a way that it is easily transferable to new situations. The second category is 'tools' which cover practical mechanisms to deal with day-to-day alliance management issues, such as alliance training programs, best practice accumulation or evaluation programs. Different tools support alliance management through their ability to ease conflict situations. Tools can furthermore stimulate sharing of collaborative experience. The third category 'control and management processes' encompasses specific aspects of alliance management, being control mechanisms, reward and bonus systems, formally structured knowledge exchange, etcetera. The last category is 'external partners' and this refers to the use of third parties as lawyers, consultants or experts to complement a firms own knowledge in the collaborative process.

The study also shows that 11 intra-firm mechanisms are especially conducive in

enhancing a firm's alliance performance. The 11 mechanisms are: alliance database, vice president of alliances, use of intranet, use of own knowledge about national culture differences, alliance manager, partner selection program, formal exchange of alliance knowledge, joint alliance evaluation, individual alliance evaluation, alliance metrics and alliance departments. Other studies have suggested that extensive use of artifacts (Hargadon and Sutton, 1997), real-time operating information as opposed to abstract accounting data (Eisenhardt, 1989), joint customer visits (Dougherty, 1992), and tangible representations of problems (Hargadon and Sutton, 1997, Bechky, 1999), help in breaking down communication barriers while increasing analogical thinking and mutual understanding, in a way that makes knowledge integration more effective. Yet, rules and routines can both impede (Dougherty, 1992) and improve (Eisenhardt, 1989; Hargadon and Sutton, 1997) knowledge integration. An influential study of 203 collaborating firms has stated that the existence of an alliance management function is vital to a successful outcome of partnerships, as firms with alliance functions has a 25 percent higher long-term alliance success rate than those firms without (Dyer, Kale and Singh, 2002). Other studies have shown evidence for the importance of alliance experience on alliance performance (Powel *et al*, 1996; Anand and Khanna, 2000, Heimeriks and Duyster, 2007). Still, empirical examination shows that collaborations are often performed on an ad hoc basis and that organizational mechanisms that could facilitate the collaborative processes are not in place. A study of 38 UK and Japan based firms that were all sourcing knowledge or technology externally showed that only two of them had a formal unit supporting external knowledge sourcing processes (Tidd and Trehwella, 1997: 362). Further, it is important to remember that the mere existence of organizational mechanisms does not guarantee a successful outcome of collaboration. Different organizational barriers exist such as departmentalization structures which limit the ability to transfer and thus leverage knowledge inside the organization and additionally it can be argued that there is a difference between having mechanisms in place to internalize knowledge and then being able to utilize it (Heimeriks and Dyuster, 2007). The mere existence of organizational mechanisms does indeed not guarantee successful dissemination and utilization of knowledge (Grant, 1996; Simonin, 1997; and Tsang, 2002).

4. Managerial Implications

All this implies that the R&D manager has a very important role to play in ensuring

alignment between the corporate aspiration to collaborate, based on either a wish for exploitation of existing resources or exploration of new ones, and the positive outcome of the collaborative ventures.

The interests of the firm to engage in a given collaborative project may simply be communicated, for example by a manager, to the employees who are expected to transfer their R&D activities to this new collaborative project. If the project is clearly beneficial to the firm, is in line with the research agenda and has a number of obvious potential gains this managerial task may not be difficult. Yet, motivating employees to share knowledge with external partners is often more complicated. One of the main reasons for an employees to be reluctant is that an instruction to undertake research in close collaboration with external partners may seem as a contradiction to the traditional conviction about the R&D activities being the absolute 'core' of the firm activities and that the activities and results should be protected as such. This means that the doors are *not* to be opened to external people. Accordingly, collaboration seems to raise questions that pertain to the nature of the firm (Caloghirou, Ioannides, Vonortas, 2003) as it is perceived both by academics and practitioners. Therefore, the decision to engage in R&D collaboration is often very challenging to communicate. In the process of communicating the collaborative decision to the employees it will be of great value if the manager can show clear and unambiguous goals for the collaborative project, as I will relate to later in the following section. Other challenges meeting the firm such as apparent resource constraints or a clear need for knowledge that can be sources externally can constitute factors that affect individual's understanding of the necessity to collaborate. The majority of scholars studying alliance capabilities as such agree that alliance management represents a unique resource or capability which is positively related to alliance performance (e.g. Anand and Khanna, 2000).

R&D management is typically not considered to be a creative process in itself. Rather it is seen as a bunch of administrative processes where resources are allocated, projects are managed, milestones are designed and deadlines are monitored, etc. But, as I have shown a row of strategically important activities, decisions and people management processes can actually be ascribed to the R&D manager, and as such the areas of R&D management responsibility does also hold opportunities for creativity to be displayed, and the act of R&D management needs continuously to be innovated upon in order to enhance the ability of

the manager to work towards a better exploitation of R&D outputs of the firm and its partners. Whereas the R&D function originally was designed as a highly specialized and separate corporate function it is now often more integrated in projects. In most firms some form of matrix organization is needed to balance the many specialists needed in a given project, including R&D employees (Katz and Allen, 1982). In many firms the R&D manager (or research project manager) is a very central function in the quest for competitive advantage and it may even be a main contributor to the development of new open business plan of the firm; a business plan that describes a more open attitude towards external knowledge sources. In stating the need for a more open attitude towards external knowledge the R&D manager comes to play a central role as he or she is often the one who conceptualize the collaboration strategy and further the R&D manager is a key source of leads to potential alliance partners. Additionally the top managers usually serve as the principal negotiators of the alliance agreement and the strategic alliance formation in the complex process of collaboration involving both strategic and social factors (Eisenhardt and Schoonhoven, 1996). The research managers' job becomes that of an integrated innovation facilitator; representatives from both research, development, production, regulatory operations, quality assurance, patent department, or the like are to be invited into the project in due time; the work processes are to be coordinated; and the overall goals need to be kept clear and present.

The R&D manager must delineate ways to manage R&D more effectively by empowering teams to work autonomously, aid the formation of collaborative networks and gather experience and expertise on collaboration to help further collaborative processes. Individuals must be encouraged to search for knowledge in new places and to incubate new businesses and the basis of this knowledge. One of the core tasks of the R&D manager is to stimulate a climate of creativity and intrapreneurship, in which highly motivated and self managed employees work towards unambiguous goals. This is, however, not an easy task. As we have seen through this study a number of challenges meet the people engaged in R&D collaboration.

References (to be finally corrected...)

- Annand, B.N. & Khanna, T. (2000) Do firms learn to create value? The case of alliances. *Strategic Management Journal* 21(3): 295-315.
- Atuahene-Gima, K. & Patterson, P. (1993) Managerial perceptions of technology licensing as an alternative to internal R&D in new product development: an empirical investigation. *R&D Management* 23(4): 327-36.
- Borgatti, S.P. & Cross, R. (2003). A relational View of Information Seeking and Learning in Social Networks. *Management Science* 49(4): 432-445.
- Burt, R. (2002) Bridge Decay. *Social Networks* 24(4): 333-63.
- Casson, M. & Mol, M.J. (2006) Strategic Alliances. A survey of Issues from an Entrepreneurial Perspective. In Shenkar and Reuer (ed.) *Handbook of Strategic Alliances*. London: Sage
- Chesbrough, H. (2003) *Open Innovation - The New Imperative for Creating and Profiting from Technology*. Boston, MA: Harvard Business School Press.
- Chesbrough, H. (2006a) *Open Business Models. How to thrive in the new innovation landscape*. Boston, Massachusetts: Harvard Business School Press.
- Chesbrough, H. (2006b) *Open Innovation: A New Paradigm for Understanding Industrial Innovation* Oxford University Press. In Chesbrough, Vanhaverbeke, and West (ed.) *Open Innovation: Researching a New Paradigm*. New York: Oxford University Press.
- Christensen, J.F., Olsen, M.H. & Kjær, J.S. (2005) The industrial dynamics of open Innovation – Evidence from the transformation of consumer electronics. *Research Policy* 34: 1533-1549.
- Coase, R. (1937) The Nature of the Firm. *Economica* 4:385-405
- Cohen, W. & Levinthal, D. (1989) Innovation and Learning: The Two Faces of R&D. *Economic Journal* 99(397): 569-596.
- Cohen, W. & Levinthal, D. (1990) Absorptive Capacity: A new perspective of learning and Innovation. *Administrative Science Quarterly* 35: 128-152
- Cohen, W. & Levinthal, D. (1994) Fortune Favors the Prepared Firm. *Management Science* , 40(2): 227-251.
- Dyer, J.H., & Singh H. (1998) The relational view: cooperative strategy and sources of inter organizational competitive advantage. *Academy of Management Review* 23(4): 660-679.
- Dyer, J. & Nobeoka, K. (2000) Creating and managing a high-performance knowledge-sharing network: the Toyota case, *Strategic Management Journal*, 21: 345-367.
- Eisenhardt, K. & Schoonhoven, C. (1996) Resource-Based View of Strategic Alliance Formation: Strategic and Social Effects in Entrepreneurial Firms *Organization Science* 7(2):136-150.

- Eisenhardt, K. & Martin, J. (2000). Dynamic Capabilities. What are they? *Strategic Management Journal* 21(10-11): 1105-1121.
- Eisenhardt, K. (1989) Building theories from case study research. *Academy of Management Review* 14(4): 532-550.
- Frederiksen, L. (2007) *Open Innovation Business Models. Innovation in firm-hosted online user communities and inter-firm project ventures in the music industry – a collection of essays*. Copenhagen: Samfundslitteratur Publishers.
- Grant, R. (1996) Toward a Knowledge-Based Theory of the Firm. *Strategic Management Journal* 17: 109-122.
- Gulati, R. (1999) Network location and learning: the influence of network resources and firm capabilities on alliance formation. *Strategic Management Journal* 20(5): 397-420.
- Hagedoorn, J. (1996) Trends and patterns in strategic technology partnering since the early seventies. *Review of Industrial Organization*. 11(5): 601-616
- Hagedoorn, J. (2002). Inter-firm R&D partnerships: an overview of major trends and patterns since 1960. *Research Policy* 31: 477-492.
- Hamel, G. (1991) Competition for Competence and Inter-Partner Learning Within International Strategic Alliances. *Strategic Management Journal* 12: 83-103.
- Hamel, G. & Prahalad, C.K. (1989) To revitalize corporate performance, we need a whole new model of strategy. *Harvard Business Review*, 67(3):63-76
- Hamel, G., Doz, Y. & Prahalad, C. K. (1989) Collaborate with Your Competitors - and Win. *Harvard Business Review*, VOL?: 133-45.
- Heimeriks, K. (2004) *Developing Alliance Capabilities*. ECIS: Eindhoven
- Heimeriks, K. & Duysters, G. (2007). Alliance capability as a mediator between experience and alliance performance: An empirical test into the alliance capability development process. *Journal of Management Studies* 44(1): 25-49.
- Huber, G. P. (1991). Organizational learning: The contributing processes and the literature. *Organization Science* 2: 88-115.
- Inkpen, A. (1998) Learning, knowledge acquisition, and strategic alliances. *European Management journal* 16(2): 223-229(7).
- Inkpen A. & Crossan, M. (1995) Believing is seeing: joint ventures and organization learning. *Journal of Management Studies* 32: 595-618.

- Kale, P., Singh, H. & Perlmutter, H. (2000) Learning and Protection of Proprietary Assets in Strategic Alliances: Building Relational Capital. In *Strategic Management Journal* 21: 217-237.
- Kale, P., Dyer, J. H. & Singh, H. (2002) Alliance Capability, Stock Market Response, and Long-Term Alliance Success: The Role of the Alliance Function. *Strategic Management Journal* 23: 747-767.
- Kanter, R. M. (1994). Collaborative advantage: Successful partnerships manage the relationship, not just the deal. *Harvard Business Review* 74(4): 96-108.
- Kanter, R.M. (2002) Strategy as Improvisational. *Leadership and Organizational Studies* 43(2): 76–81.
- Katila, R.; Mang, P. (2003) Exploiting Technological Opportunities: The Timing of Collaborations. *Research Policy*, 32(2): 317-332
- Katila, R. and Ahuja, G. (2002) Something old, something new: a longitudinal study of search behavior and new product introductions. *Academy of Management Journal* 45: 1183-1194.
- Katz, R. & Allen, T.J. (1982) Investigating the Not Invented Here (NIH) Syndrome: A look at the Performance, Tenure and Communication Path of 50 R&D project groups. *R&D Management* 12: 7-12.
- Kogut, B. (1988) Joint Ventures: Theoretical and Empirical perspectives. *Strategic Management Journal* 9: 319-332.
- Kogut, B. (1989) The Stability of Joint Ventures: Reciprocity and Competitive Rivalry. *The Journal of Industrial Economics* 38(2): 183-198.
- Kogut, B. & Zander, U. (1992) Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology. *Organization Science* 3(3) Focused Issue: Management of Technology?: 383-397.
- Kogut, B. & Zander, U. (1996) What Firms do? Coordination, Identity, and Learning. *Organization Science* 7(5): 502-518.
- Koza, M.P. & Lewin, A.Y. (1998) The Co-Evolution of Strategic Alliances. *Organization Science* 9(3): 255-264.
- Lane, P. J. & Lubatkin, M. (1998) Relative Absorptive Capacity and Interorganizational Learning. *Strategic Management Journal* 19: 461-477.
- Larsson, R., L. Bengtsson, K. Henriksson, & J. Sparks (1998) The Interorganizational Learning Dilemma: Collective Knowledge Development in Strategic Alliances. *Organization Science* 9(3): 285-305.
- Laursen, K. & Salter A. (2006) Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal* 27(2): 131-150.
- Lofstrom, S.M. (2000) Absorptive capacity in strategic alliances: Investing the effects of individuals' social and human capital on inter-firm learning. Presented at the *Organization Science Winter Conference*, 2000 in Keystone, Colorado.
- Lorenzoni, G. & Lipparini, A. (1999) The leveraging of interfirm relationships as a distinctive organizational capability: a longitudinal study. *Strategic Management Journal*, 20: 317-38.

- Lyles, M. (1988) Learning Among Joint Venture-Sophisticated Firms. In F. Contractor & P. Lorange (Eds.), *Cooperative Strategies in International Business*: 301-316. Lexington, MA: Lexington Books.
- March, J. (1991) Exploration and Exploitation in Organizational Learning. *Organization Science* 2(1): 71-87.
- McGrath, R., MacMillan, I. and Venkataraman, S. (1995) Defining and Developing Competence: A Strategic Process Paradigm." *Strategic Management Journal* 16(4): 251-75.
- Mitchell, W. & Singh, K. (1996) Survival of Business Using Collaborative Relationship to Commercialize Complex Goods. *Strategic Management Journal*. 17 (3): 169-195
- Mowery, D.C., J. E. Oxley, & B. S. Silverman (1996) Strategic Alliances and Interfirm Knowledge Transfer. *Strategic Management Journal* 17, Special Issue: Knowledge and the Firm (Winter): 77-91.
- Muthusamy, S.K. & White, M.A. (2005) Learning and Knowledge Transfer in Strategic Alliances: A Social Exchange View. *Organization Studies* 26(3): 415-441.
- Narula, R. (2004) R&D collaboration by SMEs: new opportunities and limitations in the face of globalisation. *Technovation* 24: 153-16.1
- Nelson, R. & Winter, S. (1982) *An Evolutionary Theory of Economic Change*. CITY, STATE: Belknap Press.
- Nielsen, B.B. (2005) The role of knowledge embeddedness in the creation of synergies in strategic alliances. *Journal of Business Research* 58: 1194-1204.
- Penrose, E. (1959) *The Theory of the Growth of the Firm*. Oxford: Basil Blackwell.
- Porter, M.E. (1980) "Competitive Strategy", The Free Press: New York.
- Powel, W. W., Koput, K.W. & Smith-Doerr, L. (1996) Inter-organizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly* 41: 116-145.
- Powell, W. & Brantley, P. (1992). Competitive Cooperation in Biotechnology: Learning Through Networks, in Nohria, N. & Eccles, R. G. (eds). *Networks and Organizations: Structure, Form and Action*. Boston, MA: Harvard Business School Press.
- Pisano, G.P (1990) The R&D boundaries of the firm: an empirical analysis, *Administrative Science Quarterly* 35: 153-176.
- Ring, P. S. & Van De Ven, A. (1994) Developmental Processes of Cooperative Interorganizational Relationships. *Academy of Management Review* 19(1): 90-118.
- Rumelt, R.P, Schendel, D. and Teece, D.J (1991) Strategic Management and Economics. *Strategic Management Journal*, 12: 5-29
- Ryan, R. & Deci, E. (2000) Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist* 55(1): 68-78.

- Schreiner, M. & Corsten, D. (2003) Integrating Perspectives: A Multidimensional Construct of collaborative Capabilities. Working Paper, University of St. Gallen.
- Schumpeter, J. A. (1934) *The Theory of Economic Development*. Cambridge: Harvard University Press. (New York: Oxford University Press, 1961)
- Schumpeter, J. A. (1942) *Capitalism, Socialism, and Democracy*. New York, NY: Harper and Brothers.
- Simonin, B. L. (1997) The Importance of Collaborative Know-How: An Empirical Test of the Learning Organization. *The Academy of Management Journal* 40(5): 1150-1174.
- Suen, W.W (2005) *Non-Cooperation: The Dark side of Strategic Alliances* . New York: Palgrave Macmillan
- Sveiby, K. E. & Simons, R. (2002) Collaborative climate and effectiveness of knowledge work - an empirical study. *Journal of Knowledge Management* 6(5).
- Szulanski, G. (2003) *Sticky knowledge. Barriers to knowing in the firm*. London, UK: Sage
- Teece, D.J. (1986) Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy* 15: 285-305.
- Teece, D.J. (1992) Competition, cooperation, and innovation: organizational arrangements for regimes of rapid technological progress. *Journal of Economic Behavior & Organization* 18: 1-25.
- Teece, D.J., Pisano, G. & Shuen, A (1997) Dynamic capabilities and strategic management. *Strategic Management Journal* 18(7): 509-533.
- Tidd, J. & Trehwella, M. (1997) Organizational and technological antecedents for knowledge acquisition and learning. *R&D Management* 27(4): 359–375.
- Tsang, M. (2002) *Intergovernmental grants and the financing of compulsory education in china*. New York, NY: Columbia University.
- Van de Ven, A. H. & Walker, G. (1984) The dynamics of interorganizational coordination. *Adm. Sci. Quarterly* 29(4):598-621.
- von Hippel, E. (1977) Has a Customer Already Developed Your Next Product? *Sloan Management Review* 18 (2): 73-74.
- von Hippel, E. (1978) Users as Innovators, *Technology Review* 80(3): 31-39.
- West, J. (2006) Does appropriability Enable or Retard Open Innovation? In Chesbrough, Vanhaverbeke and West (ed.) *Open Innovation: Researching a New Paradigm*. New York, NY: Oxford University Press.
- West, J. & Gallagher, S. (2006) Challenges of Open Innovation: the paradox of firm investment in open-source software. *R&D Management* 36(3): 319-331.
- Wernerfelt, B. (1984) Resource-Based View of the Firm. *Strategic Management Journal* 5(2): 171-180.

Winter, S.G. (2003) Understanding Dynamic Capabilities. *Strategic Management Journal* 24(10): 991-995.

Williamson (1985) *The Economic Institutions of Capitalism. The economic institutions of capitalism: Firms, markets, relational contracting*. Free Press: New York and London

Williamson, O.E (1991) Comparative Economic Organization: The Analysis of Discrete Structural Alternatives *Administrative Science Quarterly*, 36

Wood, D. J. & Gray, B. (1991). Toward a comprehensive theory of collaboration. *Journal of Applied Behavioral Science* 27(2): 139-162.

Yan, A. & Zeng, M. (1999) International Joint Venture Instability: A Critique of Previous Research, a Reconceptualization, and Directions for Future Research. *Journal of International Business Studies*, 30: 397-414

Zaheer, A., McEvily, B., & Perrone, V. (1998) Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. *Organization Science* 9(2): 141-159.

Zhou, J. (1998) Feedback valence, feedback style, task autonomy, and achievement orientation: Interactive effects on creative performance. *Journal of applied psychology* 83(2): 261-276.

Zollo, M. and S.Winter (2002) Deliberate learning and the evolution of dynamic capabilities. *Organization Science* 13(2): 339-352.