Alliance Performances in the Dutch Biotechnology Sector

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Abstract

In the biotechnology sector small R&D intensive firms play a fundamental role to keep innovation rates high. With less bureaucratic burdens, low level of hierarchy and high internal flexibility they are able to move fast and to make most efficient use of unique competences. Still their shortage in resources, related to company size, makes them dependent on a strong network of alliances to get access to missing competences and materials.

This paper aims at establishing the influence of alliance characteristics on the innovation performance of firms in the biotechnology sector. It presents a conceptual model to clarify the special role of collaboration intensity and how human resource exchange is related to innovation performance of biotechnology alliances.

Keywords: *collaboration intensity, human resources exchange*

1 Introduction

'*In biotechnology we see a relatively new field of technology in which a substantial number of small R&D intensive firms have found an important share of the business in performing R&D, both basic and applied, through alliances and contract research with large firms*' (Hagedoorn, 1993:381). This citation can be seen as a baled and still up to date view of an interesting situation found in this high-technology sector. It demands to have a closer look at the circumstances that stimulate or hinder the forming of successful collaborations. The biotechnology sector is subdivided into groups depending on the process applications. Red biotechnology deals with medical applications and has close links to the pharmaceutical industry, while green biotechnology deals with agricultural and white/grey biotechnology with industrial processes. The order in which the different types of biotechnology are stated corresponds to their share of the sector. The average growth of the total industry is projected to 8% through 2015 and 75% of the global revenues are made in the U.S.. The EU, where this study was performed, follows with 15 % of the global biotechnology revenues (Porter et al., 2007).

There is a certain set of problems that biotechnology companies face. One of the main problems derives from the capital needed to develop a product and to introduce it to the market successfully. On top of that, companies, especially in the 'red' biotechnology sector, face long time horizons until first revenues pour in. In addition companies face a high level of uncertainty when it comes to product development (Rothaermel and Deeds, 2004). Especially today, to raise sufficient bank loans in capital markets states a real challenge. Typically small biotechnology companies are frequently facing resources constraints (Majewski, 1998). Although small companies are confronted with a whole queue of difficulties, they also provide certain advantages compared to the large biotech/ pharmaceutical companies. Partly derived from their smaller size, they suffer from less bureaucratic constraints, what makes them more flexible and therewith better innovators. Unique competencies, a low level of hierarchy and internal flexibility (Nooteboom, 1994) seem to make up for their lower financial power. When small firms participate in R&D, they do so more intensively and efficiently (Nooteboom and Vossen, 1995). Furthermore, a small

company (for instance a start-up company) is often the product of an innovative idea itself, while in bigger companies that exist for quite some time already, the task to come up with new ideas, may even endanger their further existence (Brown and Eisenhardt, 1997). Consequently small biotech companies are interesting alliance partners for large companies (Kotabe and Swan, 1995).
Considering that small biotechnology companies posses certain merits explains the finding of the average biotechnology firm entering into three exploration and five exploitation alliances (Rothaermel and Deeds, 2004).
What remains unanswered is the question what types of alliances are most appropriate to succeed. This research will look at the influence of different alliance characteristics on innovation performance. Which form of "partnership" is the most promising when it comes to exploration and/or exploitation?

Citing Rothaermel and Deeds (2004) as evidence for the research necessity, *„linking different types of alliances to each distinct stage in the new product development process [...] has not yet been undertaken*"(Rothaermel and Deeds, 2004: 202). There is still a clear lack of knowledge and research needs to be done to light up the advantages and disadvantages of approaching the exploration and exploitation task by using different types of alliances.

The objective of the paper is to provide one part of this lacking knowledge by uncovering the effects achieved by using different types of alliances regarding their level of complementarity, cognitive distance and collaboration intensity.

This *Introduction* is followed by Section 2, the *Theoretical Framework*. In this section the discussion of the Resource based view, Knowledge creation theory and the Open innovation theory with respect to the research objectives lead to the conceptual model. In Section 3 an outlook is given on how the conceptual model should be empirically tested.

2 Theoretical framework

Central in this research is the innovation performance in strategic alliances. Powel *et al.* (1996) found in their longitudinal study on biotechnology firms that firms decide to collaborate with the goal to acquire resources and skills, they cannot produce internally, "*when the hazards of collaboration can be held to a tolerable level"*(Powel *et al.* 1996: 118). For our paper this finding translates as follows: At the beginning of every alliance there is an alliance innovation potential to be assessed. Based on this potential there is an alliance execution, facing the hazards of collaboration, which leads depending on the alliance governance to the final innovation performance. In front of this theoretical background the elements determining, Alliance potential, Alliance execution (inclucing governance mechanisms) and Alliance performance will be discussed.

2.1 Alliance Potential

2.1.1 Level of complementarity

In the management literature it has been argued that strategic technology partnering can induce an effective use of resource heterogeneity. A better understanding of this phenomenon is achieved by application of the Resource Based View (RBV) (Nooteboom *et al*., 2007) with two basic assumptions. Companies in an industry do not all posses the same resources which provides resource heterogeneity and the partial immobility of these resources preserves this state of disequilibrium (Barney 1991). This implicates that complementary resources, thus resources that bare the potential to create synergy once they are brought together, are stored at different companies waiting for their synergy potential to be recognized.

2.1.2 Cognitive distance

In RBV the ability to exploit is defined as follows: *The firm should have the systems, policies, procedures in place to take full competitive advantage of the resource* (Fortuin, 2006:25).
Ireland and Hitt (1999) stress that an alliance allows to access complementary resources without the long term commitment that is inherent to an acquisition. Alliance companies often get close enough to each other to acquire tacit knowledge (Lane and Lubatkin, 1998). But this is not the whole story, as integrative joint ventures were found to fail more often than expected by using complementary resources (Park and Russo, 1996).
A key word here is Absorptive Capacity, which origins from the companies capability to recognize the value of new information, to assimilate it, and to apply it to commercial ends (Cohen and Levinthal, 1990). The absorptive capacity is dependent on redundancy or as Nonaka (1994) states it individuals sharing *"overlapping information can sense what the others are trying to articulate"*(Nonaka 1994: 29). The Absorptive capacity may therefore decrease when the value of novelty increases in case of high cognitive distance. With growing cognitive distance there is more to learn from the alliance partner, but difficulties might arise to understand each other. Consequently there exists an optimal cognitive distance for every alliance (Nooteboom *et al*., 2007), which triggers the quest for an alliance partner that is at an optimal cognitive distance. The pure existence of complementary resources on both sides of the alliance and the understanding of their particular complementarity does not lead to the synergy creation as there needs to be a resources exchange between the partners. Consequently the influences on synergy creation due to an enhanced resources exchange of complementary assets shall be related to the cognitive distance in the alliance and the collaboration intensity.

2.1.3 Alliance importance

A company that engages in one or several alliance gives consciously or unconsciously an importance status to every alliance that will influence the collaboration intensity in this alliance.

2.2 Alliance Execution

2.2.1 Collaboration intensity

Collaboration intensity deals with the challenge of two or more individual companies to act on a chosen company task as one entity, while contributing and maintaining the individual potentials that the alliance was created for. In an organization "*Knowledge is created and organized by the very flow of information, anchored on commitment and beliefs of its holder*" (Nonaka,1994:15). Collaboration intensity in this paper is directly related to supportive actions in the form of human resource exchange. As an individual can acquire tacit knowledge without language and rather by shared expirience (Nonaka, 1994), the exchange of human resources surmounts the pure communication between individuals of both companies as the new setting is supposed to be stimulating and creating new parts of tacit knowledge in the mind of the exchanged individual. Human resource exchange, which implies a flow of information sourcing from tacit and explicit knowledge is the way to create a mutual understanding including "social practices" (Nonaka and van Krogh, 2009) and to transform resources from both alliance partners into something new. At the same time human resources exchange is supposed to allow all four modes of knowledge conversion (from tacit to tacit, from explicit to explicit, from tacit to explicit, from explicit to tacit), Nonaka states in his paper 1994 and therefore a higher level of knowledge creation.
Furthermore the "*ability of a firm to obtain a resource is dependent upon unique historical conditions*" (Barney,1991:107). If history matters, then the history of the human capital might matter more than that of physical or financial resources, as they can only provide a limited individual history compared to the complexity a researcher's life can rise up to, making them

unique company resource that can not be copied and bare the potential of competitive advantage. Therefore the core of the alliance execution is the collaboration intensity, based on human resource exchange. An alliance that is only stated on the paper without interaction happening in reality is assumed to be less promising to deliver innovations and could be rather set up to fulfill company cosmetic functions towards investors or to scare off threatening competitors. An alliance aiming at creating innovations should not spare an intense collaboration with the partner to allow the Alliance potential to result in a respective Alliance performance.

Hypothesis 1: *Innovation alliances that show a higher level of comlementarity and deal with the cognitive distance by intense collaboration, lead to synergy creation and ultimately to a higher level of innovation performance.*

2.2.2 Alliance compliance

Alliance compliance is a factor that can crush great expectations resulting from the Alliance potential assessment. Issues like trust and cooperation within high technology firms are found positively related to human resource exchange practices (Collins and Smith, 2006). If there is no compliance because of mistrust, missing coordination of company actions collaboration intensity might be lowered. In a company collaboration context this also means the process of transforming tacit into explicit knowledge slows down or even stops.

2.2.3 Governance mechanisms

On the alliance execution level several governance mechanisms are assumed to be connected to collaboration intensity and to play a role in overcoming lacks of alliance compliance.

Technology mapping

Intellectual Property (IP) is important in alliances in which partners work closely together to search certain innovation aims and objectives. IP management is connected to terms like, IP valuation, IP licensing, IP preparation for sale, detection of infringements, use of IP intermediate markets etc. (Chesbrough, 2006). To secure the ownership of IP after a completed discovery is a big issue and is becoming even more challenging in the world of Open Innovation, where "*technologies flow across the boundary of the firm"* (perhaps multiple times) and where "*obtaining the ability to practise a technology without incurring an infringement action by another firm is more challenging because the full history of the technology development is well known*" (Chesbrough, 2006:67).
Patents are used to protect knowledge from being stolen, provide a possibility to legally own it and make it tradable. Patents reduce the risk of infringement but only if all of the knowledge used in the technology application is included in that patent, or possibly in several patents. So to prevent infringements patent mapping is unavoidable. Patent mapping checks for all of the granted claims of a patent that is owned by the company and looks also at possible claims that could arise from other patent holders (Chesbrough, 2006). This might lead to efforts to get in possession of patents that are holding key positions in the firm's innovation process. In order to reduce the risk of exploring without being able to exploit one should think of starting the mapping already during the exploration process. This reduces the risk of being left with a discovery at the end of the exploration process that can not be exploited. At the same time between 75% and 95% of the patents are unused (Chesbrough, 2006). To examine all those patents is highly expensive. However, in an innovation alliance there is a possibility that alliance partners that look at those patents from a different angel see a potential in some of them and can pick the ones that are promising to examine closer. One could think, for instance, of a patent that provides a missing piece of the exploration process (Rivette and Kline, 2000). So resources exchange in the form of IP could be

enhanced by letting the alliance partner having a closer look at the patents in store or even at technologies with no patents granted yet. There might be even interesting patents that got stuck in the pipeline to submission and that can not be granted without additional knowledge input. In a study about Canadian biotechnology start-ups Baum et al. (2000) found alliances, that *provide access to more diverse information and capabilities per alliance [...] will prove most beneficial to startups*. The examination of each others patents and/ or patent applications could therefore be key to access more diverse information and reduces the risk to get stuck in the innovation process. At the same time the examination of this explicit knowledge creates further redundancies that will help to understand each other. For several reasons the term patent mapping is replaced in this paper by the term technology mapping. We extent the meaning beyond the IP protection aspect and pay more regard to the aspect of using it as an alliance internal communication tool. This means the focus is not only on having an eye on what is protected and what is not, but rather on the proper documentation of technology development. This might lead to the following impact on the alliance collaboration. On the one hand there is a proper documentation on who contributed what to the alliance, fighting back opportunism and distrust. On the other hand tacit knowledge is turned into explicit knowledge simplifying alliance coordination, reducing the risk of individuals leaving the company and with them crucial tacit knowledge that would endangers the future of the alliance cooperation.

Hypothesis 2: *The more intense alliance partners collaborate, the more they use technology mapping to support each other in building on and using each others IP for a better collaboration performance.*

<u>Outsourcing</u>

Complementarity resources posses the potential to bring up synergy. In some cases where knowledge is simply matched it could be thought of a quite straight synergy creation. However in other cases where the complexity of matching the complementarity resources is considerably bigger, the way to synergy creation might lead via outsourcing of activities to the alliance partner for reasons of missing skills or company apparatus. Outsourcing itself again demands collaboration intensity first to determine which activities will be outsourced and how the outsourcing process will be set up.

<u>New Alliance formation</u>

Forming an alliance implicates the access to a bigger set of resources and skills. However during the lifetime of an alliance new resource lacks might show up after a certain time of collaboration, where support from within the alliance is not possible and creates the need of a new alliance partner with the respective resources. If there is an intense collaboration, based on good alliance compliance the alliance partner has good insights on the partners needs and could give valuable support in a new alliance formation. This new alliance formation could indirectly also be beneficial for the supporting partner, as it might increase the collaboration potential of his actual alliance partner.

2.3 Alliance Performance

2.3.1 Synergy

Synergy describes a situation where the final outcome of a system is bigger than the sum of its parts. This can be found in an alliance in the form of new knowledge that surmounts the knowledge input that was brought into the alliance from both alliance sides as well as to a new process, technology resulting from the alliance potential of complementary resources.

2.3.2 Alliance performance

Alliance performance covers exploitation performance and exploration performance, where exploitation is concerned with the refinement and extension of existing technologies (Lavie and Rosenkopf, 2006) and exploration is rooted in the extensive search for potential new knowledge (March, 1991).

2.4 Conceptual Model

The conceptual model integrates Alliance potential, Alliance execution and Alliance performance and is displayed in Figure 1. The Alliance potential is represented by the constructs Level of complementary resources exchange, Alliance importance and Cognitive distance. In the Alliance execution phase, Collaboration intensity together with the Alliance compliance are supposed to influence the choice of governance mechanisms that will determine Synergy created and thus the Alliance performance.

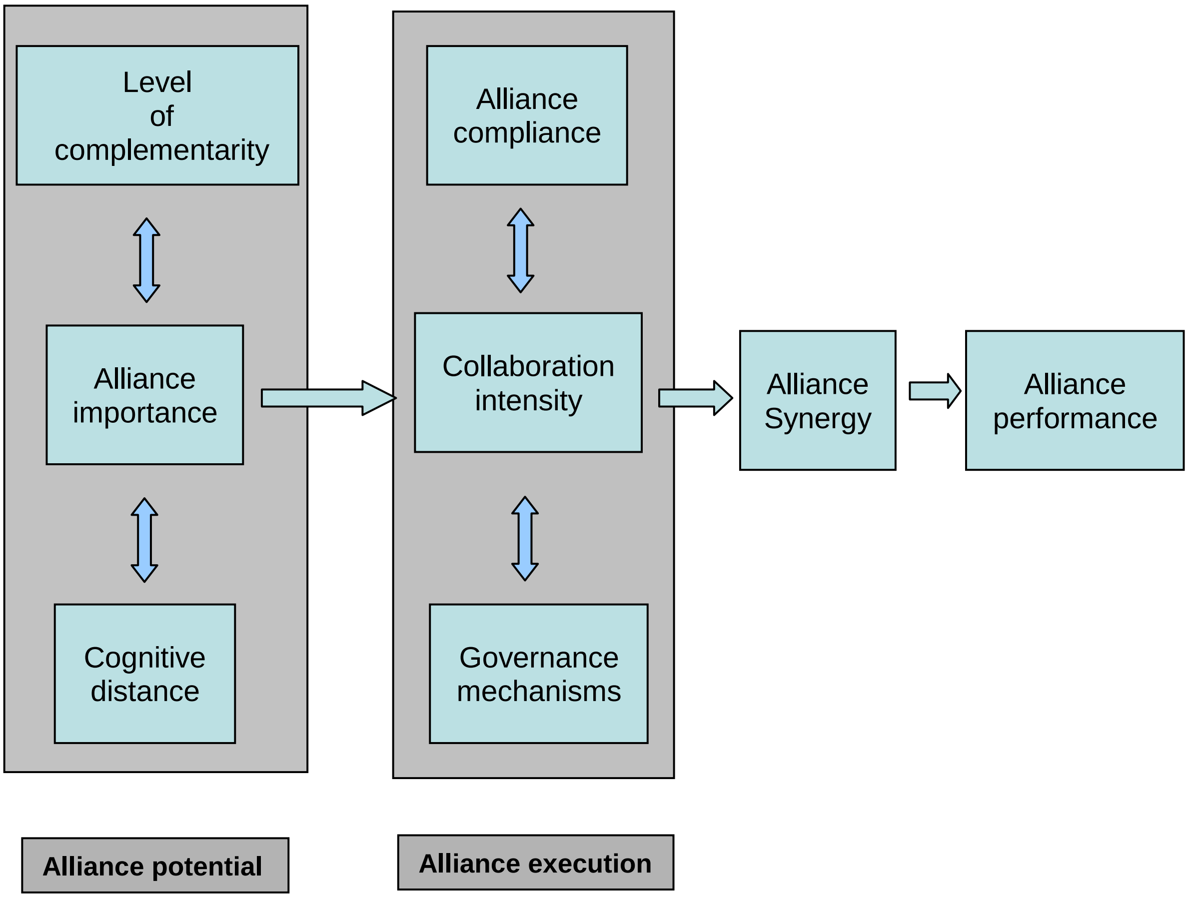

Figure 1. Conceptual model

3 Plans for empirically testing the model

Sample and data collection

To test the theoretical model empirically data from a survey in the Dutch Biotechnology sector will be used. For the survey a two step approach was chosen. A pilot study based on face-to-face interviews guided by a questionnaire was chosen to approve the understandability of the questions and the answering scheme, before sending the questionnaire to the other respondents.

Measurement

For the measures underlying the Project size and Alliance size the respondent was given the opportunity to pick from three categories. All other measures (indicators) were operationalized on a Likert scale of 1 (“not at all”) to 7 (“to a very large extent”).

Methods

The decision which statistical tests will be applied, the scaling of the data as well as the number of answers given have to be taken into consideration and exclude a lot of statistical procedures. Kolmogorov Smirnov Z will be used for a finding differences between red and green biotechnology alliances. For getting a first impression of the relations existing between variables in the data set Kendalls tau correlation will be chosen. Partial Least Squares will be used for testing the conceptual model and the hypothesized relations between the constructs.

Partial least squares

Partial least Squares (PLS) is a causal modeling approach, developed by Wold 1975 and applicable in strategic management research (Hulland, 1999). In contrast to LISREL, it can deal with small sample sizes (Chin and Newsted, 1999) and doesn't require a normal distribution of the data in order to do so (Chin et al., 2003).“*PLS is similar to regression, but simultaneously models the structural path* (i.e. theoretical relationship among latent variables) *and measurement path* (i.e. relationship between a latent variable and its indicators)” (Chin et al., 2003:25).

The procedure allows to model latent variables and gives more accurate estimates of interaction effects between constructs, as it takes the measuring errors in the underlying indicators into account.

PLS shows the significant effects, latent variables (constructs) have on each other, while every construct itself is reflected by its indicators (measures). With the help of the PLS procedures (a series of ordinary least squares) the latent variables are then estimated as linear combinations of its measures, by maximizing the explained variance for the indicators and the latent variables. As a result the latent variable is not only maximally correlated with its own set of indicators, but also with other latent variables, according to the structure of the PLS model (Chin et al., 2003). The significances of the interaction effects uncovered with PLS are tested with the Bootstrapping. Bootstrapping is a cross-validation method. It is a resampling procedure, which yields the same number of cases as in the original sample. The number of resamples was chosen to be 200 at minimum (Chatelin et al., 2002).

This paper will be followed by an empirical test of the conceptual model.

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