

Master Thesis

Inter-organisational collaboration in the biotech sector

Who takes the initiative?

Name: Michiel Oussoren
Student number: 3068595
E-mail address: M.Oussoren@students.uu.nl
Postal address: 1141 AH Monnickendam
Program: Science and Innovation Management
Number of ECTS: 45, concerns a thesis and internship
Supervisor: Dr. Jan Faber



Universiteit Utrecht

Abstract

This study focuses on inter-organisational collaboration by start-up firms active in the biotech sector. More specifically, it is focussed on what factors determine the length of inter-organisational collaboration. The following research question is stated: *'What factors determine the length of the collaboration between high tech start-up firms and their partner organizations?'*. This research question is answered with the use of the BioPartner Monitor data set containing quantitative data about the interactions between start-up firms active in the Dutch biotech industry and their partner organizations. A quantitative analysis of this data gave the following results. When the initiator of inter-organisational collaboration is a start-up firm, this has a small and statistical insignificant positive effect on the length of interaction. When the type of partner is a public research organisation, this has a positive effect on the length of interaction. When the start-up is a spin-off, this has a positive effect on the length of interaction. At last, the number of cooperation's of the start-up has a negative effect and the size of the start-up firm has a positive effect on the length of interaction. Furthermore, a qualitative analysis has been performed which has answered the following research question: *'When and how do firms in the biotech industry begin searching for partner organizations in order to start beneficial collaborations?'*. Data collection consisted of 5 interviews with firms active in the Dutch biotech industry. General findings were that 'access to technology or facilities' is the main trigger for firms to take the initiative. Furthermore, direct relationships are an important way for firms to find suitable partners.

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1. Introduction

1.1 Problem definition

Hagedoorn (2002) shows that during the last decades the number of inter-organisational collaborations has increased rapidly. This applies especially to collaboration concerning R&D. When looking at the distribution of those collaborations between different sectors, organisations in the pharmaceutical sector cooperate most.

Multiple explanations have been given for the fast increase of inter-organisational collaborations since the 1980s. A first explanation is related to the increased complexity of scientific and technological developments in the last few decades. Because of this increased complexity it has become more difficult for firms to completely rely on in-house R&D. This occurs because it is almost impossible for firms to have all the resources and knowledge in-house necessary to compete in high technology sectors (Powell et al., 1996). This particularly applies to start-up firms. Because of their size and short existence, start-up firms are less likely to have acquired all necessary resources and knowledge necessary to compete in high technological industries.

Another explanation for the fast increase of inter-organisational collaborations since the 1980s is the fact that there is a higher uncertainty surrounding R&D (Hagedoorn, 2002). By cooperation the high risks of R&D are shared by multiple parties. For start-up firms this is even more important because an unsuccessful product development is more likely to have fatal consequences for a start-up firm than for an established firm.

Another explanation is the increased costs of R&D (Hagedoorn, 2002). This affects start-up firms even more as established firms through the fact that start-up firms generally don't have the financial resources to perform high technological research on their own. One reason for this is that start-up firms cannot afford big R&D laboratories (Moensted, 2007).

A last reason for firms to collaborate is to keep track of the latest technological developments in the field (Ahuja, 2000). In sum, forming linkages and cooperation with other firms is an important strategy for high tech firms in general and even more for high tech start-up firms to get access to needed resources, share the high risks of technology development and keep in pace with the latest developments in the field. (Ahuja, 2000; Hagedoorn, 2002; Moensted, 2007; Powell et al. 1996)

Start-up firms can collaborate with many different organizations in order to acquire the resources they need. These organizations include competing and incumbent firms, research organizations, government laboratories, industry research associations, and universities (Santoro & Chakrabarti, 2002). Those organizations also benefit from the collaboration with start-up firms because they are generally highly specialized in a small niche market. It could be more efficient for organisations with a need for specialized information or technology to collaborate with such small specialized firms than to develop this knowledge in-house.

So, collaboration is extremely important for start-up firms, but also developed firms can gain from the cooperation with them. Accordingly, start-up firms are an important spill within an industry and are seen then as important for the development of an industry, because they create more competitiveness within an industry. Furthermore, they often are specialized within a small niche market bringing specialized knowledge into the industry. One high technological industry to which this applies is the biotech industry. Their development is supported in many West European countries with the help of governmental programmes. The development of high technology sectors with a science based character is considered as

important in those countries because a knowledge based economy is more likely to sustain future economic growth (Van der Valk, 2007).

For that reason, also the Dutch government started stimulating the biotech sector within the Netherlands by giving subsidies to collaboration projects in which start-up firms were involved. The Dutch government recognized the importance of this collaboration for further development of the industry. From 2000 until 2005 the Dutch government did stimulate this development via a program called 'BioPartner'. The aim of this program was to stimulate the development of the life science sector in the Netherlands. BioPartner has contributed to the foundation of 90 biotech firms in the Netherlands (EZ, 2005 - a). Furthermore, there was an increasing collaboration between firms and knowledge institutions within the Dutch biotech industry (EZ, 2005 - b). However, those linkages varied considerably in length. Possible explanations for this phenomenon have not been given yet.

This is an interesting subject to investigate from an academic view as well from a societal perspective. Still little is known about this subject. A lot of research has already been done into the subject of inter-organizational cooperation's. Street & Cameron (2007) give a nice overview of the literature concerning small business alliances between 1990 and 2002. Some research has tried to find a relationship between the propensity to partner and firm level characteristics (Ahuja, 2000; Eisenhardt and Schoonhoven, 1996). Other authors have looked at the different objectives and motives of organizations to engage in inter-organizational collaboration (Bayona et al., 2001; Hagedoorn, 1993; Yasuda, 2005). Other research has devoted attention to the organizational structure chosen for collaboration (Das and Teng, 2000; Hagedoorn and Narula, 1996). However, there is little literature that examines the factors determining the length of a collaboration. Some authors did find empirical evidence for the fact that the length of a collaboration has a positive effect on more successful product development within the collaboration (Lunnan & Haugland, 2008; Rothaermel & Deeds, 2006). Consequently, an answer to the question what factors influence the length of an inter-organisational collaboration would be a contribution to the inter-organizational collaboration literature.

Furthermore, it would be an interesting topic from a societal perspective as well. Because when we know the factors determining the length of a inter-organisational collaboration, we are able to stimulate collaborations between start-up firm's and partner organizations more effectively. For example, in the case of Biopartner the Dutch government would have had a better idea about who they should stimulate in order to get more longer lasting and probably more successful inter-organizational cooperation's. This especially is important in the biotech industry because of the long periods of new product development (Moors & Faber, 2007). So, a longer lasting cooperation is expected to increase the chance of a more successful product development, stimulating the start-up firm's and partner organisations to contribute more to each other's knowledge and resources during the process of the new drug development (Lunnan & Haugland, 2008).

1.2 Research questions

This research will look at the length of collaborations between high tech start-up firm's and partner organizations. Specifically, it will be investigated what factors determine the length of interaction between a small start-up firm and its partner organization This leads to the research question one:

RQ1: What factors determine the length of the collaboration between high tech start-up firms and their partner organizations?

This research will also put forward another important issue to take into consideration when describing inter-organizational collaboration. Namely, the fact whether the start-up firm's or its partner did take the initiative in the collaboration. Initiative taking is relevant because organisations that feel the urgency and foresee the utility of cooperation will be more motivated to start, continue and invest in a successful cooperation. Accordingly, they will have informed themselves better about potential partner organizations thereby increasing the chance of a good, more beneficial and longer lasting partnership. However, the importance of initiative taking has been neglected in the inter-organizational collaboration literature so far. To get a better understanding about what drives organisations to take the initiative in collaboration and how they manage to find suitable partners, this research will also study when and how firms in the biotech industry start searching for partner organizations in order to start beneficial collaborations. Therefore, a second research question is stated:

RQ2: When and how do firms in the biotech industry begin searching for partner organizations in order to start beneficial collaborations?

This paper tries to answer both research questions. The first part of each chapter will deal with the first research question and the second part will deal with the second research question. The following chapter contains the 'theory section' of this research. The theory about inter-organisational collaboration will be discussed and hypotheses will be formulated. After that the method section explains how the data have been gathered and how they will be analyzed. The first research question will be answered with the use of the BioPartner Monitor data set containing quantitative data about the interactions between start-up firms in the biotech industry and their partner organizations. This data set contains data about the length of the interactions as well as about the properties of the cooperating organizations and the nature of the interaction. The second part of my research has been conducted during the internship period at the Leiden University Research & Innovation Service. In order to create insight into when and how firms in the biotech industry start searching for partners in order to start beneficial collaborations I performed an exploratory research. This research is based on open interviews with 5 firms, which were recently contacted by Luris in their broker role. The first research question will be answered quantitatively with the help of statistical methods while the second research question will be answered qualitatively. In the 'data section' the data used will be presented and characteristics of these data will be discussed. The 'results section' will show the outcomes of this research. In the last chapters the results will be discussed and conclusions will be drawn.

2. Theory

This section presents the theoretical framework of the research. A definition of inter-organisational collaboration will be given together with the characteristics of a start-up firm. Furthermore, this theoretical section deals with the question why organisations collaborate. Variables will be introduced which are supposed to influence the length of a collaboration. Initiative taking is one of those variables. For all variables hypotheses will be stated describing their expected effect on the length of interaction. At last, theory concerning research question 2 will be discussed.

2.1 Definitions

The definition of inter-organisational collaboration should contain two aspects. The definition has to mention the fact that multiple actors cooperate in some sort of formal way and the definition has to describe what this cooperation embodies. Nooteboom (1999) states this as: *'capturing many forms of inter-firm cooperation that go beyond mere market transactions'* (Nooteboom, 1999, p. 1). Gulati (1998) gives a more comprehensive definition: *'voluntary arrangements between firms involving exchange, sharing or co-development of products, technologies or services'*, thereby mentioning what a collaboration could embody. But this definition is limited to the fact that it only mentions the cooperation between two firms. A more complete definition is given by Van der Valk (2007): *'An inter-organisational relationship is defined as a cooperative agreement of multiple organisations which can focus on different stages of product or process development and commercialisation, including R&D, production, marketing and distribution'* (Van de Valk, 2007, p. 15). This definition is more complete in the sense that it states the fact that multiple actors cooperate as well as the nature of this cooperation.

Additionally, it is useful to describe when a firm can be seen as a start-up and what makes a start-up firms economically relevant. Luger & Koo (2005) mention three important characteristics of a start-up firm, namely a firm which is new, active and independent. These characteristics distinguish start-up firms from other firms and determines the economic importance of a start-up firm. By active is meant that a start-up firm should be engaged in the trading of goods and/or services. This is important because when not meeting this criteria a start-up has little economic impact and is unlikely to collaborate with other firms. This is however not always the case. For instance, Scott (1980) found that about 23 percent of all companies created in Scotland in 1969 did never trade. With independent is meant that when the start-up firm is a spin-off from another organization, it should be independent of the mother organization, legally, financially, and functionally. This is important because new start-up firms are more likely to bring up new technological ideas thereby supporting economic grow. With new is meant that the start-up is founded recently. This distinguishes a start-up firm from longer existing firms, as start-ups firms are more flexible. This because of the fact that they didn't have time to create routines in doing things (Nelson and Winter, 1982), and thus are more flexible than established firms.

2.2 Collaboration theory

The resource based view of the firm is a good theoretical starting point to explain why firms cooperate. The most important question the resource based view deals with is why firms are different and how firms use their resources to achieve and sustain competitive advantage. Within this view firms are seen as bundles of resources. An important spokesman of the resource based view is Wernerfelt. He defined resources as: *'By a resource is meant anything which could be thought of as a strength or weakness of a given firm. More formally, a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi permanently to the firm.'* (Wernerfelt, 1984, p. 172). So, a distinction is made between tangible and intangible resources. Furthermore, this definition states the fact that resources are tied semi permanently to the firm. This implies that resources are limitedly mobile between organizations. The limited mobility of resources decreases the tradability of resources. To understand why a firm's resources are limitedly mobile, the concept of capabilities is useful. Capabilities refer to the capacity to use, coordinate and combine those different resources in order to reach a desired outcome (Prahalad & Hamel, 1990). These capabilities are specific for a given firm and will be developed over time by the development and interaction of the resources (Amit & Schoenmaker, 1993; Kogut & Zander, 1992). This means that particular resources could be very useful for one firm but less useful for another firm because this firm does not have the right capabilities to handle the resource. Furthermore the resource based view states that resources could lead to a competitive advantage, if they are rare, inimitable, valuable and non-substitutable (Barney, 1991; Eisenhardt & Martin, 2000). Another important claim the theory makes is that there is heterogeneity of firms resources. This means that each firm has its own unique resources, which give a competitive advantage to that firm and distinguishes the firm from others.

When the resource based view of the firm is used to explain why firms cooperate, rationales for this partnering are primarily based on the resource needs of firms. Those resource needs of firms are generated by the formulation of goals that are unachievable by organizations independently (Van de Ven, 1976). The resource based view of the firm states that resources are limitedly mobile. Consequently, the tradability of resources is low. So, resources cannot be easily moved between organizations. Closer linkages between organizations have to be made then to exchange those resources successfully. This stimulates the creation of inter-firm collaborative relations.

Start-up firms in high technological industries are examples of firms with great resource needs. As is noted in the introduction it is unlikely that a start-up firm has acquired all resources necessary to compete within a high technological industries. And because resources are limitedly mobile, start-up firms have to form collaborative linkages in order to get access to certain resources owned by other organizations. Furthermore, the fact that start-up firms have a resource need beyond their own resources makes them dependent on other firms in order to get the needed resources. The notion of resource dependency is first introduced by Pfeffer and Salancik (1979). The work of Pfeffer and Salancik (1979) is closely related to the resource based view of the firm by noting that the heterogeneous resource portfolios of firms causes that firms are dependent of one another for gaining access to specific resources. This is called the 'resource dependence perspective' (Pfeffer and Salancik, 1979). So, the cooperation between firms and the resources exchanged within those cooperation's are an effect of the external resource dependency of firms because of the heterogeneity of resources over distributed firms. In this sense, the resource based view and the resource dependence perspective explain why firms cooperate with each other.

In sum, start-up firms have a resource need and are dependent on other organisations in order to get those resources. However, it is not said that those other organisations are willing to cooperate with start-up firms.

When we talk about the cooperation between organizations, there are always at least two actors involved. The literature not only looked at what triggers organizations to cooperate, but also what makes a specific organization interesting to cooperate with from the perspective of the partner. Based on the resource based view, for a organization to be able to convince a partner to engage in a collaboration, this organization has to have resources on its own that are interesting for the partner (Ahuja, 2000; Sakakibara, 2002). This creates the paradox that an organization with a need for resources also has to have valuable resources of its own to be an interesting partner for collaboration (Eisenhardt and Schoonhoven, 1996; Powell et al. 1996). Authors have referred to this paradox as ‘strategic or resource interdependency’ (Gulati, 1998) or ‘resource alignment’ (Das and Teng, 2000). So, a firms resources determines its chances to find a suitable partner that is willing to cooperate. Ahuja (2000) has found empirical evidence on this principle. He states that a firms own resources determines its ‘opportunities’ to form linkages in a way that it makes the firm an interesting partner. A firms needs for resources is seen as its ‘inducements’ for partnering. This framework of firm inducements and opportunities to form linkages is a refinement of the resource based view in a way that its stresses not only the importance of a firms resources to achieve an competitive advantage but also to form linkages.

This theoretical perspective will be used to explain why particular firm characteristics are influencing the length of a collaboration. Seen from a resource perspective, the length of interaction is an important factor because a longer lasting cooperation is likely to be a collaboration in which more unique resources are invested and exchanged, thereby enhancing the chances of successful product development (Lunnan & Haugland, 2008. This is relevant because the start-up firm and its partner organisation can contribute more to each other’s knowledge and resources during the development process of a new product when their collaboration lasts longer. In the next section, the variables will be introduction, which are supposed to have an effect on the length of a collaboration between a start-up and its partner.

2.3 Variables influencing the length of inter-organisational collaboration - RQ1

In the introduction is written that start-up firms have a choice between different organisations to collaborate with. These organizations include competing and incumbent firms, research organizations, government laboratories, industry research associations, and universities (Santoro & Chakrabarti, 2002). More generally, these organisations can be divided in two groups. The first group embodies public organisations such as universities and governmental research organisations. i.e. ‘public research organisations’ (PRO). The second group includes the profit based organisations. I will call this group ‘established firms’ (EF). When considering the length of interaction between a start-up firm and its partner, the following question can be derived from this distinction between possible partner organisations: ‘Does the type of partner influence the length of interaction?’.

Seen from a resource based perspective public resource organisations have a different set of resources as established firms. Typical resources of public resource organisations includes technological knowledge and the facilities to produce this knowledge. While typical resources of established firms includes financial resource and the facilities and knowledge to commercialize products. A recent study of Van der Valk et al. (2010) note this difference in the set of resources between established firms and public research organisations. Furthermore, it stresses the point that those different sets of resources form the inducement for start-up firms to start a collaboration with a specific type of partner.

The difference in resource portfolios between public research organisations and established firms gives a good idea about the different intentions that the two groups of partners have. Public research organisations are funded by the government and are focused on knowledge development. Knowledge development is important for the Netherlands because it stimulates a knowledge based economy which is advocated by the Dutch government as being important to sustain further economic growth (Van den Steenhoven et al., 2006). When a start-up firm cooperates with a public research organisation like a university, this university is not likely to have a lot of interest in short-term collaboration because knowledge development takes time. A more durable collaboration is more likely to result in high quality outcomes of knowledge development. However, the core intention of a private firm is purely an financial one based on the creation of profit. Because of this, when a start-up cooperates with an established firm this firm has interest in fast product development. This because of the high costs of product development. Furthermore, a firm is likely to want its product on the market as soon as possible in order to create turnover and profit. If product development lags behind the agreed schedule then the established firm will more likely be inclined to terminate the collaboration on short notice. Consequently, it can be supposed that when a start-up firm collaborates with a public research organisation, this collaboration is more likely to last longer. This is because the core intention of a public research organisation is to create knowledge and not to create turnover and profit as soon as possible. This leads to the first hypothesis:

H1. If the partner organization is a public research organization, then the collaboration between the start-up and the partner organisation will last longer.

Next, a closer look is taken at the question what influence initiative taking has on the length of an interaction. There is no research conducted that directly investigated the effect of initiative taking on the success of a cooperation. By noting that initiative taking is relevant, it may be supposed that it matters whether or not the start-up firm takes the initiative in collaboration. The possibilities for partnering are shown in figure 1.

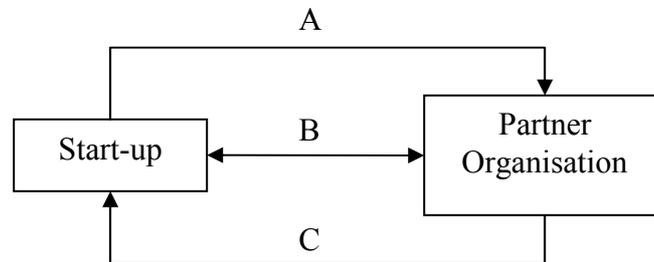


Figure 1

This model shows the different possibilities for initiative taking in collaboration. First there is the possibility that the start-up takes the initiative for collaboration. This is shown by arrow (A). The second possibility is that the partner organisation takes the initiative for collaboration. This is shown by arrow (C). A third possibility is that both actors together take the initiative for collaboration. This is shown by arrow (B).

Initiative taking may happen for two reasons. Organisations that feel the urgency or foresee the utility of cooperation will be more motivated to start and continue successful cooperation and thus take the initiative. This urgency consists of the need for certain resources. The utility is related to the competitive advantage gained by cooperation. The most adjoining theoretical literature related to this subject is the literature describing the subject of ‘first mover advantage’. Early developers of the concept of first mover advantage are Lieberman & Montgomery (1988). In their paper they define this concept as: ‘*We define first-mover advantages in terms of the ability of pioneering firms to earn positive economic profits (i.e. profits in excess of the cost of capital)*’ (Lieberman and Montgomery, 1988). The relevance lies in the fact that first mover advantage theory also noted the fact that initiative taking can lead to a competitive advantage. A start-up firm is better capable to specify the needed resources than an established firm. This is because a start-up firm is operating in a small niche marked for which there are clear resource needs. However, most of the time an established firm is using start-up firms to explore new technological opportunities (Pyka and Saviotti, 2001). An established firm then selects the most promising new technological opportunity by forming a partnership with a high-tech firm specialized in this sector. So, a start-up firm generally knows better where to look for and through this is better able to find a suitable partner. Furthermore, for a start-up firm established firms are more visible and well known than start-up firms are for an established firm. Hence, a start-up firm can better find a suitable partner. Because of this I suppose that when a start-up firm takes the initiative in inter-organisational collaboration, this collaboration will be last longer. Accordingly, the second hypotheses is formulated:

H2. If the start-up firms takes the initiative in inter-organizational collaboration, this will lead to a longer collaboration.

I now have explained the effects of initiative taking and the type of partner on the length of inter-organisational collaboration between start-up firms and their partners. However, no attention has been given up to this point to the effects of certain firm characteristics of the start-up on the length of collaboration with a partner organisation. This will be discussed next.

The first firm characteristic that influences the length of interaction is whether or not the start-up firm is a spin-off. This can happen in two ways. The start-up firm directly cooperates with its mother-firm. In this case there is a direct link which is more likely to result in a longer collaboration. When a start-up firm cooperates with its mother firm most of the time this is because the mother-firm founded the start-up for strategic reasons. One reason could be to apply its competencies to a new market (Tidd et al., 2005). This newly formed organisation is called a corporate venture. Larger firms do this to have an organisation with structures, processes and cultures that fit to the technological area wherein the start-up is active (Tidd et al., 2005). Because of this close relationship between the mother-firm and the start-up and the fact that the mother-firm has an interest in the start-up, a spin-off it is likely to collaborate longer with the mother organisation.

However, a start-up firm does not necessarily have to cooperate only with its mother organisation. A start-up firm could be a spin-off but also collaborate with another organisation not being its mother organisation. When this occurs it is still likely that being a start-up influences the length of interaction positively because the start-up is still closely connected to the network of its mother organisation. By this is meant that the start-up firm acquires knowledge of and social connections with other organisations which have already relationships with the mother organisation of the start-up. Being connected to the mother organisation's network has great implications for finding suitable partners within a certain technological area. This occurs because there is an increasing structural differentiation of such networks over time (Gulati and Gargiulo, 1999; Gay and Dousset, 2005). With this is meant that when organizations are more connected to a network they will become even more connected to each other over time while it is harder for less connected organisations to become also more connected. This tendency leads to 'hubs' within a network (Watts and Strogatz, 1998; Powell et al., 2005). A hub is defined as: 'the extent to which a firm is central because it has allied with many peripheral units' (Gulati, 1999, p. 406). So, when an organization is more connected to a network it is less difficult to get connected to organizations within that network. This increases the chance that a suitable partner will be found. Furthermore, the start-up firms are more visible for potential partner organizations, which increases the chance of being found by a suitable partner. These insights are derived from the work of Gulati (1999). He proved that when firms have more access to information about potential partners, this will stimulate the creation of successful cooperation's. This leads to the third hypotheses:

H3. If the start-up firm is a spin-off, this will lead to a longer collaboration.

Another firm characteristic that is likely to have an influence on the length of interaction is the number of inter-organizational collaborations the start-up has. When a start-up has more inter-organisational collaborations his need to start new collaborations becomes less. This happens because when a start-up has a resource need it is more likely that this start-up has already found the resources it needs in some of its collaborations. Consequently, the urgency to acquire vital resources decreases together with the urgency to secure access to those resources on the long term. As a result less essential collaborations will be terminated resulting in a decrease of the average length of the period of cooperation. This results into the fourth hypothesis:

H4. If a start-up firm has more inter-firm collaborations, the length of its collaborations will decrease.

Furthermore, the size of a given start-up firm will influence the length of cooperation between a start-up firms and its partner. When a start-up firm is bigger this is an indication that it has more valuable resources. The importance to have resources of your own to be able to form inter-organisational collaboration is stressed by Ahuja (2000) and Sakakibara (2002). As is noted earlier, for an organization to be able to convince a partners to engage in a collaboration, this organization must have resources of its own that are interesting for the partner (Ahuja, 2000; Sakakibara, 2002). This occurs because when a firm does not possess any resources that are interesting for a possible partner, this firm is less likely to find any partner, which is willing to cooperate. So, when a start-up firm possesses more resources this start-up firm will become more attractive as a partner. And when a start-up firm is more attractive to cooperate with, the chances that the start-up will find a suitable partner rise. This happens because the start-up firm has a larger set of possible partners to choose from and to find a suitable partner and because the partner is more likely to be satisfied with the cooperation. Furthermore, when a start-up firm has more resources to share within the collaboration, the importance of the collaboration for both parties becomes higher. For the partner organization the collaboration is likely to be more interesting and important when more resources are involved within the cooperation. And when a start-up firm contributes more resources to a collaboration it is likely that they play a bigger role in the relationship and that they produce a higher interest to keep the relationship going. Consequently, the size of the start-up firms is likely to have a positive effect on the length of inter-organisational collaboration. This leads to the fifth hypothesis:

H5. If the start-up firm is bigger, this will lead to a longer collaboration.

Another variable that could influence the length of an inter-organisational collaboration is the age of the start-up firm. When a start-up firm is older it is more likely that is already has experience with inter-organizational collaboration. This experience could, for example, include mistakes made in the past with collaborations. This experience is likely to have a positive effect on the ability of start-up firms to form more succesful inter-organisational collaborations, which will lead to longer collaborations. A sixth hypothesis is formulized:

H6. If the start-up firms is older, this will lead to a longer collaboration.

2.4 Conceptual model - RQ1

In the text above multiple variables are identified that have an influence on the length of inter-organisational collaboration. Furthermore, their supposed effects on the length of inter-organisational collaboration are explained and stated with the help of hypotheses. This leads to the conceptual model shown in figure 2 in which all variables are represented together with their expected effect on the length of a collaboration.

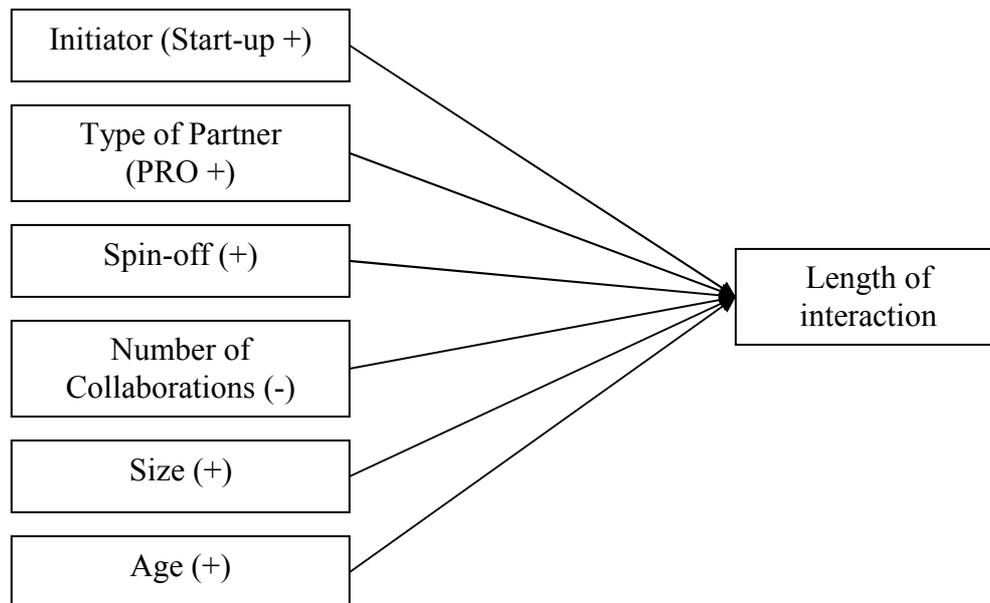


Figure 2

2.5 Initiative taken and Searching for Partners - RQ2

To get a better understanding about what drives organisations to take the initiative in collaboration and how they manage to find a suitable partners, the second part of this research will look at when and how firms in the biotech industry start searching for partner organizations for beneficial collaborations. This is important because selecting good partners can decrease the performance risk as well as the relational risk of the partnership (Das and Teng, 1998).

By taking a resource based perspective, the motivation for inter-organisational collaboration can will be fuelled by the resource needs of organisations. The term 'resources' is a very broad term that bundles a lot of different things, which an organisations might need. The first resource that start-up organisations need are financial resources. Furthermore, missing resources related to the commercialization of a product might also form a reason for collaboration (Pyka and Saviotti, 2001). Another possibility is that resources needed for product development forms the bases for inter-organisational collaboration (Hagedoorn, 2002). This includes specific knowledge about a certain technology that is missing or a certain piece of technology needed for product development that cannot be developed in-house. But it could also include the lack of facilities to perform R&D like laboratories (Moensted, 2007). Another reason for organizations to cooperate is to keep in pace with the latest developments and trends in the field (Hagedoorn, 2003). These motives of organisations will lead to inter-organisational collaboration. But the question remains what motives triggers organisations to start searching for collaboration. So what motives drives organisations to take the initiative in inter-organisational collaboration?

When investigating the partnering process of inter-organisational collaboration the role of resources in alliance formation goes further as discussed above. The resources a firm has determines its chances to find a suitable partner that is willing to cooperate (Ahuja, 2000). Resources make the firm an interesting partner to cooperate with. In this way the resources that different organisations have guide the process of searching for partners. The rationale behind this is that a specific resource need translates into motives for choosing a certain partner organisation (Nooteboom, 1999).

Van der Valk et al. (2010) used this opportunities and inducements framework to investigate how resources influence the partnering formation. One finding in this paper is that: *'there appears to be an evolution from untargeted to targeted search as the firms become more established within the technological field. Unestablished firms largely depend on accepting invitations for collaboration offered to them by partners while more established firms are able to successfully initiative partnership themselves.'* (Van der Valk et al., 2010, p. 179). Furthermore important inducement as well as opportunity resources were: access to technology/facilities, commercialisation and finance. The aspect 'inducements' as is explained by Ahuja (2000) and used by Van der Valk et al. (2010) is related to the aspect 'initiative taking' that comes forward in this study. This is through the fact that certain resource inducements to take the initiative in a collaboration can be quite the same as resource inducements leading to inter-organisational collaboration in the first place. However, whether this really is the case will be further investigated.

Having given attention to initiative taking and the reasons which could determine the decision to start a cooperation, it is not said that an organisation with a reason to start inter-organisational collaboration is also successful in finding suitable partners. As is stated by Ahuja (2000): *'linkages are only formed when actors with inducements are successful in finding collaboration opportunities'* (p. 318). When an organisation has inducements for collaboration, it will start searching for appropriate partners within its environment. To do this successfully it needs to have information about potential partners within its environment (Gulati, 1998). Furthermore, when a firm is more visible within a technological field its chances of being found by a suitable partner increases as is stated by Ring & Van de Ven (1994). So, becoming widely known within a sector is also important in order to get involved in successful collaborations. Within high technological industries it might even be more difficult to find appropriate partners. This because of the high specificity of technological knowledge sought for within those industries. Especially, start-up firms might find problems in finding suitable partners because they generally don't have stable network relations (Van der Valk et al., 2007). Furthermore, they often are unknown to more established firms and more often than not are lacking information about potential partners. Taking this in consideration, a question that can be derived from this is what search methods small firms use in order to find partner collaborations.

Literature has focused on the processes in which collaborations are formed. A first notion this literature makes is that the social capital of firms is related to the number of partnerships of the firm (Eisenhardt & Schoonhoven, 1996; Ahuja, 2000; Sakakibara, 2002). For example, the social network of the management has found to be important for the formation of partnerships by small firms (BarNir & Smith, 2002). So, the networks to which a firm is related can be an important instrument for the firm to find partner organizations. Furthermore, this can also happen indirectly. In this case, cooperation's are formed via the network of contacts of the firms (Gulati, 1998). A more coincidental way of finding partners is to participate in events such as workshops or conferences. These different processes of partnership formation will be the starting point of our explorative research into the ways in which firms in the biotech industry find partners.

3. Method & Operationalization

This section describes how the data have been gathered. Furthermore, the methods used for data analysis are discussed.

3.1 Data collection - RQ1

The first research question will be answered with the use of the BioPartner Monitor data set. This data set contains quantitative data about the collaborations between start-up firms operating in the biotech industry with partner organisations from 2002 until 2005. This data set contains data about the length of the interactions as well as the identified relevant properties of the cooperating organizations and the nature of the interaction. The data are gathered with the help of a questionnaire to which all participants in the BioPartner program had to respond in order to get subsidy.

3.2 Methods of analysis - RQ1

The method of analysis is linear regression with the help of ordinary least squares (Wonnacott & Wonnacott, 1990). Because the dependent variable is discrete, linear regression would give unreliable results. In order to deal with discrete variables in regression analysis, this analysis will be based on a correlation matrix containing appropriately estimated correlations. The correlation between two discrete variables will be estimated as a polychoric correlation. The correlation between a discrete and a continuous variable will be estimated as a polyserial correlation and the correlation between two continuous variables will be estimated as a Pearson-correlation. This correlation-matrix will be used to estimate the regression-equation. The statistical analyses have been performed with the help of the statistical computer programs PRELISTM (Jöreskog & Sörbom, 1995) and SPSS (De Vocht, 2008).

3.3 Operationalization - RQ1

The operationalization of the concepts is shown in table 1. The length of interaction is measured as the number of years that each collaboration has existed, running from 0 to 3 years. Initiation is measured as a dummy variable in which start-up did get the score 1 if it started the cooperation. The type of partners is also measured with the help of a dummy variable where 1 stands for a public research organisation (PRO) and 0 stands for an established firm (EF). The fact whether the start-up is a spin-off is also measured as a dummy variable; 1 means that the start-up is a spin-off and 0 means that the start-up is an independently founded organisation. The number of collaborations is measured as the total number of collaborations of each start-up in the year wherein the collaboration started. The size of a start-up firm is measured as the numbers of full time employees in the year wherein the collaboration started. At last, age is measured as the number of years of existence of the start-up firm in the year wherein the collaboration started.

Variables	Indicator
Length of interaction	Number of years (0 to 3)
Initiator	Start-up = 1 / Partner organisation or both = 0
Type of partner	PRO = 1 / EF = 0
Spin-off	Yes = 1 / No = 0
Number of collaborations	Total number of collaborations
Size	Numbers of full time employees
Age	Years of existence

Table 1

For the length of interaction there was information for three years, namely 2002, 2004 and 2005. Table 2 gives an overview about how these data are used to determine the length of an interaction. An 1 means that there was cooperation between the start-up and its partner in that years while a 0 means that there was not a cooperation in that given year. When a cooperation did start and end in the same year the length of interaction is determined as less than one year. When a cooperation did start in 2002 and end in 2004 the cooperation did last for two years. And when a cooperation did start in 2002 and end in 2005 the cooperation lasted at least for 3 years. All other possibilities are shown in figure 4. When a cooperation did start in 2005 it is unknown what the length of the given cooperation is.

2002	2004	2005	Years
1	0	0	< 1
1	1	0	2
1	1	1	3
0	0	1	Unknown
0	1	1	1
1	0	1	< 1
0	1	0	< 1

Table 2

3.4 Data collection and method of analysis - RQ2

The data used to answer RQ2 is collected with the help of in-depth interviews. A total of 5 firms has been interviewed. This were all Dutch firms active in the biotech industry. Considering the explorative nature of this study it is justifiable to take such a small sample of total firms active in the sector. Interviews were taken with the managers of those firms. Permission to record the interviews was asked and granted by all interviewees. Those interviews are written down and are included in confidential appendixes. It is made sure to include firms of different age and size. Table 3 shows the characteristics of the firms, which were interviewed. In order to ensure confidentiality, they are referred to as Firm A to Firm E. It is shown that young firms (Firm A, C and D) are small, while more mature firms (Firm B and E) are larger. However, with none of the firms being older than 15 years, they all can be considered as young firms.

	Firm size < 20 fte	Firm size > 20 fte
Firm age < 10 years	Firm A Firm C Firm D	
Firm age > 10 years		Firm B Firm E

Table 3

The interviews focuses on the most important collaborations the firms did have with other firms and public research organisations in resent time. By concentrating on the most important collaborations the firms did have within the last three years, one disadvantage of using interviews as a method of date collection can be avoided. Namely an inaccuracy in the obtained date through memory decay. This implies that the longer the time span is between the interviewing of an actor and the actual cooperation wherein the actor was involved, the less likely the actors is to remember precisely and accurate what happened during that cooperation.

Information is gathered for a total of 8 inter-organisational collaborations. Data on those collaborations will be analyzed with the use of the case study survey method as is described by Yin and Heald (1975). This method makes it possible to find a general pattern within the data without going into detail about the specific aspects of the individual cases. The data obtained through the interviews are analyses by making categories for each concept which has been discussed during the interviews. Data for each concept from the interviews are then labeled by assigning it to one of the categories. The results are presented in a matrix of categories and placing the evidence within these categories (Yin, 2003). An disadvantage of this method is that it generalizes about the specific aspects of each case. However, in this study it is an appropriate method because the aim is to give a global view on the reasons firms have to start inter-firm cooperation's and how they searched for partners, and not to examine in detail the characteristics of individual cases.

3.5 Operationalization - RQ2

Appendix 1 shows the list of questions used to guide the interview. First, some questions are stated to determine general firm characteristics such as age and size. Then it is asked in which inter-organizational collaborations the firm has been involved in. After this, for each collaboration the reason for initiative taken (if this was the case) is asked as well as the objective of the cooperation. Furthermore, there is asked in which way the partner has been found, as well as what specific characteristics this partner had, and if those characteristics did play a role in the choice for this partner. At last, questions are asked about the form of the cooperation as well as about if the success of the cooperation.

The categories used in order to analyse the interviews obtained are shown in table 4. Categories are made according to the reasons firms might have to take the initiative for collaboration as well as for objectives of the cooperation. Furthermore, categories are made for the ways in which firms did find a partner. Those categories are derived from the theory section on research question 2.

Concept	Categories (Operationalization)
Why initiative taken	<ul style="list-style-type: none"> - Access to technology/facilities - Commercialization - Finance - Product development
Objectives of the cooperation	<ul style="list-style-type: none"> - Access to technology/facilities - Commercialization - Finance - Product development
Finding Partners	<ul style="list-style-type: none"> - Directly (via a contact of the firm) - Indirectly (through the network of contacts of the firms) - Events

Table 4

4. Results

In this section the data are analyzed. Characteristics of the data are discussed in the descriptive results. Furthermore the analytical results show the outcome of the statistical analyses, and the qualitative results show the results on research question 2.

4.1 Descriptive results - RQ1

The first research question is answered with the use of the BioPartner Monitor data set. This data set contains information about 419 inter-organisational collaborations between start-up firms and their partners. All organizations are operating within the biotech industry in the Netherlands. Now, for each observed variable the data will be discussed.

Length of interaction

Table 5 shows the frequencies table for the dependent variable 'length of interaction'. From this table it becomes clear that most interactions are short of nature with 75,3 percent of all cooperation's lasting less than a year. Furthermore, in 79 cases the cooperation started in 2005. Those cases will not be further taken into account, so the database contains 340 useful cases.

		Length of interaction			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<1 year	256	61,1	75,3	75,3
	1 years	37	8,8	10,9	86,2
	2 years	22	5,3	6,5	92,6
	3 years	25	6,0	7,4	100,0
	Total	340	81,1	100,0	
Missing	missing value	79	18,9		
	Total	419	100,0		

Table 5

Initiator

In the database there are three possibilities for initiative taking. The start-up or its partner organisation could have taken the initiative. Furthermore they could have taken the initiative together in which it is not clear who was the first mover. For the variable initiative taking the latter two instances will be assigned the value 0. Table 6 shows the frequency table of the variable initiative taking. The spin-offs took the initiative for many collaborations. Furthermore, there is a relatively large amount of missing values (-9 and system) for this variable. For some cases pattern identification is used to determine the values. For example, when for one cooperation the data was missing and a start-up did take the initiative in all other cooperation's then it is assumed that in the missing case the start-up also did take the initiative.

		Initiative taking			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Spin-off	145	34,6	53,5	53,5
	Partner	41	9,8	15,1	68,6
	Together	85	20,3	31,4	100,0
	Total	271	64,7	100,0	
Missing	-9	23	5,5		
	System	125	29,8		
	Total	148	35,3		
	Total	419	100,0		

Table 6

Type of Partner

In table 7 the frequency table for the variable 'type of partner' is shown. There were 250 established firms and 164 public research organisations as partners of a start-up firm.

		Type of partner			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Established firm	250	59,7	60,4	60,4
	Public research organisation	164	39,1	39,6	100,0
	Total	414	98,8	100,0	
Missing	not sure	5	1,2		
	Total	419	100,0		

Table 7

Spin-off

Table 8 shows the frequency table for the variable spin-off. The majority of start-up firms are spin-offs. However, independent start-up firms are also well represented in the database with 38,4 percent of all start-up firm being no spin-off.

		Spin-off			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	independent	148	35,3	38,4	38,4
	spin-off	237	56,6	61,6	100,0
	Total	385	91,9	100,0	
Missing	-9	34	8,1		
	Total	419	100,0		

Table 8

Number of collaboration

As is shown in table 9 the number of additional collaborations the start-up did have in the year that the collaboration started has a mean of 3,17 with a standard deviation of 2,053.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
number_cooperations	418	0	12	3,17	2,053
Valid N (listwise)	418				

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
number_cooperations	1,178	,119	2,821	,238

Table 9

Size

The average size of a spin-off firm was 19,74 employees. This with a high standard deviation of 30,82. Table 10 shows the descriptive statistics for the variable size.

	N	Minimum	Maximum	Mean	Std. Deviation
number of employees	412	,00	209,00	19,7482	30,82444
Valid N (listwise)	412				

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
number of employees	2,812	,120	9,334	,240

Table 10

Age

At last the variable age is represented in table 11 below. The average age of a start-up in our database is 4,96 years. Furthermore, the standard deviation is 5,360 years. This high standard deviation is due to some outliers in the database. However in 49,9 percent of all cases the start-up firms was 2 years or younger.

	N	Minimum	Maximum	Mean	Std. Deviation
age in years	407	0	29	4,96	5,360
Valid N (listwise)	407				

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
age in years	1,565	,121	2,886	,241

Table 11

4.2 Analytical results - RQ1

Table 12 presents the correlation matrix wherein the correlations between all variables are presented. It shows a high correlation between the variable ‘age’ and ‘spin-off’ and ‘age’ and ‘number of cooperations’. Because of this multicollinearity between ‘age’ and ‘spin-off’ and ‘age’ and ‘number of cooperations’, ‘age’ has been excluded from the regression analyses.

	LOI	TP	Age	NCOOP	Size	Spin-off	Initiator
LOI	1						
TP	0,327	1					
Age	-0.137	0.042	1				
NCOOP	-0.178	-0.245	0,401	1			
Size	0.031	-0,097	0,271	0,296	1		
Spin-off	0.177	-0.057	-0,499	-0,080	-0,167	1	
Initiator	0.076	0.184	-0,149	0,109	-0,099	-0,048	1

Table 12

Table 13 shows the estimates of the regression-coefficients of the linear regression equation together with their T-value. The R^2 of the linear regression was 0,178. The number of cases used is 340. This determines that a regression-coefficient is statistical significant when the absolute T-value is bigger as 1,64 corresponding with a significance level of $p < 0,10$. All variables have a significant effect on the length of interaction except the variable ‘initiator’.

Variable	Regression-coefficient	T-value
Initiator (X_1)	0,058	1,121
Type of partner (X_2)	0,310	5,915
Spin-off (X_3)	0,210	4,179
Nr. of cooperation’s (X_4)	-0,134	-2,463
Size (X_5)	0,142	2,669

Table 13

This results in the following regression-equation in which Y is the length of interaction:

$$Y = 0,058X_1 + 0,310X_2 + 0,210X_3 - 0,134X_4 + 0,142X_5 + error$$

Summarized, this equation states that when the initiator of inter-organisational collaboration is a start-up firms, this has a small and statistical insignificant positive effect on the length of interaction. When the type of partner is a public research organisation, this has a positive effect on the length of interaction. When the start-up is a spin-off, this also has a positive effect on the length of interaction. Furthermore, the number of cooperation’s has a negative effect and the size of the start-up firm has a positive effect on the length of interaction. All estimated effects are in accordance with their hypothesized effects. However, the effect of X_1 on Y is insignificant thereby disconfirming H2. H1 and H3-H5 are confirmed.

4.3 Qualitative Results - RQ2

Why initiative taking

Table 14 provides the data on the reasons why firms did take the initiative in the collaboration. It has been distinguished whether the partner firm was a public research organisation (PRO) or an established firm (EF). Furthermore, when more collaborations are discussed in one interview those are distinguished by a superscript numbering. This is done according to their chronological discussion within the interviews. Table 14 shows clearly that in almost all cases the reason for initiative taking was to get access to technology or facilities. Only for firm A the reason was a financial one. For the collaborations D¹ and E² the initiative was taken mutually and for collaboration C the partner took the initiative. No clear pattern arises whether the partner was a PRO or an EF.

Why initiative taking	PRO	EF
Access to technology/facilities	E ¹	B ¹ B ² D ²
Commercialization		
Financial	A	
Product development		

Table 14

Some quotes from the interviews give a good illustration in why the access to technology or facilities is such an important trigger for firms to take the initiative in inter-organisational collaboration. To quote a manager on the question about what triggers them to take the initiative:

'This is purely guided by our needs. Do we have a certain technology or knowledge in house, or do we have enough man-power? So, it is purely driven out of necessity. For example, because we had determined to start a certain research program, and we did not have a certain key technology or knowledge in-house.' (manager of firm B).

Another manager did give a quite similar answer:

'A need. It could be a specific commercial problem that we are trying to solve. For example, marketing resources. That drove the Biofocus collaboration. And it could be a specific technological issue and that drove our collaboration with C-Change.' (manager of firm D).

So, both managers stresses the point that initiative taking is related to a certain need a firms has. Where the manager of firm B specifically mentions technology or knowledge related resources the manager of firm D also mentions marketing resources as an important trigger. But the message is clear. Firms did take the initiative when they had a certain need. And according to table 14, most of the time this need consist of the access to certain technologies or facilities.

Objectives of Cooperation

Table 15 shows the objectives of the cooperation's. Access to technology and facilities and product development are the main objectives of the cooperation. Also, a clear but unexpected pattern can be seen in the type of partner. When the type of partner is a PRO the objectives of cooperation leans toward product development while when the partner was an EF they lean towards access to technology and facilities. This is unexpected because established firms as well as universities have a lot of technological knowledge and facilities in the form of laboratories.

Objectives of Cooperation	PRO	EF
Access to technology/facilities		B ¹ B ²
Commercialization		D ¹
Finance		
Product development	A C E ¹ E ²	D ²

Table 15

When comparing the objectives of the cooperation with the reasons the initiators had to take the initiative it is shown that firms take the initiative because they have a certain need. While product development is the prime objective of the cooperation. This can be explained in a way that product development creates a certain need by the fact that a firm misses certain technological or facilitating resources in order to develop the product. And because of this, it starts searching for inter-organisational collaboration.

How searching for Partners

Table 16 shows the ways in which the firms find their partner organisation. Most of the time this happens through direct link the firms did have with other organisations. The type of partner doesn't have an effect on this pattern. Only for B² the partner is found via the network of contacts of the firm. So, this shows that networks of contact are important in order to find partners. Furthermore, all managers noted that going to events was an important way in order to establish new contacts.

How searching for Partner	PRO	EF
Directly (via a contact of the firm)	A E ¹ E ²	B ¹ D ¹
Indirectly (through the network of contacts of the firms)		B ²
Events		D ²

Table 16

Why Partner selection, form and success of the cooperation

Table 17 summarizes three aspects of each cooperation. Namely, the reasons the firms had to choose a certain partner. This also includes important characteristics that the partner organisation's should have according to the interviewees. Furthermore, the form of the cooperation and the success of the cooperation are included. As is shown, most cooperations were at least reasonably successful. When looking at what characteristics of the partner were noted as important by the interviewed firm some interesting characteristics do come forward. Firstly, the partner organisation should have a high quality reputation as noted important within the cooperations B¹, D¹ and D². One manager nicely deliberates on this point:

'They must have an extremely high quality reputation, whether this is for their science or for their business. We had a Indian company that approached us about a similar go-marketing agreement as Biofocus did and I did not know them and I was not willing to associate with an unknown partner. They must be well known and they must have a strong reputation. Through a lot of hard work we have established a reputation as doing some of the best science in our field and our customers pay a lot for that, they pay a lot more for us as they pay for our competitors and I am not going to risk this reputation.' (manager of firm D).

Secondly, clear agreements about property rights and related to this the patentability of those products are also stated as important within a cooperation as is noted important within cooperation B² and C, E¹ and E². When developing a new product together, the managers of those firms stated that it is important to make clear agreements about how the outcomes of this cooperation are being divided between the organisations involved, as well as to be clear about that specific technology is the property of one of the firms. As is noted by the manager of firm C:

'One thing we really focussed on was the fact is there was a clear division of property. This is important because we are working together with a big firm as EIF. They have much more resources to put some jurist on a case and claim a certain technology'

The patentability of products was noted as important because otherwise the product cannot be sold on the market without having other firms copying it. So, to ensure long term profitability for a given product.

Cooperation's	Reasons Partner choice (important characteristics)	Form of the cooperation	Success of the cooperation
A	- Choice was determined by the social network we did have	Research consortia	A success but expected more
B¹	- In-house expertise - Experience with the tech. - Past successfulness (reputation) - Experience with cooperation's	Contract out agreement	Reasonable successful
B²	- Fast delivery of business plan - Clear agreements about property rights	Contract out agreement	Successful
C	- Clear agreements about property rights	Consortium agreement	Successful
D¹	- high quality reputation	Co-marketing agreement	Not clear yet
D²	- Business model complementary - valuable technology -high quality reputation	Consultancy agreement	Not clear yet
E¹	- Patentable technology - Valuable resources	Promotion through Aio's	Successful
E²	- Interesting product - Patentable product	Licensing agreement	Successful

Table 17

5. Conclusion

The first research question of this paper was: *'What factors determine the length of the collaboration between high tech start-up firms and their partner organizations?'*. By taking a resource based framework 6 factors were identified affecting the length of collaboration between a start-up firm and its partner. Those 6 factors are: whether or not the start-up firm did take the initiative in the collaboration, whether the partner firm is a public research organisation or an established firm, whether the start-up firm is a spin-off or not, the number of additional collaboration the start-up had and the age and size of the start-up at the beginning of the collaboration.

Furthermore, the expected effects of those factors on the length of an inter-organisational collaboration were stated in the following six hypotheses:

- H1. *If the partner organization is a public research organization, then the collaboration between the start-up and the partner organisation will last longer.*
- H2. *If the start-up firms takes the initiative in inter-organizational collaboration, this will lead to a longer collaboration.*
- H3. *If the start-up firm is a spin-off, this will lead to a longer collaboration.*
- H4. *If a start-up firm has more inter-firm collaborations, the length of its collaborations will decrease.*
- H5. *If the start-up firm is bigger, this will lead to a longer collaboration.*
- H6. *If the start-up firms is older, this will lead to a longer collaboration.*

A quantitative analysis did found evidence for all supposed relationships except for hypothesis 2 and hypothesis 6. Considering hypothesis 2, the analysis did show a positive effect between the start-up taking the initiative in collaboration and the length of collaboration, however this effect was not significant. The variable 'age' has been excluded from the regression analyses because of a high multicollinearity between the variables 'age' and 'spin-off' and 'age' and 'number of cooperations'.

The quantitative analysis results in the following regression-equation in which Y is the length of interaction and the subscript numbering of the X variables refers to the numbers of the hypotheses:

$$Y = 0,058X_1 + 0,310X_2 + 0,210X_3 - 0,134X_4 + 0,142X_5 + error$$

T-value = (1,121) (5,915) (4,179) (-2,463) (2,669)

Summarized, this equation states that when the initiator of inter-organisational collaboration is a start-up firms, this has a small and insignificant positive effect on the length of interaction. When the type of partner is a public research organisation, this has a positive effect on the length of interaction. When the start-up is a spin-off, this has a positive effect on the length of interaction. Furthermore, the number of cooperation's has a negative effect and the size of the start-up firm has a positive effect on the length of interaction.

The second research question of this paper was: *'When and how do firms in the biotech industry begin searching for partner organizations in order to start beneficial collaborations?'*. Firstly, I will concentrate on the first part of the question: *'When do firms in the biotech industry begin searching for partner organizations?'*. From a qualitative analysis of the interviews it seems that firms are triggered to take the initiative in inter-organisational collaboration when they are missing certain technological or facilitating resources. For most cooperations the main objective was 'product development'. Through this a pattern can be seen in which product development creates a certain need though the fact that a firm misses certain technological or facilitating resources in order to develop the product. And because of this start searching for inter-organisational collaboration. Another conclusion that can be drawn from the results is that when the type of partner is a PRO the objectives of cooperation leans toward product development while when the partner was an EF they lean towards access to technology and facilities. This is unexpected because organisations as well as universities have a lot of technological knowledge and facilities in the form of laboratories.

The second part of the research question states the question: *'How do firms in the biotech industry begin searching for partner organizations?'*. From the results it can be concluded that networks of contact are important in order to find partners. Furthermore, all managers noted that going to events was an important way in order to establish new contacts. Further conclusions can be made on the characteristics of the partner firms/cooperation that were stresses as important by the interviews firms. A first characteristic that is seen as important is that the partner organisation should have a high quality reputation. This can be explained through the fact that it lowers the risk of an unsuccessful partnership for the initiating firm. Furthermore, clear agreements about property right and related to this the patentability of those product are also stated as important. This because it prevents discussions about the distribution of patents or results obtained by for instance joint product development.

As a conclusion from the results on both research questions the following statement can be derived. Larger spin-offs with a little number of collaborations tend to collaborate longer with especially highly reputed public research organisation's with the purpose of product development.

6. Discussion

In this section the results obtained in this study will be discussed. Furthermore, based on this study, suggestions for further research will be given.

Looking at the quantitative results on research question 1 almost all the stated hypotheses were confirmed. This strengthens the theoretical rationalities made within the theoretical section to come to the hypotheses. It can be concluded that using a resource based framework to explain the effect that variables have on the length of inter-organisational collaboration is quite successful. These results favours the idea that the resource based view is a useful theoretical starting point to explain inter-organisational collaboration like in for example Ahuja (2000) and Van der Valk et al. (2007).

When considering the reliability of results obtained for the first research question the following remarks can be made. Given the fact that the Biopartner data set included a large part of Dutch start-up firms active in the biotech industry these data sustain the reliability of our results. However, the point has to be stressed that for the dependent variable 'length of interaction' data was available for only three years within a time span of four years. It would be preferred to have data on a longer time span. This because the effects that variables have on the length of interaction would become more clear. However by using an appropriate correlation matrix as input for our regression analysis, this study does give valid results. Furthermore the R^2 of the regression analysis is 0,178. This means that there are other factors not included in this study that also have an effect on the length of interaction. Further research should focus on those factors. This preferably by making use of a data set containing data over a longer time span. Also, further search could focus on the question whether the notion that the length of collaboration has a positive effect on success product development applies to different sectors. While Rothaermel & Deeds (2006) did found empirical evidence on this in high technology sectors and Lunnan & Haugland (2008) did found empirical evidence on this in general, no research has focussed on the question whether those finding are applicable to other sectors as well.

The results obtained in the qualitative part of this research have a descriptive nature and should be interpreted as such. It is tried to give some insight into the reasons that firms have to take the initiative in inter-organisational collaboration and into the process of searching for partners. By no means it said that the results obtained give a complete picture of the issues considered. However when comparing the results of other studies done into the same subject there are similarities with the results obtained in this study.

When comparing the results on partner search studies also stressing the important role of existing networks for organisation's to find partners are for example Gulati (1999), Ahuja, 2000) and Van der Valk et al. (2000). Studies done to the searching mechanisms organisation's use to find partners also stress the important role of existing networks for organisation's to search for partners, as for example Gulati (1999), Ahuja, 2000) and Van der Valk et al. (2000). Furthermore, Van der Valk et al. (2000) also stated the importance of the factor 'access to technology/facilities' as an important inducement to start inter-organisational collaboration. Those similarities between our findings and the findings of other authors strengthened our own findings as well as the findings of the other authors. Further research should focus on the validity of the patterns derived from the exploratory study.

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8. Appendix

Appendix 1 (Questionnaire used for interviews)

Aantal bedrijfsgegevens

- 1 - Wat is uw functie binnen het bedrijf? (Weten met wie ik spreek)
- 2 - Hoeveel werknemers (fte's) heeft het bedrijf in dienst?
- 3 - Is uw bedrijf een Spin-off, en zo ja van welke organisatie? (definitie bij de hand)
- 4 - Hoeveel jaar bestaat het bedrijf al?

Recente samenwerkingsrelaties

5 – Bij welke samenwerkingsrelaties is het bedrijf de afgelopen jaren betrokken geweest? (laatste 2 jaar) (eerst een op een relaties, daarna research consortia en subsidieprojecten)

Initiatief genomen (ervaring)

6 - Hebben jullie bij een of meerdere van deze samenwerkingsrelaties zelf het contact gelegd om tot de samenwerking te komen? (Bij research consortia kijken of het bedrijf een partner mee heeft genomen in het consortia, dus ze hoeven het niet zelf te hebben opgezet)

(Nu voor iedere samenwerkingsrelatie waarin het bedrijf het initiatief heeft genomen de volgende vragen stellen.)

Motief (waarom samenwerking gestart)

7 - Met welk doel werd de samenwerkingsrelatie gestart? (bekorten time-to-market, toegang tot financiering, samen basic R&D uitvoeren, risico/kosten delen, toegang tot een markt verkrijgen, technologische complementariteit gebruiken, monitoring van technologische ontwikkelingen)

Manier waarop (hoe partner vinden)

8a - Hoe is de samenwerking met deze partner tot stand gekomen? (Hoe zijn de twee organisaties bij elkaar gekomen?) (Na doelbewust zoeken of bij toeval?)

8b - Welke methoden gebruiken jullie om mogelijk interessante samenwerkingspartners te vinden? (internet, sociaal netwerk, biotechnologie conferenties) (in het geval van een biotechnologie conferentie vragen of het vanuit het bedrijf door wetenschappers of door de business geïnitieerd is)

Wanneer (initiatief)

9 - Waarom werd het initiatief genomen in de samenwerkingsrelatie?

Selectie (wie)

10a - Wat voor soort organisatie is/was de partner? (Farmaceutisch bedrijf, universiteit, onderzoeksinstelling van de overheid).

10b - Werd de keuze om samen te werken met deze specifieke 'soort organisatie' bepaald door overwegingen betreffende de core-business, mogelijke uitbreiding van het product/service portfolio of was het een toevallige interessante kans? (Dus duidelijk krijgen of het een strategische overweging was of de keuze door toeval werd bepaald)

11a - Welke kenmerken moest de partner bezitten?

11b - Waarom zijn juist deze kenmerken (van de partner) belangrijk om jullie strategische doelen te bereiken

12a - Was de samenwerkingspartner van tevoren al bekend bij het bedrijf?

(als van toepassing)

12b - Heeft het feit dat de samenwerkingspartner bekend was bij het bedrijf bijgedragen aan de keuze voor deze partner/totstandkoming van de relatie?

Realisatie (vorm en succes)

Vorm samenwerkingsrelatie

13a - Welke vorm had de samenwerkingsrelatie?

- Is er een aparte joint venture, stichting etc. opgericht?
- Welke afspraken in samenwerkingsrelatie betreffende R&D, Licentie, stuk advies etc.? (R&D, verkoop, distributie)

13b - Waarom werd voor deze specifieke vorm gekozen?

Succes Samenwerking

14 - Wat is/was de afgesproken duur van de samenwerking?

15 - Wat was de werkelijke duur van de samenwerking?

16a - Wat werd van de samenwerking verwacht?

16b - In welke mate is hieraan voldaan? (bijvoorbeeld, mate van nuttige kennisoverdracht)

16c - Is bovengenoemde de reden dat de samenwerking: werd beëindigd voor de afgesproken termijn / de afgesproken termijn voortduurde?

(Zo niet)

16d – Wat waren de redenen dat de samenwerking: werd beëindigd voor de afgesproken termijn / de afgesproken termijn voortduurde?

Vragen Luris (bedrijf benaderd vanuit Luris)

17 - Wat was jullie motivatie om samen te werken met het LUMC? (Unieke te commercialiseren kennis, omdat het LUMC minder hoge eisen stelt aan de partner)

18 - Hebben jullie zelf ook gezocht naar mogelijke partners om mee samen te werken?

19 - Wanneer gaan jullie zelf op zoek naar een samenwerkingspartner?

20 - Was het LUMC voordat ze jullie benaderde al in beeld als mogelijke samenwerkingspartner?

21 - Wat zou Luris kunnen doen om beter in beeld te komen bij biotechnologie bedrijven als mogelijke samenwerkingspartner?

(bedrijven werken samen met het LUMC en Luris is een broker voor het LUMC om tot samenwerkingsrelaties te komen)

Appendix 2 – 6 (Interview descriptions)

See confidential appendix