

Thesis

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The role of alliance formation in new business development

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Abstract

New science based firms face the challenge of obtaining necessary complementary resources for successful business development. Such a firm will be motivated, in order to gain access to the resources and competences that a firm has not in-house, to enter an alliance with another firm that has these resources. As different phases of the innovation process ask for different complementary resources, it would make sense that the type of alliances (R&D alliance or a commercial alliance) reflect this. In this paper the role of alliances in successive stages of new business development is researched. From the results, obtained for 218 surviving new ventures in the Dutch life sciences industry, over the period 2002-2005, the following conclusions have been drawn. Commercial alliances play an important and positive role in the pre-market phase, but have a negative influence in the market phase. R&D alliances boost revenues but not profits in both phases. Help from a parent in the form of commercial capital helps new business development but technological support is never a good thing. Another important factor that negatively influences business development is the diversity of the management team in both the pre-market and the market phase.

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1. Introduction

Firms need a unique asset, which gives them a sustainable competitive advantage vis-à-vis their competitors, and the resources to develop, protect, commercialize and market that asset successfully (Wernerfelt, 1984; Mahoney & Pandian, 1992). Apart from these resources, also good dynamic capabilities, i.e. the routines and processes needed to make optimal use of these unique assets while remaining flexible and able to adapt to market changes, are essential for a firm's success (Teece et al., 1997). The type of capabilities and resources that are needed, in order to exploit an unique asset so that a competitive advantage is achieved, depends on the development stage the firm is in with its innovation. New product development is an iterative stage-gate process, with stages like idea-formulation, concept formulation, product development and marketing that follow one after another. In each stage a firm needs different resources for optimal performance (Tidd & Bessant, 2009). Furthermore, the nature of innovation changes from product to process development over the product life cycle (Utterback & Abernathy, 1975; Klepper, 1996). At the start of the product development stage, especially assets and capabilities are needed that support research and development of the firm's unique assets; i.e. dynamic capabilities like product development and opportunity identification (Teece, 2007; Eisenhardt & Martin, 2000). In a later stage, when the product has been developed, resources that assist in the commercialization of the product become more relevant (Dougherty, 1992). However, firms that are in the process of developing a new product or service often don't have all the needed assets and capabilities in house. Some of the resources needed for optimal product development and commercialization can be hired or bought. However, forming alliances is often a more efficient way to get access to needed resources because of lower transaction costs, i.e. the costs that occur with acquiring an asset (Williamson, 1981). In this context, an alliance is defined as "any voluntarily initiated cooperative agreement between firms that involves exchange, sharing, or co-development, and it can include contributions by partners of capital, technology, or firm-specific assets" (Gulati & Singh, 1998).

To gain access to the resources and competences that are missing, while minimizing transaction costs, a firm will be motivated to enter an alliance with another firm that has these competencies (Kogut, 1988; Gulati, 1998). An alliance can strengthen the strategic position of a firm in a competitive market as the risks and costs are shared with a partner while additional resources can be accessed. As firms need different kinds of resources in different stages of development, it is to be expected that the type of alliances they engage in reflect this. New firms that are in the early stages of business development need resources that support them in this task. As technological capital is positively related to the amount of previously successfully developed products (Ahuja, 2000), this type of capital is not abundant in new firms. Therefore, an inter-firm relationship that is focussed on getting access to technological assets and capabilities is most welcome. Firms that have a technological innovative product ready, can be expected to be more interested in resources that help them with the

commercialization of the product in an optimal fashion. So alliances aimed at getting access to commercial capital, i.e. capabilities that support manufacturing and marketing, and assets like distribution networks, manufacturing facilities and customer services, will be formed (Ahuja, 2000; Teece, 1986).

New science based firms face the challenge of obtaining the necessary complementary resources for successful business development in particular, as they are in an industry where both technological and commercial capital are needed (Pavitt, 1984). Biotech firms are prime examples of firms in a science based industry. In this sector it is almost unheard of that a firm has all the competences required to develop a new product in house (Powell et al., 2005).

Powell et al. (2005) observed, contrary to what might be expected from the resource based view and transaction cost theory as outlined above, that the primary activities organizations in the life science industry get engaged in during collaborations, do not shift over time from R&D to commercialization but from commercialization to R&D and venture capital funding. So, the empirical sequence of types of alliances formed by start-ups during the life science industry development is opposite to the theoretically expected one.

When looking at the biotech industry and the type of alliances formed, Muijers & Faber (2012) found that Dutch biotech firms especially enter foreign alliances with public research organisations after successful product development, having obtained a strong financial position (amount of venture capital attracted) and having acquired patents (Muijers & Faber, 2012). This also indicates that the formation of alliances is not motivated by a lack of complementary resources during the product development stage, but by the availability of complementary resources acquired during the product commercialization stage. This is in line with Powell et al.'s (2005) observation that research collaborations are positively related to the age and size of the industry and the previous successful commercialization of new products by firms operating in that industry. Both studies present insights in how and why success fosters success.

Eisenhardt & Schoonhoven (1996) also noticed this discrepancy between theory and empirics. Contrary to their hypotheses, namely that in growth-stage markets alliances would occur more often than in mature markets, they found that growth-stage markets have the lowest rates of alliance formation. In order to study these empirical anomalies in alliance formation in further detail, the following research question has been formulated:

What is the role of alliances in successive stages of new business development and for what reasons?

In order to answer this question, the relation between alliance formation and firms' business development will be investigated. A firm's business development will be indicated by the growth in profits and turnover, two indicators frequently used (Schutjens & Wever, 2000). By looking at both

the direct effects of multiple types of resources (social, commercial, financial and technological capital) on a firm's success and the indirect effect of a firm's resources on its success via the formation of alliances, and the relation between alliance formation and success, all before and after having brought a new product to the market, the role of alliance formation, in successive stages of new business development, will become more clear. The data that will be used for this study come from the BioPartner program. This program was instigated by the Dutch Ministry of Economic Affairs and ran from 2000 until 2005. The goal of the BioPartner program was to boost entrepreneurship in the Dutch life science industry (Dongen et al., 2005), which was annually monitored by means of a survey since 2002.

This research will provide more insights into the role of alliance formation in successive stages of new business development within the life science industry. The results also might produce some clues for future improvements of policies aimed at this industry, instigated by the government, governmental institutes or the private sector.

2. Theory

According to the resource-based view, firms are able to gain a competitive advantage because they have unique assets which are hard to imitate or to buy on the market (Wernerfelt, 1984). However, firms with a novel technological idea or concept need access to complementary resources, in order to develop a concept into a new product, after which they need resources that support them in bringing the product to the market successfully (Teece, 1986). In the pre-market phase, which refers to the phase when a concept is developed into a product, a firm will most likely need resources like R&D facilities and personal with technological know-how, i.e. technological capital (Ahuja, 2000). The complementary assets a firm needs in the pre-market phase are not necessarily similar to the assets they need in the market-phase, which is the phase that starts when a product is ready to be commercialized. In the market phase a firm will need resources that support commercialization, i.e. commercial capital (Ahuja, 2000). The type of resources a firm needs thus depends on the business development stage it is in (Tidd & Bessant, 2009). Both technological and commercial capital support a firm in developing a new business. However, their importance differs between the pre-market phase and market phase. Technological capital is especially important in the pre-market phase, as in this phase the development of a new product is the most important, while having access to commercial capital is crucial especially in the market phase when a new product has to be commercialized. This line of reasoning and the hypotheses that will follow from it are not in line with the empirical findings of Powell et al. (1996), who found that commercial alliances and commercial capital are already in the pre-market phase of great importance. While developing a novel idea into a product, a firm potentially could already develop services based on that idea, for example, a new way to determine a rare disease in a patient and can market this service or license the idea. For licensing and/or providing a service as

well as developing a new product the firm will need complementary assets that support these activities. For licensing and/or providing services based on a novel idea, a firm will need commercial capital, which is in line with the findings of Powell et al. (2005), while for the development of a new product, a firm will need technological capital the most. This difference might explain the discrepancy. However, since it is not totally clear what the reason is for the discrepancies between theory (Wernerfelt, 1984; Teece, 1986; Mahoney & Pandian, 1992; Ahuja, 2000; Tidd & Bessant, 2009) and empirics (Powell et al., 1996; Muijers & Faber, 2012), this research will base its hypotheses on theory, as outlined above. Therefore the following two hypotheses are formulated:

Hypothesis 1: Technological capital has a positive effect on new business development, especially in the pre-market phase.

Hypothesis 2: Commercial capital has a positive effect on new business development, especially in the market phase.

Many business development activities, like conducting research, hiring high quality personal, investing in equipment and conducting marketing involve costs. Therefore, a strong financial position of a firm is beneficial for new business development in the pre-market phase, as well as the market phase (Song et al. 2008). However, there is evidence that too much money can be detrimental to a firm's business, as it can lead managers to grow their firm beyond its optimal size (Jensen, 1986). Nonetheless, this research will assume a positive linear relation between financial capital and business development, since an excess of cash is not expected to be an issue in young biotech ventures. The following hypothesis is thus formulated:

Hypothesis 3: Financial capital has a positive effect on new business development in both the pre-market phase and the market phase.

A fourth factor, next to commercial, financial and technological capital, that is of great importance for a firm's new business development, are the characteristics of its management team (Eisenhardt & Schoonhoven, 1996). Especially for new ventures solid leadership is important, since there are no standard procedures or structures in place to build on (Ensley et al., 2004). Characteristics that have been shown to positively influence a firm's business development are the size (to a certain point) and diversity of the management team (Brown & Eisenhardt, 1995; Cooper & Kleinschmidt, 1995; Eisenhardt & Schoonhoven, 1996; Christensen & Raynor, 2003; Hambrick et al., 1996). There is evidence that a management team's size can pose a problem when it is so large and diversified that coordination and process problems arise which overwhelm the advantages of having more experience and knowledge (Yermack, 1996). Management teams that are larger and more diversified than optimal for business development are not expected in this research as it investigates young and small ventures. In accordance with previous results, the following hypotheses are formulated:

Hypothesis 4: The top management team's size has a positive effect on new business development in both the pre-market phase and the market phase.

Hypothesis 5: The top management team's diversity has a positive effect on new business development in both the pre-market phase and the market phase.

If a firm does not have the necessary commercial capital and/or technological capital in-house, it is forced to find ways to get access to them. Alliance formation is an efficient way to get access to needed resources (Williamson, 1985). Apart from transaction cost minimization there are other rationales to want to engage in an alliance. Alliances are a way to share risks with a partner and to make use of economies of scale and scope (Kale et al., 2000). Alliance formation can thus be used to enhance a firm's competitive position by increasing its market power or efficiency (Kogut, 1988). Firms that have more linkages to other firms enjoy higher returns because of access to more information and business opportunities (Zaheer et al., 2000). Furthermore, a firm's network influences its possibilities to find suitable partners to collaborate with (Gulati, 1998). The embeddedness of a firm in (social) networks enables it to enter alliances and influences its success in attracting attention from both investors and other firms (Powell et al., 1999). The network position influences the information the firm has about possible suitable partners and the extent to which other firms are aware of the firm's existence and what it has to offer (Gulati, 1998). So, alliance formation can be a way to get access to complementary assets and improve a firm's competitive position. This is supported by empirical research (Baum & Oliver, 1991; Stuart et al., 1999; Baum et al., 2000), which found that especially young firms' performances are positively related to the number of linkages they have established. This leads to the sixth and seventh hypotheses of this study:

Hypothesis 6. The number of R&D alliances entered has a positive effect on new business development, especially in the pre-market phase.

Hypothesis 7. The number of Commercial alliances entered has a positive effect on new business development, especially in the market phase.

As an alliance is a two sided endeavour, the determinants of alliance formation have to be looked at from two perspectives: the inducements and the possibilities of a firm to engage in alliance formation. The more resources a firm has, the more interesting it becomes for others to collaborate with this firm. A firm's possibilities to form inter-firm relations depends on its attractiveness as a partner for others. However, the more attractive a firm is for others to collaborate with, i.e. the more resources it has, the less incentives it has to enter an alliance. In other words, when a firm has most of the resources it needs, its inducement to enter an alliance is low. This tension between inducements and possibilities to collaborate is demonstrated by Ahuja (2000). When a firm has the resources it needs, it is not inclined to pursue getting access to them by means of alliance formation. When a firm lacks the resources it

needs, partner organizations are not attracted to provide the firm access to them by means of alliance formation since they are not likely to get anything out of forming an alliance with a firm that has nothing to offer (Ahuja, 2000). So, the chances that a firm will engage in alliance formation will be highest if it has some resources in-house, to be an attractive partner, while still needing access to resources possessed by other organizations, so that they are induced to enter an alliance. This implies an inverted U-relationship between a firm's resource position and the number of alliances it is engaged in, since the optimal setting for alliance formation is in the sweet spot where a firm needs resources but also has resources to offer, so that both the inducement and opportunity to enter an inter-firm relation are in equilibrium. In the pre-market phase, firms especially need technological capital. The more technological capital a firm has in-house, the less need there is for alliance formation in order to get access to it. The alliances formed will thus most likely be aimed at R&D in the pre-market phase. In the market phase commercial capital becomes more important and technological capital less, since the product has to be commercialized and the R&D stage has ended. Therefore it is expected that in the market phase alliances are aimed at improving commercial opportunities. So, the amount of commercial capital a firm has, influences its inducement and opportunity for alliance formation mainly in the market phase, while its technological capital will influence alliance formation predominantly in the pre-market phase. In accordance two hypotheses have been formulated:

Hypothesis 8: There is an inverted U-relationship between the amount of technological capital and the number of R&D alliances formed by a new firm, especially in the pre-market phase.

Hypothesis 9: There is an inverted U-relationship between the amount of commercial capital and the number of commercial alliances formed by a new firm, especially in the market phase.

The resource position of a firm works thus directly on a firm's success but also indirectly, as it influences both the inducement and opportunities to engage in alliance formation. Apart from a firm's resource position there are other factors that influence the number of alliances formed, in order to gain access to complementary assets.

Some characteristics of a firm's management team have been found to influence a firm's alliance formation possibilities (Brown & Eisenhardt, 1995; Cooper & Kleinschmidt, 1995; Eisenhardt & Schoonhoven, 1996; Christensen & Raynor, 2003). Large and diversified management teams have capabilities (e.g. skills, connections, reputation and time) that positively influence alliance formation (Eisenhardt & Schoonhoven, 1996). With the size and diversity of the management team its social network increases and becomes more heterogeneous. It is known that social and intellectual ties facilitate collaborations (Powell et al., 1999). In accordance with these previous results, the following hypotheses are formulated:

Hypothesis 10: The top management team's size has a positive effect on the number of commercial alliances entered by a firm in both the pre-market phase and the market phase.

Hypothesis 11: The top management team's size has a positive effect on the number of R&D alliances entered by a firm in both the pre-market phase and the market phase.

Hypothesis 12: The top management team's diversity has a positive effect on the number of commercial alliances entered by a firm in both the pre-market phase and the market phase.

Hypothesis 13: The top management team's diversity has a positive effect on the number of R&D alliances entered by a firm in both the pre-market phase and the market phase.

During the process of new business development, especially young and small firms are confronted with multiple hazards, as they often lack resources whether it is social capital (a large and diversified management team), commercial capital, technological capital or financial capital (Eisenhardt & Schoonhoven, 1996; Song et al., 2008). This phenomenon is known as the liability of newness and smallness (Stinchcombe, 1965) and is a reason for young and small ventures to have high failure rates (Baum, 1996). Furthermore, new firms face the liability of unconnectedness (Powell et al., 1996), they lack the reputation and network that larger firms have. Therefore new firms, which have not yet built up a reputation by successfully bringing a product to the market, experience difficulties in finding attractive alliance partners (Powell et al., 1999). So, firms with a small management team and little technological and/or commercial capital, will find it hard to form alliances in order to get access to complementary resources since social ties and a strong resource position increase the opportunity for finding suitable partners (Powell et al., 1999; Ahuja, 2000). For new ventures the help of a parent organization is therefore especially helpful, as the parent can provide complementary resources that are not in-house (Rogers et al., 2001). When firms have been able to make a product that is commercialized, they can be expected to have established the alliances and reputation to do so. Therefore the influence of a parent organization on business development is expected to be lower for firms in the market phase.

Firms that are in the pre-market stage will need especially complementary technological capital; in later stages of the product life cycle, in the market phase, this type of capital becomes less important. If a parent organization can support a firm by providing technological capital, hereby helping a firm to develop a high quality product, this will positively influence the firm's business development, especially in the pre-market phase since this is the time R&D is most important. This leads to the following hypothesis:

Hypothesis 14: Technological capital support received from a parent organization has a positive effect on the success of new business development, especially in the pre-market phase.

However, the help of a parent organization can also have the effect that a firm focuses on the wrong value network, an issue coined by Christensen & Rosenbloom (1995) and defined by them as “the context within which a firm competes and solves customers’ problems”. A parent organization and the experience it conveys can lead a firm, which receives support from this parent, to develop capabilities, structures and cultures to fit a position that meets the requirements demanded by the value network of the parent organization (Christensen & Rosenbloom, 1995). This can have the consequence that the firm becomes myopic and misses out on opportunities in other, more promising, value networks. This hazard of focussing on the wrong value network is especially relevant in stages when commercial capital is demanded, as value networks relate to having knowledge of what customers want and need, having the right marketing competences and knowing how to commercialize a product, and what customer group it should focus on. This leads to the following hypothesis:

Hypothesis 15: Commercial capital support received from a parent organization has a negative effect on new business development, especially in the market phase.

Apart from the problem of firms focussing on the wrong value network, having a parent organization can lead firms to feel a bit too comfortable. Therefore it is for new firms, which have a parent organization, very important to strive for profit and less for growth in order to show they have a solid business case (Christensen and Raynor, 2003), i.e. that there is both demand for their product and that their margins are healthy. Agterberg’s (2012) results support this argument, as he found that receiving large chunks of financial support and coercive management support from a supportive organization has a negative influence on high-tech venture business development. Furthermore, having the support of a parent organization also decreases the necessity for a firm to engage in collaborations with other firms and improve its position in the strategic network. Since firms in the pre-market phase need especially capital that supports R&D, technological capital support from a parent will decrease the necessity for these firms to form R&D alliances in the pre-market stage. In the market phase, when firms need capital that supports commercialization, the need to form non-R&D ties decreases when commercial capital support is received from a parent organization. Therefore the following hypotheses are formulated:

Hypothesis 16: Commercial capital support received from a parent organization has a negative effect on the number of commercial alliances entered, especially in the market phase.

Hypothesis 17: Technological capital support received from a parent organization has a negative effect on the number of R&D alliances entered, especially in the pre-market phase.

All aforementioned hypotheses are visualized in the conceptual model below (figure 1).

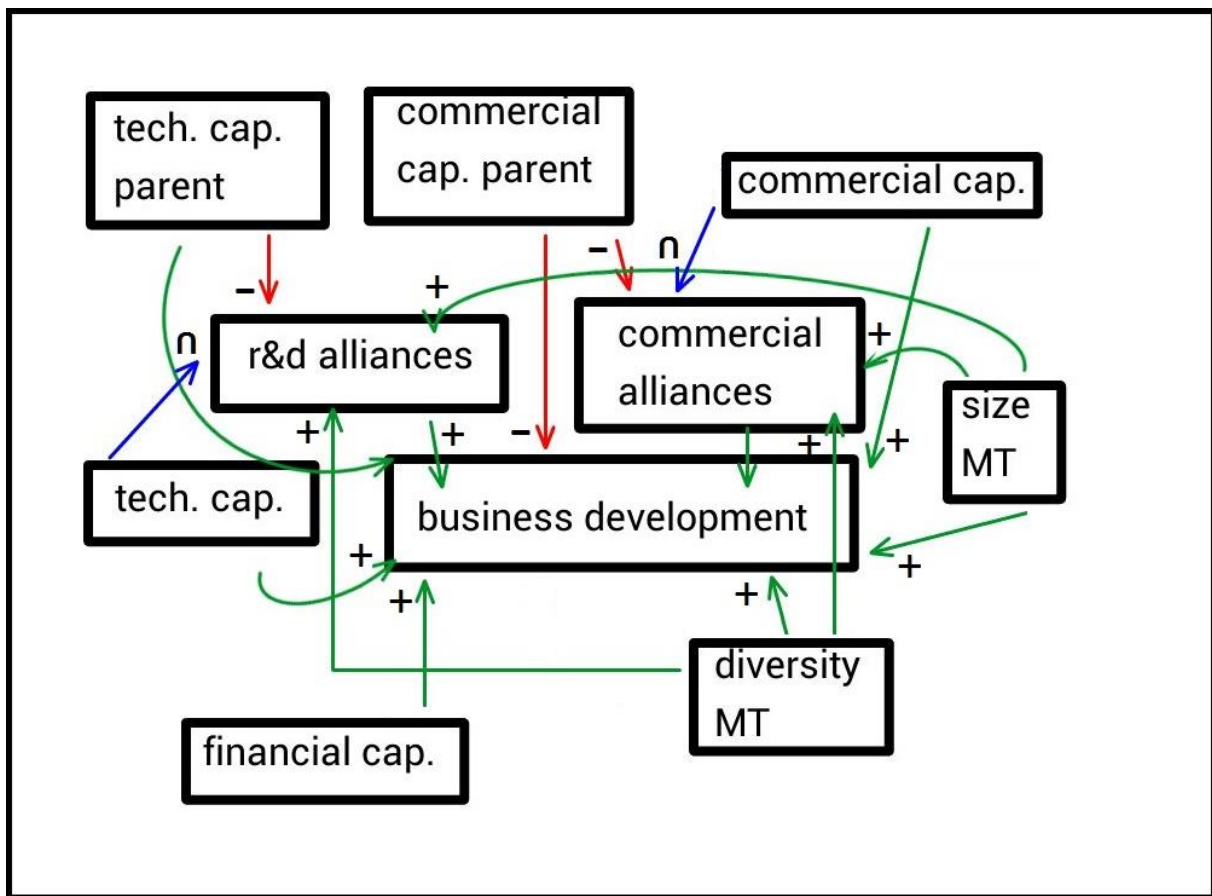


Figure 1: conceptual model

In order to estimate and test the hypothesized effects of a firm's capital position, the characteristics of a firm's management team and the support a firm receives from a parent organization on the number of alliances a firm forms and the firm's new business development, and in order to estimate also the effect of alliances formation on new business development, the methods of data collection and data analysis are described in the next section.

3. Method

3.1 Data collection

The role of alliance formation in new venture business development is studied by investigating the differences and similarities of Dutch firms in the life science industry. This research has the design of a cross-sectional study (Bryman, 2008) as it is based on data obtained for multiple cases. As the observations of a firm's revenues and its profits are not correlated over time, these observations can be seen as independent data points, even though they are collected over a period of multiple years. For all

the indicators of the concepts identified in the conceptual model is quantifiable data available. Therefore it is possible to examine the relationships between variables with the use statistical methods.

BioPartner, an intermediary organization, monitored the development of the firms that were active in the Dutch life science industry. This was done through annual surveys in the years from 2002 till 2005. It was obligatory for firms that received funding from the BioPartner program to participate in these surveys. The data from the BioPartner Monitor database will be used in this research. It contains 218 observations of two successive venture years, which are needed to assess a new venture's business development. So the data used in this study have already been collected. The dataset provides information on various characteristics of the new ventures in the program.

3.2 Operationalization

In order to test the hypotheses formulated in chapter two and to provide an empirical answer to the research question, each variable is operationalized, by creating a quantitative measure of each variable (Bryman, 2008). The independent variables of this study are: *size management team*, *diversity management team*, *financial capital*, *commercial capital*, *technological capital*, *commercial capital provided by parent organization* and *technological capital provided by parent organization*. The intermediate variables of this study are the *number of commercial alliances* and the *number of R&D alliances*. The dependent variables of this study are *revenues growth* and *profit growth* as indicators of *business development*.

Business development

A firm's success in new business development is high when it is able to sell their products or services with a profit. The more it sells and the higher the margins are the more successful a firm is. These two variables, profit growth and revenue growth, are, however, independent of each other ($r=0.003$), and will be operationalized and measured separately for each firm as the annual growth rates of its revenues (R) and profits (P). The growth rates are calculated, based on each new venture's revenues and profits compared to the revenues and profits of the previous year (t), with $t = 2002, 2003, 2004$.

$$\text{Growth rate R (t)} = \frac{R(t+1) - R(t)}{R(t)}$$

$$\text{Growth rate P(t)} = \frac{P(t+1) - P(t)}{P(t)}$$

As an indicator for successful business development profit growth is superior to revenue growth, especially for young firms. Davidsson et al. (2009) showed that started companies that grow, even if this is at a slow rate, while making profit are more likely to achieve a desirable state of high growth and high profitability in the long run than firms with a high growth rate without positive profit margins. Revenue growth is thus only desirable if it is coupled with profit growths.

Number of commercial alliances

The number of commercial alliances a firm is engaged in is measured by the number of substantial partnerships a firm has with other organizations aimed at improving marketing, sales, distribution and production. The number of commercial alliances is measured on a discrete scale.

Number of R&D alliances

The number of R&D alliances a firm is engaged in, is measured by the number of substantial partnerships a firm has with other organizations aimed at improving their R&D in general or the R&D of their product. The number of R&D alliances is also measured on a discrete scale.

Size management team

The size of the management team is measured as the number of members of the firm's management team. This variable is also measured on a discrete scale.

Diversity management team

The indicator used to measure the diversity of the management team is the number of functional areas that are represented in the management team. The eleven functional area's distinguished in the BioPartner data are: finance, clinical development, alliances, business development, intellectual property rights, marketing & sales, production/operations, human resources, R&D, customer resources, distribution/logistics. So, management team diversity is measured on a discrete scale ranging from 1 to 11.

Technological capital provided by parent organization

The indicator used to measure the extent to which a firm received support in the form of technological capital from a parent organization, is measured on whether there is a transfer of intellectual property and whether the firm receives technology and knowledge from a parent organization. This variable is measured on a discrete scale from 0 to 2; with 0 indicating that neither a transfer of intellectual property nor that technology and knowledge is received from a parent, 1 indicating that either there is transfer of intellectual property or that technology and knowledge is received from a parent and 2 indicating that there is both a transfer of intellectual property and that technology and knowledge is received from a parent.

Commercial capital provided by parent organization

Indicators used to measure the extent to which a firm receives commercial capital support from a parent organization are if they receive help from a parent organizations to get customers or orders. This is operationalized and measured for each firm as the access given to either the distribution channels of a parent organization its customer base or both. The commercial capital provided by a

parent organisation, is measured on a discrete scale with scores 0, 1 or 2; with 0 meaning no access to the distribution channels or the customer base of a parent organization, 1 representing access to either the distribution channels or the customer base of a parent organization, and 2 indicating access to both the distribution channels and the customer base of a parent organization.

Financial capital

The indicator used to measure the financial capital of a firm is the extent to which a firm attracted external funding. This is operationalized and measured as the amount of external financial capital received (in 1000 euro's) in total in year (t), with t = 2002, 2003, 2004.

Commercial capital

The indicator used to measure the amount of commercial capital at the disposal of a firm is whether a manager, dedicated to areas linked to the commercialization of a product, is present in the management team. The four areas identified to operationalize this variable are marketing & sales, production/operations, customer services and distribution/logistics. This variable is measured on a discrete scale ranging from 0 to 4.

Technological capital

Indicators used to measure a firm's technological capital is the amount of assets that support a firm in creating an innovation. This is operationalized by measuring the number of R&D employees. The number of employees is measured on a discrete scale.

Control variables

Because the measurements of the indicators mentioned above will vary with firm age and firm size, these two are taken as control variables. These control variables are operationalized and measured as follows. Firm age is measured as the number of years passed since foundation. Firm size is measured as the number of full time employees.

3.3 Data Analysis

The conceptual model is a non-recursive model with direct effects and indirect effects. In order to estimate these effects and their total effects, a linear structural equations model approach is used. This model is estimated and tested based on appropriate estimates of the correlations of the various indicators measured on discrete and continuous scales (Jöreskog & Sörbom, 1996). A simple linear regression analysis method is not capable of estimating the direct and indirect effects of the intermediary and independent variables in the model. Therefore it is necessary to apply path analysis (Duncan, 1966). The sum of the direct and indirect effects make up the total effect of one variable on another. These direct, indirect and total effects are estimated for the pre-market (n= 95) and market

phase (n=123) by means of the maximum likelihood method after specifying the conceptual model in the computer program LISREL 8 (Jöreskog & Sörbom, 1993).

4. Results

Getting a better insight in the role alliances formation plays in new business development is the main goal of this study. Even though this topic has been researched multiple times before, investigating the role of alliance formation in successive phases of development of a firm is a novelty. The process of new business development, which is a process of innovation, asks for different skills, knowledge and assets in order to go from a good idea, to a proto-type, to a product and to a successful commercialization of the product. The needs of a firm are not constant over time, so it may be expected that the role of alliance formation reflects this. In this study a differentiation is made between firms that are in one of two successive phases of product development, i.e. the pre-market phase and the market phase. First the results of the regression analysis and the path analysis for the pre-market are discussed, followed by the results for the market phase. After this the results for the two phases are compared and an overview of the results is given.

4.1 Pre-market phase

The coefficients of determination (R-squared) for the pre-market phase are presented in table 1. For the pre-market phase the theoretical model explains the revenue growth of firms for 46.9% and profit growth for 33,2% (Bryman, 2008). The F-value's for the regression models for revenue growth and for profit growth are significant with $p < 0,01$. This indicates that the relations, as specified in the theoretical model, present the main structure well (Field, 2009).

Table 1: Coefficients for determination pre-market phase

<u>R-squared</u>	Intermediate variables	Independent variables	Total variables	F-value
<i>Revenues (pre-market phase)</i>	0,13	0,339	0,469	6,035**
<i>Profit (pre-market phase)</i>	0,069	0,263	0,332	3,396*

*: F-value significant for $p < 0,01$

**: F-value significant for $p < 0,001$

The results of the regression analysis and path analysis of the theoretical model are presented in table 2. The numbers that are bold and underlined represent a significant relation with $p < 0,05$. The total effect of one variable on another is the sum of its direct and indirect effect.

Table 2: Regression results pre-market phase

Pre-market phase	Direct effect				Indirect effect		Total effect	
	<i>Revenue</i>	<i>Profit</i>	<i>R&D all.</i>	<i>Com. all.</i>	<i>Revenue</i>	<i>Profit</i>	<i>Revenue</i>	<i>Profit</i>
<i>Com. all.</i>	0,109	<u>0,307</u>	x	x	x	x	0,109	<u>0,307</u>
<i>R&D all.</i>	<u>0,34</u>	-0,018	x	x	x	x	<u>0,34</u>	-0,018
<i>Com. cap.</i>	<u>0,647</u>	-0,241	-0,368	-0,232	-0,15	-0,064	<u>0,496</u>	-0,306
<i>Com. cap. parent</i>	-0,06	<u>0,276</u>	-0,027	-0,084	-0,018	-0,025	-0,078	<u>0,251</u>
<i>Financial cap.</i>	0,09	<u>0,151</u>	0,558	-0,295	0,157	-0,101	0,247	0,05
<i>MT diversity</i>	<u>-0,86</u>	0,152	<u>0,412</u>	<u>0,491</u>	<u>0,193</u>	<u>0,143</u>	<u>-0,667</u>	0,295
<i>MT size</i>	<u>-0,318</u>	0,099	-0,097	<u>-0,345</u>	-0,071	<u>-0,104</u>	<u>-0,389</u>	-0,005
<i>Tech. cap.</i>	0,198	0	0,476	<u>0,595</u>	0,227	0,174	<u>0,425</u>	0,174
<i>Tech. cap. squared</i>	x	x	-0,134	-0,274	-0,075	-0,082	x	x
<i>Tech. cap. parent</i>	-0,078	<u>-0,804</u>	0,147	<u>0,361</u>	0,084	0,094	0,006	<u>-0,71</u>
<i>Firm age</i>	<u>-0,369</u>	<u>-0,376</u>	0,144	<u>0,243</u>	0,075	0,072	<u>-0,294</u>	<u>-0,304</u>
<i>Firm size</i>	-0,152	-0,276	-0,366	-0,93	-0,135	-0,022	-0,287	-0,298

In the pre-market phase alliance formation is positively related with the success of new business development, this is in line with hypothesis 6 and 7. Commercial alliances are positively related to profit growth (Beta= 0,307) and R&D alliances have a positive relation with revenue growth (Beta= 0,34). It was hypothesised that especially R&D would be of importance in the pre-market phase but the results show that commercial alliances might play an even more important role. Apparently there are firms that, even though the product that they are developing is not ready, benefit from commercial alliances. This indicates that commercial alliance formation, in the pre-market phase, helps firms with the commercialization of their basic knowledge via related activities (i.e. licences and/or services) (Willemstein et al., 2007).

Apart from the number of alliances a firm is engaged in, also the amount of capital a firm has in house is expected to have a positive influence on new business development. The three types of capital identified in this paper are commercial-, technological- and financial capital. The amount of capital a firm has, is expected to have both a direct effect on new business development and an indirect effect, since it influences a firms inducement and possibilities for forming alliances with a suitable partner. Both the amount of commercial capital (Beta= 0,496) and technological capital (Beta= 0,425) of a firm have a positive effect on its revenue growth in the pre-market phase. Even though the size of their influence is similar, it is notable that commercial capital affects revenue growth mainly directly (Beta= 0,647), while technological capital's total effect on revenue growth is largely based upon an indirect effect, namely through the significant positive effect of technological capital on commercial alliance formation (Beta= 0,595). So, commercial capital and technological capital both boosts revenue growth in the pre-market phase, but where the effect of commercial capital is a direct one and the effect of technological capital is an indirect one via commercial alliance formation. Financial capital, the third

type of capital distinguished in this paper, has no significant total effects on new business development. This indicates that it is important to already exploit the technological know-how that is in-house and to start some commercial activities in the pre-market phase in order to get money. Borrowing money is not a prerequisite of itself for successful business development. Since the results show that in the pre-market phase commercial capital has a positive total effect on profit growth and technological capital a positive effect on revenue growth there is support for hypotheses 1 and 2. At best there is little support for hypothesis 3 since financial capital has a positive direct effect on profit growth but the total effect is not significant. In order to test whether there is an inverted U-relation between the different types of capital and the two types of alliances, the regression analysis is performed with the variables technological capital squared and commercial capital squared. Because the correlation between the squared value of commercial capital and commercial capital is 0,955 the variable commercial capital squared is discarded, as these two variables virtually measure the same. The results show no significant effect between technological capital squared and the number of R&D alliances or between commercial capital and the number of commercial alliances. As no significant inverted U-relationship was found between commercial capital and the number of commercial alliances or between technological capital and the number of R&D alliances, the results give no support for hypotheses 8 and 9.

That commercial capital is important already in the early stages of new business development is further underlined by the positive effect that commercial capital received from a parent organization has on profit growth (Beta= 0,251). The positive total effect of the help of a parent in the form of providing commercial capital has mainly a direct effect (Beta=0,276). This result is striking because, apparently, commercial help from a parent works complementary to the formation of commercial alliances and is not the substitute it was hypothesised to be. After all, there is no significant negative effect of commercial help from a parent on commercial alliance formation. Accordingly, hypothesis 15 must be rejected.

Contrary to commercial help, firms that receive technological capital from a parent organization show less profit growth. There is a large negative total effect (Beta= -0,71) of receiving technological capital from a parent organization on profit growth. Even though the total effect is quite substantial the direct effect is even more negative (Beta= -0,804). Therefore hypothesis 14 is rejected. Because technological help from a parent helps with the formation of commercial alliances (Beta= 0,361), just like having technological capital in-house does, the total effect is not as large as the direct effect. The picture that arises from the results regarding technological capital in the pre-market phase is that it's effect on new business development is mainly through its positive effect on commercial alliance formation, an effect Ahuja (2000) described as well. While the positive direct effect that was expected of having more technological capital in-house in the pre-market phase is not visible in the results, firms that depend on technological support of parent organization perform very bad. This indicates

that it is important to have the needed technological capital in-house in order not to become depended on the help of a parent organization.

Other variables that shows quite severe negative effects are those linked to the characteristics of the management team. Both the size (Beta= -0,389) and the diversity (Beta= -0,667) of the management team have a negative total effect on revenue growth. When we look at the direct and indirect effects of size and diversity of the team a few things stand out. First the direct effects of both are negative and significant regarding revenue growth. Second, both also show significant indirect effects. Firms with more diverse teams are more engaged in both commercial - and R&D alliances. On the other hand, the size of the team has a negative effect on the amount of commercial alliances. So, even though more diverse teams have a positive effect on the formation of alliances, this positive effect is counteracted by larger negative effects. Larger and more diverse teams apparently find it hard to agree and get the faces in the same directions, with inefficiencies and struggles as a result. In the pre-market phase firms are better off with a small uniform management team that is better able than large and more diverse teams to make their decisions fast and with a clear goal which is supported by the whole team (Clarysse & Moray, 2004). Accordingly, hypothesis 4, 5 and 11 must be rejected and 12 accepted.

The results for the control variables show that the size of the firm has no effect on any of the dependent variables. The age of a firm that is in the pre-market phase however is negatively related to revenue and profit growth but positively with the amount of commercial alliances. A possible explanations for this is that since in the pre-market phase the age of the firm is equal to the time it has spent developing a new product while not yet having completed it yet, older firms experience more problems with developing their idea into a commercial product. When a firm experiences problems with its own technology, it seems unlikely it could be successful in developing services based on this technology or license the technology in the pre-market phase.

4.2 Market phase

Firms that are in the market phase currently have one or more products on the market. They have passed the phase of researching and developing a new product and now need to capitalize on the efforts made in the pre-market phase. The regression and path analysis for the market phases show that the theoretical model explains 32,4% of the growth of revenues but only 12,2% of the profit growth (Table 3). Furthermore, the model of profit growth specified fits poorly to the data on the variables included ($F= 1,402$; $p>0,10$). All the results for the market phase are presented in table 4.

Table 3: Coefficients for determination

<u>R-squared</u>	Intermediate variables	Independent variables	Total variables	F-Value
<i>Revenues (market phase)</i>	0,113	0,211	0,324	4,836*
<i>Profit (market phase)</i>	0,009	0,113	0,122	1,402

*: F-value significant for $p<0,01$

Table 4: Regression results market phase

<u>Market phase</u>	Direct effect				Indirect effect		Total effect	
	<i>Revenue</i>	<i>Profit</i>	<i>R&D all.</i>	<i>Com. all.</i>	<i>Revenue</i>	<i>Profit</i>	<i>Revenue</i>	<i>Profit</i>
<i>Com. all.</i>	<u>-0,421</u>	0,002	x	x	x	x	<u>-0,421</u>	0,002
<i>R&D all.</i>	<u>0,371</u>	-0,11	x	x	x	x	<u>0,371</u>	-0,11
<i>Com. cap.</i>	<u>1,428</u>	0,322	<u>-0,78</u>	<u>1,168</u>	<u>-0,781</u>	0,088	<u>0,647</u>	<u>0,41</u>
<i>Com. cap. parent</i>	-0,027	0,043	<u>0,367</u>	<u>-0,302</u>	<u>0,263</u>	-0,041	<u>0,236</u>	0,002
<i>Financial cap.</i>	0,006	-0,028	-0,152	<u>-0,67</u>	<u>0,226</u>	0,015	<u>0,232</u>	-0,013
<i>Financial cap. squared</i>	x	x	0,023	<u>0,4</u>	-0,16	-0,002	x	x
<i>MT diversity</i>	<u>-1,272</u>	<u>-0,542</u>	<u>0,831</u>	<u>-0,771</u>	<u>0,632</u>	-0,093	<u>-0,639</u>	<u>-0,635</u>
<i>MT size</i>	<u>0,427</u>	<u>0,201</u>	-0,062	<u>0,23</u>	<u>-0,12</u>	0,007	<u>0,307</u>	<u>0,208</u>
<i>Tech. cap.</i>	<u>0,984</u>	0,162	0,067	0,409	-0,147	-0,007	<u>0,836</u>	0,156
<i>Tech. cap. squared</i>	x	x	0,06	0,255	-0,085	-0,006	x	x
<i>Tech. cap. parent</i>	0,093	0,027	-0,091	<u>0,278</u>	<u>-0,151</u>	0,011	-0,058	0,038
<i>Firm age</i>	<u>-0,25</u>	-0,023	<u>0,376</u>	0,081	<u>0,105</u>	-0,041	-0,145	-0,064
<i>Firm size</i>	<u>-0,851</u>	-0,162	-0,156	<u>-0,572</u>	0,183	0,016	<u>-0,668</u>	-0,146

The results show that there is no relation between the number of commercial - or R&D alliances a firm is engaged in and their profit growth in the market phase. However, the number of commercial alliances does have a negative effect on revenue growth (Beta= -0,421), while R&D alliances have a positive effect on the growth of revenues (Beta= 0,371). It was expected (H6 and H7) that alliances have a positive influence on new business development in the market phase. For commercial alliances the opposite is the case and thus the results provide only for hypothesis 6 some support since R&D alliances have a positive effect on revenue growth.

When we look at the capital position of a firm and how it influences its business development in the market phase, a few things stand out. As was expected (H2), the amount of commercial capital is especially important in the market phase. Commercial capital has a significant positive effect on revenue growth (Beta= 0,647) and a significant positive effect on profit growth (Beta= 0,41). No other variable has such an important positive impact on new business development as the amount of commercial capital that is in-house, in the market phase. This is not to say that technological capital and financial capital are not important, however none of them have a significant positive effect on profit growth. Technological capital has a significant positive effect on revenue growth (Beta= 0,836) but not on profit growth and financial capital also boosts only revenues albeit the effect is the smallest of the three (Beta= 0,223). Interesting to note is that financial capital has no direct effect on either revenue or profit growth and its effect is thus indirect, through its negative effect on having commercial alliances (Beta= -0,67). The amount of commercial capital has strong effects on alliance formation. Commercial capital has a strong negative effect on R&D alliance formation (Beta= -0,78) and a strong positive effect on commercial alliance forming (Beta= 1,168), both having a negative indirect effect on revenue growth as a consequence. The results thus give support to hypothesis 1, 2 and 3 as all three types of capital help new business development in the market phase. Similar to the pre-market phase, no inverted U-relationship was found between commercial capital and commercial alliances and technological capital and R&D alliances. Accordingly, hypothesis 8 and 9 must be rejected.

Some firms do not only depend on the capital they have in-house or that they are able to acquire through alliance formation, but have the luxury, or some would argue curse, to have a parent firm that supplies them with capital. The effect of receiving help from a parent organization in the market phase is not very large. There are however still some significant effects. In contrast to what was expected, there is a positive total effect of receiving commercial capital from a parent organization on new business development, since it is a stimulus of revenue growth (Beta= 0,236). This total effect is however mostly indirect in nature, since this type of help significantly affects the number of both commercial and R&D alliances a firm is engaged in, in the market phase. Commercial capital help from a parent organization has a negative effect on the number of commercial alliances (Beta= -0,302), as was expected (H16), and a positive effect on the number of R&D alliances (Beta= 0,367). So, there seems to be a trade-off between the commercial resources a firm acquires from a parent organization and the technological capital of an alliance partner. However, since parental commercial capital support boosts commercial alliance formation and revenue growth no support is found for hypothesis 15 and 16. No significant total effects have been found of parental technological capital support on either R&D alliance formation, revenue growth or profit growth. Accordingly, hypotheses 14 and 17 are rejected.

Just like in the pre-market phase, also in the market phase is the influence of the size and diversity of the management team large. Especially the total effect of the diversity of the management team is striking. The results show that more diverse teams show less revenue growth (Beta= - 0,639) and less profit growth (Beta= -0,635). Contrary, firms with larger teams perform better, since the size of the management team has a positive effect on both revenue growth (Beta= 0,307) and profit growth (Beta= 0,208). Based on these results, hypothesis 4 is accepted and 5 rejected.

The results show that the development phase a firm is in matters, when discussing a firm's needs during new business development. However, not all hypotheses that make the theoretical model of this study are supported by the results of the regression analyses and path analyses that have been performed based on the data derived from the yearly questionnaire of BioPartner program. Hypotheses 1, 2, 3, 6, 12 and 16 have been confirmed and hypotheses 4, 5, 7, 8, 9, 10, 11, 13, 14, 15 and 17 have not been confirmed, or only partially so.

4.3 Comparison pre-market phase and market phase

When looking at the results for the pre-market phase and the market phase it is clear that there are substantial differences, which on itself is an interesting finding. The variables of the theoretical model better explain a firm's profit growth and revenue growth in the pre-market phase than in the market phase, as indicated by the higher coefficients for determination. As the theoretical model is derived from literature that is mainly focussed on new venture business development, i.e. on firms that are in the phase of developing products based on their unique resources and not on firms that are already in the phase of the commercialization and diversification of a product, it is not a total surprise that the R-squared value is higher in the pre-market phase than in the market phase, as this is a sign that the independent variables explain the outcome of the model better in the pre-market phase than in the market phase (Field, 2009). This does, however, not make it less interesting to look at the differences between pre-market and market phase. So, what that stands out when we compare the results of the two phases?

Since profits are a better indicator for success in the development of new business than revenue's (Davidsson et al, 2009), based on the results, it is fair to say that the most important factor that helps firms with the development of their business, in the pre-market phase, is their ability to get access to commercial capital, whether this is through alliance formation, via a parent organization or in the most optimal situation both. While commercial alliances do help firms, when their product is not yet ready, to capitalize on their technological capital, either by selling services or licensing, it is important for firms, when they reach the market phase, to not be dependent on commercial alliance partners anymore. So, where collaborations with other firms, especially links focussed on commercial activities, positively influence business development in the pre-market phase, in the market phase the firms do well by having internalized this capital when their product is ready and put on the market,

since commercial alliances have a negative effect on revenue growth in the market phase and the positive effect that was in place in the pre-market phase has gone.

While in the pre-market phase the capital position of a firm plays a minor role, in the market phase it is a strong capital position that seems most crucial for a firm's success. All three types of firm capital show larger positive effects in the market phase on revenue growth, with commercial capital also having a positive effect on profit growth in the market phase, an effect that is not visible in the pre-market phase.

The effects of the help provided by a parent organization are different in both phases. While in the pre-market phase receiving technological capital from a parent has a dreadful effect on profit growth, this effect is gone in the market phase. Overall, technological help from a parent organization is in neither phase a help but it is especially a bad sign in the pre-market phase. The opposite is true for support in the form of commercial capital. In both phases commercial help from a parent organization helps with business development but where it boosts profits in the pre-market phase, it boosts revenues in the market phase. A more striking difference with regard to this commercial help between both phases is its influence on alliance formation. In the pre-market phase, parental commercial capital support has no influence, but in the market phase firms that receive parental commercial help form more R&D alliances but less commercial alliances. It might be interesting to point out that in the market phase commercial support from a parent organisation has a negative effect on commercial alliance formation and a positive effect on R&D alliances. In the market phase commercial capital that is in house has a positive effect on the number of commercial alliances engaged in but a negative effect on R&D alliances.

In both phases, the more diverse a firm's management team is, the worse it performs. In both phases a negative effect of diversity is visible on the revenue growth, and while there was no significant effect on the profit growth in the pre-market phase and there is a negative effect on the growth of a firm's profit in the market phase. While size of the management team also has a negative effect on revenue growth in the pre-market phase, larger teams perform better in the market phase, since size is positively correlated with both profit - and revenue growth in the last phase.

5. Discussion

5.1 Theoretical implications

In theory, in order to develop a novel idea into a successful product, firms need complementary resources (Teece et al., 1997). These resources are not always in-house, especially not for new high-tech ventures. Possible ways to attain the needed complementary resources are alliance formation (Ahuja, 2000), getting help from a parent organization or buying the resources on the market. Since

financial resources are often a problem for new firms (Christensen & Raynor, 2003) and complementary resources are not always easily bought or too expensive (Williamson, 1981), alliance forming is a good way to keep costs low while tapping into the supply of resources that are needed (Kale et al., 2000). However, due to the possible liability of unconnectedness (Powell et al., 1996) and newness (Stinchcomb, 1965) it can be challenging for new firms to find suitable partners that are willing to collaborate. There are factors that could help firms to be more attractive to potential partners and that enlarge the network in which they can find these partners like a capital position of the firm in that network and the characteristics of the management team. Firms that receive support from a parent organization might feel less inclined to enter into alliances.

In practice, this study shows indeed that for firms that start with new business development alliance formation helps. A surprise is that it are especially commercial alliances that seem beneficial as this variable shows the largest positive effect on profit growth in the pre-market phase. As it is for new firms of utmost importance to show that they can hold up their own pants, they must be able to make profit already in an early stage. Apparently this is possible, since the results show that there are firms that are capable of using commercial know-how from their parent organization and alliance partners to reap benefits from their unique assets. The results show furthermore that the capital position becomes more and more important over time. This is somewhat in contrast to what we would expect based upon the Resource Based View. Apparently, it is not so much the amount of capital, whether it is commercial, technological or financial capital, but it are the commercial linkages that are the most important in the first phases of development. Commercial capital and technological capital boost revenues but not so much profit, a combination of both a strong capital position and strong commercial linkages seems to be the ideal mix in the pre-market phase. One of the more interesting findings of this study is that, contrary to what we would expect, commercial alliances have a negative impact on business development in the market phase, while R&D alliances have the same positive effect in both phases. So, while the firms that are able to use the commercial capital of others, perform better than their peers, they will lose ground in the market phase if they are not able to internalize this knowledge, and as a consequence still need to depend on commercial partners. R&D alliances and technological capital boosts revenues and its importance for a firm's success is at least as important in the market phase as in the pre-market phase. Apparently, technological capital is needed in the pre-market phase to develop the product but in the market phase it helps to diversify the product and boost revenues. Technological capital support from a parent is, however, never a good thing. Firms receiving parental technological capital support show less profit in the pre-market phase and no total effects are in place in the market phase. The problems that were associated with receiving commercial support from a parent organization, like myopic behaviour and the adaptation of old routines, do not seem to occur or at least not to the degree that it has a large negative impact. This study shows that firms benefit from commercial parental support in both phases, which works complementary to the

commercial capital that is in-house. On the other hand, the negative impact of receiving parental technological support has been underestimated. It seems that parental technological support reduces pressures and might lead to lazy behaviour. Another interesting finding regarding parental support is that it seems that technological and commercial support from a parent is used as a means of exchange in alliance formation. In both phases, commercial support boosts R&D alliance formation and technological capital support boosts commercial alliance formation.

The conflict between theory and the empirical findings of, among others, Powel et al. (2005) is one of the main triggers of this research. Reflecting, it is fair to say that the results of this study and the accompanying conclusions, give further support that the expected sequence of events, based on the resource based view and transaction cost theory, is not in line with what happens in practice. Firm's should not have to depend on a parent organization or R&D alliances for technological support, especially not in the early stages of development. Firm's do well to commercialize their unique assets as soon as possible and should try to benefit from the commercial capital provided by an alliance partner or a parent organization as much as they can early on. The results, after all, show that commercial alliances are beneficial in the pre-market phase and not in the market phase. This suggests, as Powel et al. (2005) noted as well, that firms that develop successfully transcend from commercial alliances in the pre-market phase to R&D alliances in the market phase. Commercial alliances and in-house and parental commercial capital play an important and positive role in the pre-market phase. In later stages of business development, when a firm has developed a finished product that can be put on the market, R&D alliances will help them to diversify and hereby boost revenues. The needed commercial capital should by then be internalized. The importance of commercial capital and not technological capital in the pre-market phase suggests that it is not so much the unique asset of a firm that gives them above normal rents in the first stages of development, but the ability of a firm to commercialize their assets making use of commercial capital of themselves, from a parent organization and/or alliance partners, since all of them work complementary in supporting new business development in this phase. Another finding of this study that is not in line with the theoretical framework is the negative influence of the diversity of the management team. While it is *en vogue* to proclaim that diversity of a firm's management is a good thing, the results of this study paint a very different picture. Management team diversity has a severe negative impact on new business development. Even though firms with more diverse management teams are better able to set up alliances, especially in the pre-market phase, this does not offset the negative influence that multiple different, clashing, perspectives seem to have. This leads us to the managerial implications.

5.2 Managerial implications

As noted, more diverse management teams are expected to be a plus, since they would offer different but complementary insights and capabilities. With each member having its network in a different field

and hereby giving the new firm a wide and diverse field of contacts, the liabilities of smallness and newness might be diminished. The results of this study show, however, a very different picture. More diverse teams perform worse. Yes, it is true that diversity boosts alliance formation, especially in the pre-market phase, but this positive influence stands in the shade of the negative direct effect it has on revenue and profit growth. Different views not only provide a larger and more diverse network, it also heightens the chance of disagreement and might paralyse the management team, which accordingly cannot act quickly and resolute as required in a dynamic environment. In the pre-market phase, small and homogeneous teams perform best whereas in the market phase homogeneity is still important but now larger teams, because more tasks must be fulfilled now, do better than small teams.

Management teams of new firms entering the life science sector should not be afraid to engage in alliances with a parent or non-parent organizations, that help them to commercialize their technological know-how. However, they should be aware that in the long run it is important to have the commercial capabilities internalized. R&D alliances help firms to boost their revenues but they will not help much in raising profits. It is more important to have technological capabilities in-house from the start. They need not be provided by a parent organization or by an alliance partner. So, technological capabilities, the unique asset that gives a firm an edge over others, is a prerequisite, but if the management team is not able to capitalize on this knowledge from the early start the chance of success is low.

5.3 Limitations

The data used in this study was extracted from the answers given by Dutch life science firms in the period of 2002-2005. The question can be raised whether this period is recent enough. Since 2005, the problems encountered by firms in the Dutch life science industry have not changed much and also the number of firms that competes in this industry is as similar now as it was in the period of 2002-2005 (van Eenennaam & Koomans, 2014). Therefore, it seems plausible that the findings of this study are still relevant.

Even though the response rate to the BioPartner monitor dropped over the period, from 72% in 2002 to 46% in 2005, the response rate to the questionnaire was, with an average of above 50%, quite high. Because the questionnaire was focussed on firms in the Dutch life science industry, the results cannot be generalised to other industries or to other countries, which limits the external validity of this study.

Because the questionnaire and the answers to it existed long before this study took place some recalculations are needed in order to measure some concepts in this study since the indicators for these concepts could not always be derived from the answers given. An example of this is the indicator used for the support received from a parent organization. More questions explicitly addressing the type and amount of help received would have been useful. Furthermore, the revenues and profits of a firm

where not given as exact numbers but indicated on successive categories which made it necessary to recalculate them from class means. A questionnaire made to measure the concepts and indicators of this study more directly would improve the construct validity of this study.

This study has tried to arrange the knowledge and conclusions of previous research in a proper chronological order. It has done so by splitting the process of new business development into two phases. The choice for two is justifiable because of the extensive research regarding the difference between product and process innovation in successive stages of product and business development and the different types of routines and assets firms need during these stages. The choice for two is, however, also made for practical purposes as the number of observations was limited and the data did not lend itself to identify more phases of business development, as some literature argues to exist (Tidd & Bessant, 2009). Given the fact that the theoretical model is mainly based on literature regarding start-up firms, the theoretical model could especially be improved for the market-phase. Further research is needed to get a better insight into what determinants are most important for new business development in later phases of business development and how they relate to the process of alliance formation.

6. Conclusion

This study has tried to shed some light on the role of alliances in successive stages of new business development and the determinants that influence the alliance formation process in these phases. The results of this study show that R&D alliances and commercial alliances both play their own role in new business development. For R&D alliances this role changes over time. In the pre-market phase it helps a firm in developing their product while in the market phase it helps diversifying their core product. The role of commercial alliances does also differ between both phases. In the pre-market phase it helps firms to capitalize on their technological know-how, since it helps them in making profit even though the main product is not yet ready for the market. In the market phase, commercial alliances have a negative influence on revenue growth whereas in-house commercial capabilities have a positive effect on both revenue and profit growth, implying that the commercial capabilities needed should be in-house when the product is ready for commercialization.

While alliances influence a firm's profit and revenue growth, the determinants that were identified in the theoretical framework as possible influential on the alliance formation process, show to have significant effects especially in the market-phase. In the pre-market phase the most important factor that influences the number of alliances a firm is engaged in is the diversity of the management team. Firms with more diverse teams are engaged in more R&D and commercial alliances. No other factor affects the number of R&D alliances in the pre-market phase. Other determinants of commercial alliance formation in the pre-market phase are the amounts of technological capital, available both in-house and provided by a parent organization. Furthermore, it is not per se that more people in the

management team means a larger network and thus more alliances, since size of the management team is negatively correlated with the number of commercial alliances in the pre-market phase.

In the market phase there are multiple determinants for the formation of alliances. Diversity of the management team is the most important factor that positively influences the number of R&D alliances, followed by the amount of in-house commercial capital which has a negative effect on R&D alliances. In-house commercial capital also plays an important positive role in commercial alliance formation in the market phase. Striking is that the diversity of the management team has a negative effect on the number of commercial alliances in the market phase. Also, a strong financial position makes that firms will form less commercial alliances, probably because it gives them the opportunity to internalize the commercial knowledge, which is a smart thing to do since commercial alliance formation negatively influences revenue growth in the market phase.

This study's results open multiple avenues for further research. First, the exact role commercial alliances play in the pre-market phase is not totally clear. Is it with the aim to help with the commercialization of services based on the internal available technological knowledge, or is it a more a tactical move in anticipation to what knowledge is needed in the market phase. The question to what extent there is knowledge transfer in commercial alliances in the pre-market phase thus deserves further attention in later research since this study shows that firms should try to have the essential commercial capabilities internalized when they are in the market phase. The theoretical framework of this study is better suited for the pre-market phase than the market phase. This is not a total surprise since most of the literature on which the theoretical framework is build, is based on research performed on firms in the early stages of development, further research on later phases of business development and what role alliances play in this development are thus desirable.

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Appendix

Correlation matrix of the pre-market phase (no product on market) is presented in figure 1.

Pre-market phase	RevRate	ProfRate	RD_All	Com_All	MTsize	MTdiv	TCapPar	CCapPar	FinCap	CommCap	TechCap	TechCapS	FirmAge	FirmSize
RevRate	1,000	0,131	0,329	0,186	-0,400	-0,139	-0,016	-0,157	-0,014	-0,071	-0,096	-0,039	-0,336	-0,146
ProfRate		1,000	0,066	0,207	-0,264	0,106	-0,388	-0,061	0,029	0,110	-0,049	0,000	-0,006	-0,016
RD_All			1,000	0,442	-0,121	0,068	0,120	0,013	-0,116	-0,059	-0,047	-0,052	-0,019	-0,144
Com_All				1,000	-0,178	0,277	0,148	0,005	0,023	0,120	0,081	0,055	-0,063	-0,008
MTsize					1,000	-0,128	0,185	0,247	0,009	-0,028	0,412	0,361	0,279	0,411
MTdiv						1,000	-0,018	-0,011	0,190	0,858	0,019	0,040	-0,134	0,002
TCapPar							1,000	0,303	0,064	-0,155	-0,143	-0,178	-0,404	-0,269
CCapPar								1,000	-0,156	0,114	0,018	-0,069	0,217	-0,052
FinCap									1,000	0,152	0,073	-0,016	0,007	0,100
CommCap										1,000	-0,022	-0,017	0,002	-0,030
TechCap											1,000	0,929	0,009	0,907
TechCapS												1,000	0,014	0,870
FirmAge													1,000	0,014
FirmSize														1,000

Figure 1: Correlation matrix pre-market phase

Correlation matrix of the market phase (no product on market) is presented in figure 2.

Market phase	RevRate	ProfRate	RD_All	Com_All	MTsize	MTdiv	TCapPar	CCapPar	FinCap	CommCap	TechCap	TechCapS	FirmAge	FirmSize
RevRate	1,000	-0,149	0,091	-0,132	0,173	-0,026	0,063	0,248	0,126	0,041	0,079	0,005	-0,176	0,062
ProfRate		1,000	-0,175	-0,050	0,121	-0,253	-0,003	0,019	0,019	-0,176	-0,016	-0,034	-0,036	0,004
RD_All			1,000	0,255	0,032	0,169	0,071	0,155	-0,215	0,014	0,165	0,107	0,122	0,145
Com_All				1,000	0,058	0,300	-0,005	-0,183	-0,183	0,410	-0,002	0,060	0,186	-0,013
MTsize					1,000	0,073	0,057	0,003	0,039	-0,050	0,360	0,202	0,110	0,481
MTdiv						1,000	0,114	0,111	0,017	0,883	0,049	0,049	0,002	0,043
TCapPar							1,000	0,522	-0,141	-0,060	-0,102	-0,109	-0,524	-0,154
CCapPar								1,000	-0,099	0,079	-0,052	-0,060	-0,552	-0,039
FinCap									1,000	0,107	-0,030	-0,041	0,028	-0,027
CommCap										1,000	-0,138	-0,080	0,089	-0,105
TechCap											1,000	0,910	0,191	0,947
TechCapS												1,000	0,073	0,849
FirmAge													1,000	0,254
FirmSize														1,000

Figure 2: Correlation matrix market phase