Structural Antecedents of the Seemingly Random Walks of Sales Growth, Profit Growth and Survival of New High-Tech Ventures

empirical evidence on Dutch dedicated life sciences firms

MSc-IS Thesis

of

Esmée Blijdorp – 3185222

Contact: E.L.Blijdorp@students.uu.nl

Supervisor: dr. Jan Faber

Second reader: dr. Giovanna Capponi

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Abstract

New High-Tech Ventures are needed to bring new knowledge and innovation to the market but struggle to survive. In their search for the best business strategy to stimulate firm survival they are set on a path to be either 'patient for growth but impatient for profit' or 'impatient for growth and patient for profit'. This research provides insights into the structural antecedents of these seemingly random walks of business growth, profit growth and survival. A comprehensive perspective is taken by relating resources (technological and financial), capabilities (commercial and managerial), firm age, firm size, type of parent organization, business models applied and changes therein to business growth, profit growth and subsequent survival. The results show one independent variable to affect all three behavioral outcomes of 100 new ventures in the Dutch life science industry (2002-2005), namely the amount of venture capital received per funding round. Furthermore, these antecedents affect the path for profit growth opposite to those that affect the path for revenue growth and seem to be related to the parent organizations involved. These insights are translated into managerial implications and business strategies for new High-Tech ventures.

Keywords: new ventures, profit, revenues, survival, resources, management, strategies

Contents

1. Introduction

1.1 New venture survival

New ventures in high-tech industries are better capable of bringing knowledge and technology based innovative concepts to the market than incumbent firms (Sternberg and Wenneker, 2005; van Praag and Versloot, 2007) and are therefore deemed important for the development of a knowledge based economy in order to sustain future economic growth and wealth (European Commission, 2019). However, only relative small numbers of new ventures in traditional as well as high-tech industries are able to survive over longer periods of time, i.e. only 35-37% after 6-8 years (Phillips and Kirchhoff, 1989; Delmar et al., 2013). Many new ventures have serious problems with growing their businesses profitably (Davidsson et al., 2009). Firms that achieve high levels of business growth accompanied by low levels of profitability are found to have significant worse prospects of growing their business profitably in the near future than firms that achieve low levels of business growth accompanied by high levels profitability. The former group of firms even has a significant chance of becoming poor on both dimensions with the prospect of non-survival in the near future. Davidson et al. (2009) conclude that new ventures should first focus on becoming profitable as a prerequisite for profitable business growth in the future. The rational of this conclusion is quite simple. A firm's profitability is much more important than its business growth in the assessment of its market-value (Cho and Pucik, 2005), which is a serious criterion in the decision taking of external investors whether or not to provide a firm with funds. So, new ventures first need to demonstrate the profitability of their business in order to be able to raise the funds needed for further business growth. New ventures that demonstrate business growth without profitability will face serious problems with raising the funds needed for further business growth in order to become profitable in the end via economies of scale. Therefore, new ventures should be 'patient for growth but impatient for profit' and not 'impatient for growth but patient for profit' (Christensen and Raynor, 2003).

The results of Davidsson et al. (2009) are obtained for groups of Australian and Swedish SMEs with above or below median business growth and profitability in the period 1995-1998 and 1997-2000, respectively. However, their presumed effects on future (non-)survival have not been tested. So far, only Delmar et al. (2013) have included these effects explicitly in their empirical analyses. Based on a sample of over 35,000 observations of individual knowledge-

intensive new ventures (Sweden, 1995-2002), they present estimated direct effects that seem to lend support to the results of Davidsson et al. (2009). However, the estimated direct and indirect effects of profits on business growth and firm survival and of business growth on profits and firm survival counteract each other thereby producing relatively small total effects and very small explained structural variances (R^2-within ≈ 0.05). Also the autocorrelations of business growth and profits are quite weak (<0.15). Furthermore, the statistical significance of these effects depends much more on the huge number of observations utilized than on the magnitudes of their estimates. Practically, one might interpret these results equally well as non-existing as suggested by Coad (2007), who found that the business growth rates of 8405 French manufacturing firms in the period 1996-2004 are virtually uncorrelated over time indicating a seemingly random walk over time.

In order to gain more insight into the seemingly uncorrelated sequences of business growth and profitability of firms over time, Coad (2013) investigated multiple business development strategies of individual firms over time other than the two discussed before. He found that individual firms may deploy various business development strategies in order to become (un)successful over time in terms of business growth and profitability and that all these different strategies of the firms included in the research together result in uncorrelated business growth and profitability rates over time for the entire group of firms studied. But if business growth, profit growth and survival are not structurally related to each other and do not support each other and many new ventures fail to develop their businesses successfully, the question arises if there are other structural firm features that foster each of these dimensions of firm success? Insight into these firm features has become highly relevant in order to reduce the current huge waste of resources, capabilities and time invested by the new ventures themselves and other stakeholders involved (i.e. parent organizations, venture capitalists, incubators, government, etc.), and to improve new venture business development.

In a rather recent study, Coad (2018) found that especially younger firms focus on profitability in order to grow their business in the future and especially older firms focus on business growth in order to become (more) profitable in the future, while together they still produce uncorrelated patterns of business growth and profitability at each moment of observation as well as over time. These results indicate that firms may also have structural features other than

only firm age that produce the seemingly random walks of business growth and profitability over time in different ways. Some partial empirical support for this view has recently been provided by Pajunen and Järvinen (2018), who derived that private business financing has a negative effect on the survival of individual Finnish dedicated biotechnology firms but a positive effect on their success (i.e. profitability), and that the number of patents available to these firms has a positive effect on their success but no effect on their survival.

1.2 Research question

These indicative outcomes are further investigated and elaborated on in this study. Based on a sample of 159 3-year-period observations of 100 new ventures in the Dutch life sciences industry during the period 2002-2005, we also find that business growth, profit growth and subsequent (non)survival are uncorrelated with one another and over time (see Appendix 1). In order to gain more insight into the determinants of these random walks, a comprehensive set of structural features of firms will be identified, which are deemed relevant for their business development. These structural features will be specified and allowed to expose dissimilar patterns, strengths and directions of influence capable of predicting the firms' seemingly random patterns of business growth, profit growth and (non)survival over time. Together the structural features of firms identified and their varying structural patterns, strengths and directions of influence constitute the structural antecedents of their seemingly random patterns of business growth, profit growth and (non)survival. Accordingly, the research question of this study has been formulated as follows.

What are the structural antecedents of the seemingly random patterns of business growth, profit growth and (non)survival of new ventures in the Dutch life sciences industry?

For a long time, relevant structural firm features for business development have been derived based on the resource based view (RBV) of the firm (e.g. Wernerfelt, 1984; Eisenhardt and Schoonhoven, 1990; Powell et al. 1996; Zahra, 1996; Baum et al. 2000; Ensley and Hmieleski, 2005; Geroski et al., 2010; Gimmon and Levie, 2010; Colombo and Piva, 2012). More recently, this approach has been criticized for paying too much attention to the resource endowment of new ventures (i.e. 'how much') and too little to the business development strategies deployed by them (i.e. 'how') necessary for bringing their innovative product to the market (e.g. Priem and Butler, 2001; Mishina et al., 2004; McKelvie and Wiklund, 2010). In this study, both views on

business development by new ventures will be combined in order to develop a more comprehensive perspective by relating assets (technological and financial), capabilities (commercial and managerial) and business models and changes therein to business growth, profit growth and survival.

1.3 Research outline

In Section 2, the theoretical framework of this study will be further elaborated by focusing on firm characteristics that are capable of explaining the heterogeneous outcomes of business growth, profit growth and survival by new ventures. Hypotheses on the relationships between these firm characteristics and the business growth, profit growth and survival of new ventures will be formulated. For the purpose of testing these hypotheses, the methods of data collection, measurement and data analysis are described in Section 3. The results are presented in Section 4 after which their theoretical and managerial implications and limitations are discussed in Section 5. The conclusions drawn from this study are presented in Section 6.

2. Theoretical Framework

2.1 Background

The rational of new venture development is provided by the resource-based view of the firm (RBV) (Wernerfelt, 1984; Mahoney and Pandian, 1992). In the RBV, resources are heterogeneously distributed over firms resulting in firm-specific bundles of unique resources, which are rare and difficult to imitate and trade. These unique resources enable a firm to gain a competitive advantage when they are timely commercialized and allow the firm to earn above-normal rents (Teece, 1986). For new high-tech ventures, key unique resources are their technological assets and the capabilities of their founding management teams to turn those assets into marketable products and commercialize them successfully. However, they often lack the necessary complementary resources to perform the leveraging process adequately (Dierckx and Cool, 1989; Yli-Renko et al., 2001). In order to gain access to complementary resources, i.e. finance, technological assets, commercial and managerial capabilities, they have to establish relationships with other organizations that do possess those resources. However, since new high-tech ventures are new to the technological fields and product markets in which they try to operate, they suffer from the liabilities of newness (Stinchcombe, 1965) and unconnectedness (Powell et al., 1996). Both liabilities form serious barriers for new ventures to establish

relationships with other organizations possessing the complementary resources needed. Consequently, for gaining access to complementary resources, new ventures are very dependent on the quality of the founding management team and their personal networks (Eisenhardt and Schoonhoven, 1990; Kakati, 2003; Ensley and Hmieleski, 2006; Gimmon and Levie, 2010; Stam et al., 2014). Accordingly, new ventures originating from established firms or universities often rely on their corporate or academic parent organizations for access to complementary resources, which are obtained directly from the parent itself or indirectly via the parent's networks (Zahra, 1996; Ensley and Hmieleski, 2005). Independently founded new ventures, partly due to the denial of support by their corporate or academic parent, often turn to venture capitalists for financial support of their activities, who also help them in a non-financial way by means of strategic management advice and the utilization of their networks (Sapienza, 1992; Colombo and Grilli, 2011). In return for their support, academic and corporate parent organizations and venture capitalists (or other supportive organizations) will demand an equity stake and some degree of influence over the utilization of the provided resources via mandatory management advice or management control, possibly by membership of the management team of the new venture (Fried et al., 1998; Christensen and Raynor, 2003; Clarysse et al., 2007).

2.2 Concepts and relationships

Previous research has shown that supportive organizations should provide new ventures with only small chunks of financial capital (Christensen and Raynor, 2003) and other complementary resources (Zahra, 1996) in order to keep them focused on small-scale profitable product development as soon as possible. Management support should be limited to giving new ventures advice on how to allocate the complementary resources efficiently and effectively without heavily restricting the flexibility of new ventures' founding management teams in searching and finding profitable business models and consumer markets (Huang, 2008; van der Valk et al., 2009).

If external management support becomes too much and too coercive, this may put a new venture's development at risk. Management decisions could be enforced that are not necessarily in the best interest of the new venture, such as boosting business growth before an adequate alignment of the innovative product to latent unsatisfied user needs has been achieved. Accordingly, huge quantities of the innovative product are launched on the market that do neither address the most attractive potential customers nor their highest valued unsatisfied user

needs. Subsequently, the sales of the innovative product will lag behind expectations and cannot compensate for the investments made in boosting business growth. This results in loss-making operations of the new venture and the end of its viability (Christensen and Raynor, 2003). So, if the founding management team of a new venture is deprived of the flexibility to search, find and change a profitable business model and consumer market(s) and receives large chunks of financial capital, then the new venture is prone to boosting business growth at the cost of profit generation and subsequently its survival in the industry. Stated more formally,

H1a: Managerial flexibility left to the founding management team has a negative effect on new venture business growth.

H1b: Managerial flexibility left to the founding management team has a positive effect on new venture profit growth.

H1c: Managerial flexibility left to the founding management team has a positive effect on subsequent new venture survival.

H2a: Complementary financial capital received (per funding round) has a positive effect on new venture business growth.

H2b: Complementary financial capital received (per funding round) has a negative effect on new venture profit growth.

H2c: Complementary financial capital received (per funding round) has a negative effect on subsequent new venture survival.

Besides these effects of external management support and financial aid, also the provision of complementary technological assets to new ventures may endanger their performance. If a new venture is provided with access to complementary technological resources (knowledge and/or R&D facilities), it becomes tempting for the new venture to utilize these complementary resources for further improvement of the technological features of its innovative concept (Zahra, 1996). This temptation occurs because the technological knowledge and experience available within the new venture's founding management team regarding its own technological asset(s) have already been proven whereas the available knowledge and experience regarding how to develop its technological asset(s) into a profitable business are not proven yet. It is easier and presumably less risky, financially and otherwise, for a new venture's founding management team to focus on further improvement of the technological features of the innovative concept than to concentrate on continuation of the more hazardous track of searching and finding a profitable

market for the innovative concept with higher chances of non-survival on the short term. Accordingly, three hypotheses can be formulated.

H3a: Complementary technological resources have a negative effect on new venture business growth.

H3b: Complementary technological resources have a negative effect on new venture profit growth.

H3c: Complementary technological resources have a positive effect on subsequent new venture survival.

Furthermore, if a new venture is provided with access to complementary commercial resources (distribution channels and marketing capabilities), it becomes tempting for the new venture to leave the difficult job of identifying and articulating latent unsatisfied user needs partly to the supportive organization. However, the commercial resources granted access to by a supportive organization are aligned with its own existing product portfolio and not with the new venture's innovative product that still has to be brought to market. This may result in that neither the most attractive potential customers are addressed nor the most valuable latent unsatisfied user needs are identified, which both jeopardize the new venture's prospects of profitable business development and subsequent survival (Christensen and Raynor, 2003). Accordingly, another three hypotheses are formulated.

H4a: Complementary commercial resources have a negative effect on new venture business growth.

H4b: Complementary commercial resources have a negative effect on new venture profit growth.

H4c: Complementary commercial resources have a negative effect on subsequent new venture survival.

The hypotheses stated above reflect the notion that new ventures should receive only limited amounts of complementary resources and management support in order to stimulate them to develop their own business in a profitable way and thereby safeguarding their prospects of survival. These outcomes do, however, also depend on the quality of the founding management team. A better founding management team will better perform the leveraging process of bringing the new venture's unique technological assets to the market. Ceteris paribus, this will result in

more revenues and profits. Two dimensions of the quality of the founding management team are distinguished in this study, namely the diversity of its composition and the experience of the team's champion (Burgelman, 1983; Brown and Eisenhardt, 1995).

Diversity of the founding management team refers to the presence of expertise in various functional areas relevant for new venture business development like science/engineering, manufacturing, marketing, finance and business development (Eisenhardt and Schoonhoven, 1990; Brown and Eisenhardt, 1995; Kakati, 2003; Ensley and Hmieleski, 2005). More diversified teams have a larger amount and variety of information, knowledge and experience available for the development of new business models, which enable them to identify and fix problems before they occur. This contributes to a more efficient and faster business development process (Tidd et al., 2009) and either more sales and larger revenues or more profits (Eisenhardt and Schoonhoven, 1990; Kakati, 2003; Ensley and Hmieleski, 2005) and better chances of subsequent survival. Accordingly, the following hypotheses have been formulated.

H5a: Diversity of the founding management team has a positive effect on new venture business growth.

H5b: Diversity of the founding management team has a positive effect on new venture profit growth.

H5c: Diversity of the founding management team has a positive effect on subsequent new venture survival.

The champion of a new venture is the entrepreneur and CEO of the venture as he/she has oversight over the entire process of business development (Brown and Eisenhardt, 1995). A good champion has technological knowledge, entrepreneurial experience (preferably in the industry of the venture) and a strong personal network (Clarysse and Moray, 2004). Especially because of the last two characteristics and the small size of a new venture, the impact of the champion on business development is generally large (Burgelman, 1983). A champion not only stimulates communication among the members of the founding management team in order to induce shared leadership but also acts as an ambassador "lobbying for support and resources as well as buffering the team from outside pressures and engaging in impression management" (Brown and Eisenhardt, 1995: 356). A high quality champion has extensive entrepreneurial experience in the

industry to which the new venture belongs and knows that it is important to focus on being 'patient for growth but impatient for profit', i.e. small scale profitable business development first. The hypotheses are formulated accordingly.

H6a: A high quality champion in the founding management team has a negative effect on new venture business growth.

H6b: A high quality champion in the founding management team has a positive effect on new venture profit growth.

H6c: A high quality champion in the founding management team has a positive effect on subsequent new venture survival.

2.3 Control variables

Other characteristics of new ventures that need to be taken into account are firm age, firm size, type of parent organization and the business model(s) applied. Firm age as an indicator of accumulated general experience with business development has been assessed to have weak positive effects on some indicators of new venture performance (Zahra, 1996; Ensley and Hmieleski, 2005; Ensley and Hmieleski, 2006). In these studies, firm size as an indicator of accumulated resources and past success also has been assessed to have only weak positive effects on some indicators of new venture performance. Furthermore, ventures with a corporate or academic parent organization have been found to perform worse than independent ventures (Zahra, 1996; Ensley and Hmieleski, 2005). Finally, the effects of the number of business models applied by a new venture on its performance indicators must be controlled for. In this study, the degree of managerial flexibility is measured by the changes made in the business model(s) applied. The effects of these changes on the performance indicators of new ventures should be controlled for the effects of the number of business models already applied. A new venture applying more than one business model has more opportunities for changing business models than a new venture applying just one business model.

In order to estimate and test the hypothesized effects of managerial flexibility (inversely related to external management support), complementary resources and quality of the management team and the specified effects of relevant control variables on the business growth, profit growth and the subsequent survival of new high-tech ventures, the methods of data collection, measurement and data analysis will be described in the next section.

3. Research Methods

3.1 Data collection

In order to estimate and test the hypothesized effects on new high-tech venture development for their validity, data has been collected on Dutch dedicated life sciences firms participating in the BioPartner program. This program was implemented by the Dutch government in 2000 in order to stimulate new venture formation and development in the Dutch life sciences industry, which was lagging behind developments taking place in Denmark, Germany and the UK during the 1990's (Van Geenhuizen, 2008). For reasons of monitoring the development of the Dutch life sciences industry, a registration was set up of all dedicated life sciences firms in the Netherlands in 2000, which was updated on a regular basis. Furthermore, measures were taken to stimulate new venture formation and development during the period 2000-2005. These measures comprised the provision of seed capital and management advice regarding patenting, business development and entrepreneurship (BioPartner, 2004). Since 2002, an annual survey was sent to the registered Dutch dedicated life sciences firms until 2005. The participants in the BioPartner program were obliged to respond to the survey.

At the end of the BioPartner program in 2005 there were 229 registered, mostly entrepreneurial dedicated life sciences firms in the Netherlands (HollandBIO, 2018). The data on the dependent concepts profit growth and business growth are calculated from the data on the profits and revenues realized by individual ventures in two successive years and its (non)survival is assessed for the third successive year. This implies that only Dutch dedicated life sciences firms are investigated that survived at least two years in the period 2002-2005. From the annual BioPartner surveys 159 observations of three successive venture years for 100 new ventures could be derived. These 159 observations are used for estimating and testing the various effects on new high-tech venture development specified in the previous section on their validity.

3.2 Measurement

The dependent concepts business growth and profit growth will be operationalized and measured for each new venture as the annual growth rates of its revenues and profits. These growth rates are calculated from each new venture's revenues (R) and profits (P) (in 1000 euro's) realized during two successive years *t* and *t+1* as [R(*t+1*)-R(*t*)]/R(*t*) and [P(*t+1*)-

P(*t*)]/P(*t*), respectively, and its subsequent (non)survival is assessed for the third successive year *t+2*, with *t=2002* or *2003*.

The independent concepts of managerial flexibility and complementary financial capital, technological resources and commercial resources will be operationalized and measured as follows. Managerial flexibility will be operationalized as the number of changes in the business model(s) applied by each new venture in year *t* and *t+1*. Three business models and combinations thereof have been distinguished in the annual BioPartner surveys, namely being a service company, tool/platform company or product company. Accordingly, each Dutch dedicated life sciences firm made 0, 1 or 2 annual changes in the business model(s) applied. Complementary financial capital will be operationalized and measured for each new venture as the average amount of external financial capital received (in 1000 euro's) per funding round in year *t*. Firms experiencing difficulties with attracting sufficient financial capital often engage in multiple funding rounds per year. This operationalization will be applied in order to measure the relative size of the chunks of financial capital received by each new venture during year *t*. Complementary technological resources will be operationalized and measured for each new venture as the number of patents that the venture has access to in year t minus the accumulated number of patents granted to the new venture or its founders in year *t*. The first number of patents was asked for in the annual BioPartner surveys and the second number has been obtained from the EPO PATSTAT database (EPO, 2016). Complementary commercial resources will be operationalized and measured for each new venture as the access given to either the distribution channels or the customer base of an external organization or both. The complementary commercial resources of a new venture will be measured on a discrete scale with scores 0, 1 or 2.

The managerial capability dimensions of management team diversity and the presence of a champion in the management team will be operationalized and measured for each new venture in year *t* as follows. Management team diversity will be operationalized and measured as the number of distinct areas of expertise represented in the management team in year *t*. The areas of expertise distinguished in the BioPartner surveys were: finance, human resources, alliances, business development, IPR, R&D, clinical development, production/operations, distribution/logistics, marketing & sales and customer services. Accordingly, management team diversity will be measured for each new venture on a discrete scale with scores from 1 to 11. The presence and quality of a champion in the founding management team in year *t* will be measured

as the CEO's experience: no entrepreneurial and industrial R&D experience (0), industrial R&D experience (1), entrepreneurial experience (2) or both entrepreneurial and industrial R&D experience (3). The strength of the personal network of the champion cannot be taken into account due to the lack of data on the personal network of the CEO in the annual BioPartner surveys.

The control variables firm age, firm size, type of venture and business model(s) applied in every year *t* will be 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. The type of venture is indicated by two dummy variables for being either a corporate or an independent venture; an academic venture scores zeroes on both dummies. Business model(s) applied by each venture (i.e. service, tool/platform and/or product) is measured as the total number of different business models applied, ranging from 1 to 3.

3.3 Data analysis

In order to estimate and test the effects of the independent and control variables, which are measured on ratio, discrete, ordinal and dichotomous scales, on the dependent variables business growth and profit growth measured on interval scales and on the (non)survival measured on a dichotomous scale, the correlations between all of them are estimated. As discrete, ordinal and dichotomous variables are measured on consecutive categories, the correlations of pairs of these variables are estimated as polychoric correlations (Olsson, 1979). The correlations of pairs of a categorical variable and an interval or ratio variable have been estimated as polyserial correlations (Olsson et al., 1982). The correlations of interval and ratio variables are estimated as (standard) Pearson correlations (Wonnacott and Wonnacott, 1990).

All estimated polychoric, polyserial and Pearson correlations are placed in one correlation matrix for all three dependent variables defined in this study, i.e. revenues growth, profit growth and survival. As all three dependent variables are statistically independent of each other instantly and over time (*largest r = -0.200; p>0.10* in Appendix 1), the specified effects of the independent and control variables on each dependent variable will be estimated and tested as standardized regression coefficients for each linear equation individually by means of multiple

regression analysis based on the correlation matrix containing the estimated polychoric, polyserial and Pearson correlations described before (see Appendix 2).

4. Results

4.1 Regression Analyses

The results of the data analysis described in section 3.3 are presented in Table 1 and will be addressed in further details in sections 4.2-4.5.

Table 1. Estimated standardized regression coefficients (N=159)[1]

``	Firm Survival	Profit Growth	Revenues Growth
Control Variables			
Firm Age	0.091	0.221*	-0.483$^{\#\#}$
Firm Size	0.171	-0.167	0.377$^{\#\#}$
Independent Venture	-0.105	0.557$^{\#}$	-0.585$^{\#}$
Corporate Venture	-0.291	0.222	-0.252
Business Models	-0.219	-0.568*	0.667$^{\#}$
Independent Variables			
Flexibility	0.252	0.611$^{\#}$	-0.525**
VC per Fund-Round	-0.489$^{\#}$	-0.558$^{\#}$	0.911$^{\#\#}$
Compl. IP –res.	-0.005	-0.014	-0.084
Compl. Commercial cap.	0.110	0.262**	-0.290**
MT-Diversity	-0.160*	-0.204**	0.053
MT-Champion	-0.083	0.050	-0.030
R^2	0.225	0.398	0.619
F-Value	4.036$^{\#}$	8.835$^{\#\#}$	21.712$^{\#\#}$

Legend: *: p<0.10; **: p<0.05; #: p<0.010; ##: p<0.001

[1] *None of the estimated regression coefficients for only the set of control variables represented a significant effect on any of the three dependent variables specified. Every R^2 <0.065.*

4.2 Firm Survival

The results presented in the left column of Table 1 show that only small chunks of venture capital per founding round and a low degree of management team diversity (f.e. only an entrepreneur supported by a CSO/CTO) have positive effects on the survival of new ventures in the Dutch life sciences industry after two years (t+2; t=2002 or 2003). All other specified effects are found to be insignificant ($p>0.10$). So, lean financial support and a lean management team turn out to be prerequisites for the survival of new ventures in the Dutch life sciences industry after two years. Accordingly, only hypothesis H2c can be accepted and hypotheses H1c, H3c-H6c must be rejected, although for H5c a significant opposite (negative) effect of management diversity is estimated.

4.3 Profit Growth

In order to grow their profits in the intermediate period (t+1), new ventures in the Dutch life sciences industry have relied also on small chunks of venture capital per funding round and a low degree of management team diversity, i.e. on lean financial support and a lean management team. Additionally, previous experience with survival (= firm age), being an independent venture (instead of an academic or corporate venture), focus on one business model (instead of more), being flexible in changing focus to another business model (= managerial flexibility) and having access to complementary external commercialization capabilities also supported new ventures in the Dutch life sciences to grow their profits before subsequent (non)survival (t+2). Accordingly, hypotheses H1b and H2b can be accepted and hypotheses H3b-H6b must be rejected. But for hypotheses H4b and H5b a significant positive and negative estimate are obtained instead of a significant negative and positive estimate as postulated.

4.4 Revenues Growth

The firm antecedents stimulating new ventures in the Dutch life sciences industry to grow their revenues in the year t+1 are quite opposite to those stimulating these new ventures to grow their profits in the year t+1. The new ventures that grow their revenues are young academic ventures, which already grew considerably in terms of employment in the past (= firm size). Furthermore, these new ventures focus on more than one business model and refrain from changing between business models. Additionally, they also refrain from using complementary external commercialization capabilities and are able to attract considerable amounts of finances

per funding round. Accordingly, hypotheses H1a, H2a and H4a can be accepted and hypotheses H3a, H5a and H6a must be rejected.

4.5 Summary

The results presented in the previous sections are summarized in Figure 1, wherein the red lines indicate significant negative effects and the green lines indicate significant positive effects ($p<0.10$).

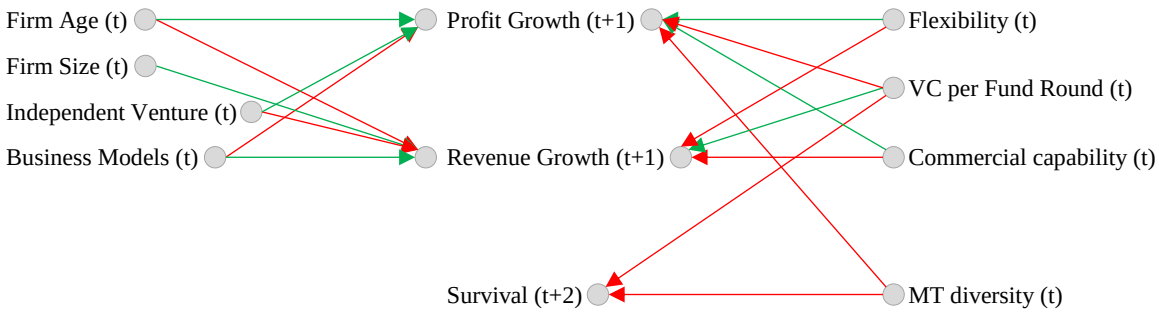

Figure 1: Visual overview of the results obtained

5. Discussion

5.1 Theoretical implications

As can be seen in Figure 1, there is only one independent variable that significantly affects all three behavioral outcomes of new ventures in the Dutch life sciences industry, although with different influences. This is the amount of external capital per funding round acquired before. Acquired small chunks of venture capital stimulate new ventures' profit growth and subsequent survival. New ventures having obtained large chunks of external capital engage in revenues growth. So, financially lean new ventures are focusing on profit growth and survival whereas new ventures with more financial flesh on their bones are focusing on revenues growth, which diminishes their prospects of survival. These results are not surprising and in accordance with the insights presented by Christensen and Raynor (2003) and Blank (2013).

These estimated effects must, however, be placed against their contextual and historical backgrounds. The financially lean ventures are mostly independent ventures supported by venture capitalists and their networks whereas the financially richer ventures are mostly academic ventures supported by university incubators and their networks. Corporate ventures tend to follow independent ventures but not significantly (Blank, 2013). Furthermore, young new ventures that have grown fast in the past (in terms of employment), as indicated by their firm age and firm size effects, continue their growth path leading to further revenues growth (Coad, 2018). Lean new ventures will be more successful with their profit growth if they have become more experienced with profit growth and survival in the past, as indicated by the positive effect of their firm age on profit growth. These results imply that the new ventures in the Dutch life sciences studied are seemingly path dependent in their business development and growth strategies applied, which might be related to the nature of the parent organization supporting them since birth.

In accordance with the results obtained by Zahra (1996) and Ensley and Hmieleski (2005), independent ventures are found to be better in profit growth generation and survival than corporate and academic ventures but not in revenues growth. So, independent ventures seem to be "patient for growth but impatient for profits". Academic ventures are found to be better in revenues growth but not in profit growth and survival. They seem to be "impatient for growth but patient for profits", which looks like an incumbent's growth strategy (Christensen and Raynor, 2003). However, why and how academic ventures follow a seeming incumbents' strategy in their business development is a subject for future research. But one of the reasons supported by the results obtained may be that Dutch university technology transfer offices and university incubators stimulate academic ventures to collaborate with an interested established industrial partner for reasons of receiving licensing revenues, cost and knowledge sharing, providing management support etc. But in order to be of interest for established industrial partners, these academic ventures have to demonstrate their value as a new growth engine capable of generating sizeable and increasing revenues independent of the profitability of their operations. For that purpose, large chunks of venture capital are needed as demonstrated by its estimated positive effect on revenues growth. This view of the growth path of academic ventures is also supported by the results discussed below.

New ventures on a revenues growth path depend on multiple business models next to each other in order to reach large numbers of customers and stick to these models as indicated by the estimated positive and negative effects of the number of business models applied and the changes made between business models (flexibility) on their revenues growth. Furthermore, they seem to rely on the commercial capabilities of their involved industrial partners for reaching their customers, which are the customers already reached by those partners. Therefore, they do not rely on complementary commercial capabilities obtained from third parties to reach their more/most profitable customers as shown by its estimated negative effect on revenues growth. Last but not least, new ventures on a revenues growth path do not rely on a lean management team to grow their revenues, which is also not feasible due to the recently realized employment growth. Accordingly, management team diversity has no effect on their revenues growth.

Independent ventures seem to rely on venture capitalists providing them with only small chunks of venture capital in order to demonstrate their profitability and prospects of survival. For that, they rely on a lean management team with a low degree of diversity. Although it was argued in section 2.2 that management teams with a high degree of (knowledge) diversity are better able to take more informed decisions, it was ignored that such management teams might be much slower (in time) with decision taking than management teams with a low(er) degree of diversity. Accordingly, management teams with a low degree of diversity can change more swiftly from one business model to another. This aspect seems to dominate among new ventures striving for profit growth and survival as demonstrated by the estimated significant negative effects of management team diversity on both dependent variables. So, independent new ventures in the Dutch life sciences industry with lean management teams and lean financing lack the means to focus on more than one business model whereas, at the same time, they are able to switch swiftly between business models in order to comply with changed/other customer needs in order to generate profit growth and enhance their chances of survival.

These inferences derived from the results obtained in this study show the importance of where the cradle of new ventures in the Dutch life sciences industry stood, i.e. at an academic parent, a corporate parent or a (specialized) venture capitalist. These different birth situations may have a very large impact on the endowment of these new ventures with combinations of resources, capabilities and strategies employed and their different effects on the development of the new

ventures' businesses in terms of scale, scope, success and survival. Accordingly, a set of structural antecedents has been identified, which explains a substantial part of the variances in the seemingly random patterns of revenues growth, profit growth and subsequent survival of new ventures in the Dutch life sciences industry during the period 2002-2005 (see the R^2-s in Table 1). This set of structural antecedents is the answer to the research question and is also the main theoretical contribution of this study.

5.2 Managerial implications

The prospects of further business development by new ventures in the Dutch life sciences industry are grim. New, mostly independent, ventures successful with profit growth and subsequent survival lack the structural antecedents to engage in revenues growth. New, mostly academic, ventures successful with revenues growth lack the structural antecedents to engage in profit growth and subsequent survival. So, to become successful on all three dimensions of business development some management implications will be derived from the results presented before.

Lean (independent) new ventures lack the structural antecedents to grow their revenues adequately in order to become an established firm. This situation leaves two ways of further development open to them. First, stay on the same muddling-through path as before but with the risk of a decreasing interest of the venture capitalist involved as the prospects of further business development into an established firm deteriorate and, as a consequence, also the prospects of survival. Second, realize and admit that this is it and prepare for a merger with or an acquisition by an industrial partner interested in further development of your business in terms of revenues growth either as a part of its main business or as a new business.[2] Past experiences with third parties, which provided you with complementary commercial capabilities in order to search, find and address ever more profitable customer needs may provide a first doorway in finding such an interested industrial partner.

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[2] *This is exactly what venture capitalists strive for. It is not in their interest to provide small profitable new ventures with large chunks of venture capital in order to stimulate their revenues growth because of the risks involved.*

Financially better endowed (academic) new ventures lack the structural antecedents to grow their profits and survive in the future as an established firm. Also for them two ways of further business development are open. First, keep on doing what you did before and perish in the end as your external financers will lose faith in your operations due to your increasing debts. Second, reduce your expenditures on further revenues growth. The money saved should be used to improve your debt situation. And at the same moment, you should try to gain access to complementary commercial capabilities provided by third parties in order to find more profitable customer needs and markets. If successful, your profit growth will improve as well as your debt situation and your need for external finances will decline. Ultimately, also your prospects of survival will become better.

5.3 Limitations

Every study has its limitations, also this one. These limitations are related to the validity and reliability of the data used and results obtained.

As the data from the yearly BioPartner surveys 2002-2005 are not controlled for non-participation and non-response biases, the results derived from these data should be regarded as tentative because they only apply to the 100 new ventures in the Dutch life sciences industry contained in the sample. In total 186 new ventures participated in the BioPartner program[3], of which 84% were less than 8 years old and 71% had less than 10 employees, 25% had 10-50 employees and 4% had more than 50 employees. In 2005 there were in total 229 firms registered to belong to the Dutch life science industry, of which 55% had less than 10 employees, 27% had 10-50 employees and 18% had more than 50 employees (including large established firms) (HollandBIO, 2018)[4]. So, the BioPartner dataset contains 16% more very small firms (<10 employees) and 14% less rather large firms (>50 employees) than in the 2005 registration.

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[3] *Of these 186 participating new ventures, 86 were active during one year, 41 were active during two years and 59 were active during three years. For the purpose of this study only the last two categories of new ventures are included in the sample utilized.*

[4] *In 2015 there are 455 firms registered to belong to the Dutch life sciences industry but with virtually the same distribution over these employment categories as in 2005, namely 55%, 28% and 16% (HollandBIO, 2018). So, the situation of business development in 2015 does not seem very different from that in 2005.*

Accordingly, in the sample utilized very young and small firms are overrepresented instead of underrepresented as in many other studies (Coad, 2018) and in the set of 229 registered firm mentioned above. This is exactly what the BioPartner program was meant for, namely to help and stimulate (financially with seed capital and non-financially with management advice) new ventures to get started. In this respect, one might say that the data utilized in this study are quite representative for the targeted (new) ventures in the Dutch life sciences industry in order to find out what structural antecedents invoke their seemingly random patterns of business development over time in terms of revenues growth, profit growth and subsequent survival. Nevertheless, the results obtained should be retested in the future for their validity in other high-tech industries and/or other countries.

A second limitation might be brought up regarding the linear regression methods applied to estimate the standardized regression coefficients, their standard errors and *t*-values and accordingly the levels of significance derived. The reason for this is that the three estimated regression equations might represent so-called Seemingly Unrelated Regression Equations (with correlated regression errors) (Zellner, 1962). Nevertheless, ML estimation of all three regression equations specified in one linear model with correlated regression errors by means of the computer program LISREL®8 (Jöreskog and Sörbom, 1992) produces exactly the same estimated values of the standardized regression coefficients involved with very little differences in their estimated standard errors and *t*-values not leading to any differences in the probabilities of significance of these estimated regression coefficients, as predicted due to the specification of identical sets of regressors for each regression equation included (e.g. Johnston, 1984). The regression errors of revenues growth and profit growth and those of revenues growth and subsequent survival are, however, significantly correlated with one another (0.390** and 0.378**, respectively) indicating that these variables still have some non-specified structural antecedents in common. So, there is room for further improvement/extension of the set of structural antecedents specified, f.e. the number of alliances formed with third parties for further business development, while the dependent variables revenues growth, profit growth and subsequent survival remain unrelated to each other.

The third limitation is related to possible multicollinearity among the control and independent variables specified. High correlations between these variables result in inflated estimates of the

standard errors of their estimated effects on the dependent variables and thereby in underestimated *t*-values and larger probabilities of wrongly rejecting the null-hypotheses (H_0: parameter =0 with p>0.10) (O'Brien, 2007). In order to identify these effects of multicollinearity, the variance inflation factor (VIF) is calculated as $1/(1-R^2)$, where R^2 is the proportion of variance of each control or independent variable explained by the other control and independent variables. A VIF<4 is argued to have insignificant effects on the *t*-values (and thus on the probabilities of incorrectly rejecting the H_0) of the estimated regression coefficients of the control and independent variables specified (O'Brien, 2007). In this study only the VIFs of the dummies representing independent ventures and corporate ventures are larger than 4, namely almost 17. This is due to the very high mutual correlation of -0.970 between them, which is to be expected for mutually exclusive variables. This results in substantially deflated *t*-values of the estimated effects exerted by both variables. But leaving out one of these variables in the equations estimated would have ruined the representation of the parent organizations involved. Therefore, both variables have remained in the equations estimated, because their effects are quite considerable in magnitude even when not found statistically significant, as argued by O'Brien (2007).

6. Conclusions

Profits and sales/revenues are key-themes in discussions about firm strategies to be applied in order to develop new businesses, i.e. 'impatient for growth but patient for profit' versus 'patient for growth but impatient for profit' (Christensen and Raynor, 2003). However, empirical evidence increasingly shows that the profits and sales/revenues generated by new ventures are quite unrelated to each other but also to their (non)survival, instantly as well as over time (Coad, 2007; Delmar et al., 2013; this study). These results raise the question that if the profits, sales/revenues and survival of new ventures follow seemingly random patterns over time, what other characteristics of new ventures might be held responsible for these outcomes?

The results obtained in this study that give an answer to this question are derived from the analyses of 159 three-years observations of 100 new ventures in the Dutch life sciences industry during the period 2002-2005. The results show that these new ventures had at least three resource indicators in common together with two market strategy indicators and four control variables, which "explain" substantial parts of the variances in profit growth, revenues growth and

subsequent survival (i.e. 40%, 62% and 22.5%). Furthermore, the results show that new ventures endowed with different values/amounts of these indicators grow either their revenues or their profits and subsequent survival chances. Older independent new ventures initially endowed with small chunks of venture capital, a low degree of management team diversity, access to complementary commercialization capabilities, one business model and a high degree of flexibility to switch between business models become focused on profit growth and increasing their chances of survival. Young and large academic new ventures initially endowed with large chunks of venture capital, no access to complementary commercialization capabilities, more than one business model and a low degree of flexibility to switch between business models are focused on revenues growth. The validity of these results in other high-tech contexts (industries/nations) need to be retested in future research.

As a consequence of the current results, the endowment of new ventures with resources and market strategies to be applied seems to determine what business develop path will be followed. Furthermore, this endowment of new ventures also prohibits them from changing between both business development paths. As being an academic or independent new venture also plays a significant role in what business development path will be followed, the question arises whether the choice of a new venture to apply for help from a particular type of supportive parent organization at the start of its business development also shapes/determines its endowment with resources and market strategies applied. So, the supportive parent organization where the cradle of a new venture stood might have been very important for the business development path followed. In order to obtain more insight into this issue more research is needed in the future.

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Appendix 1: Correlations among (Lagged) Revenues and Profit Growth and subsequent Survival of new ventures in the Dutch life sciences industry during the period 2002-2005

Correlations						
		Survival	Rev_grow	Prof_grow	LRevG	LProfG
Survival (T2)	Pearson Correlation	1				
	Sig. (2-tailed)					
	N	159				
Rev_grow (T0, T1)	Pearson Correlation	.104	1			
	Sig. (2-tailed)	.247				
	N	127	127			
Prof_grow (T0, T1)	Pearson Correlation	.087	-.015	1		
	Sig. (2-tailed)	.424	.894			
	N	87	84	87		
LRevG (T-1, T0)	Pearson Correlation	-.094	-.079	.062	1	
	Sig. (2-tailed)	.516	.607	.755		
	N	50	45	28	50	
LProfG (T-1, T0)	Pearson Correlation	-.014	-.191	-.151	-.200	1
	Sig. (2-tailed)	.937	.286	.462	.248	
	N	35	33	26	35	35

All correlations have a significance (2-tailed) > 0.10 ($p > 0.10$), which implies that they are all insignificant.

Appendix 2: Statistics and the Polychoric, Polyserial and Pearson Correlations of the Observed Indicators (N=159)

Variables	Mean	St.dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Survival (t+2)	0.000	1.000	1.000									
2. Rev.Growth (t+1)	0.989	3.117	0.104	1.000								
3. Prof.Growth (t+1)	-0.209	2.364	0.087	-0.015	1.000							
4. MT diversity (t)	0.000	1.000	-0.051	-0.103	-0.131	1.000						
5. MT champion (t)	0.000	1.000	-0.109	0.151	0.050	-0.281	1.000					
6. Firm Age (t)	4.419	4.124	0.006	-0.225	0.048	0.069	-0.209	1.000				
7. Firm Size (t)	16.604	27.625	0.183	0.003	0.020	0.025	-0.165	0.231	1.000			
8. Bus.Models (t)	0.000	1.000	0.076	0.157	-0.081	-0.034	0.338	0.037	-0.009	1.000		
9. Corp.Venture (t)	0.000	1.000	0.014	0.113	-0.017	-0.107	-0.089	-0.194	0.235	-0.228	1.000	
10. Ind.Venture (t)	0.000	1.000	0.034	-0.087	0.151	0.102	0.045	0.337	0.158	0.034	-0.970	1.000
11. VCperFR (t)	443.719	840.736	-0.461	0.338	-0.082	-0.144	0.123	0.185	-0.245	-0.205	-0.034	0.353
12. IP-resources (t)	0.000	1.000	0.036	-0.027	-0.051	0.019	-0.104	-0.014	0.019	0.130	-0.123	0.029
13. Compl.Comm.cap (t)	0.000	1.000	-0.037	-0.185	0.139	0.004	-0.002	-0.048	0.019	-0.048	0.385	-0.144
14. Flexibility (t)	0.000	1.000	-0.085	-0.054	0.249	-0.096	0.353	-0.192	-0.255	0.632	0.188	0.058

Variables	(11)	(12)	(13)	(14)
11. VCperFR (t)	1.000			
12. IP-resources (t)	-0.011	1.000		
13. Compl.Comm.cap (t)	0.001	0.028	1.000	
14. Flexibility (t)	0.086	0.082	-0.229	1.000