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ORIGINAL PAPER

Towards a better understanding of performance measurements: the case of research-based spin-offs

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Abstract Although performance measurement has been a prominent topic especially in an entrepreneurial context, researchers struggle to obtain conclusive results. We link this to the fact that the key role of different performance measurements has been neglected and consequently want to fill this gap by contrasting five different performance measures against each other, being: general performance, long-term perspective, technological application, financial indicators and growth. The new perspective we are offering is taking different performance measures into account at the same time and examining whether one specific measurement seems to favor, correlate or stand in some kind of causal relationship with specific exogenous success factors. By investigating the phenomenon in the case of research-based spin-offs (RBSOs), a type of newly founded ventures that is exemplary for an entrepreneurial context, we are offering insights on best performing spin-offs regarding their starting configuration, support mechanism and product-market combination. Drawing on a database of 177 spin-offs from publicly funded non-university research institutes, an analysis via logistic regression showed that each performance measurement shows different results, but the negative effect of push

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motivation and the positive influencing factors of a high degree of innovation and profound knowledge in assessing the targeted market are accepted success factors independent from the measurement used.

Keywords Performance measurement · Research-based spin-offs · Spin-off success factors · Innovation · Scientific entrepreneurship · Public research organizations

Mathematical Subject Classification L25 · L26 · M13 · 032

1 Introduction

Although performance measurement has been a prominent topic in literature over the last years (Dess and Robinson 1984; Dewangan and Godse 2014; Song et al. 2008), it remains a highly debated issue—especially in an entrepreneurial context—and researchers struggle to obtain conclusive results (Nelson et al. 2014). Dewangan and Godse (2014) as well as Nelson et al. (2014) both explicitly voiced their discontent with existing performance measurements. We posit that research has produced diverse outputs so far, because the interplay of different performance measurements with success factors that are used in an analysis has been neglected so far (Song et al. 2008). Inspired by Meyer's and Gupta's (1994) 'performance paradox', we decided to put the focus on performance measurements in our study and investigate the phenomenon in the case of Research-based spin-offs (RBSOs), since this type of newly founded venture is exemplary for an entrepreneurial context.

RBSOs focus on the transfer of scientific results or technological know-how into marketable processes, products or services (Chiesa and Piccaluga 2000; Steffensen et al. 2000), thus constituting an important means of technology transfer from academia to business This is why governments have strong interests in promoting spin-offs as the core of technology clusters, although their economic impact in terms of jobs and revenues is only beginning to be understood (O'Shea et al. 2008; Scillitoe and Chakrabarti 2010). In a surrounding as complex as that of newly founded ventures, the complexity reduction obtained by one performance measure can be misleading. Dewangan and Godse (2014) underline the problems of a uni-dimensional performance measurement. Therefore, we broaden the scope of this analysis by taking various selected measurements into account.

We want to fill the above mentioned gap by contrasting five different performance measures against each other, being: general performance (Roberts 1991; Scholten 2006), long-term prospects (Li 2001), technological application (Zahra and Bogner 2000), financial performance (Tübke 2005; Scholten 2006) and growth (Roberts 1991; Colombo and Grilli 2010), to find out whether or not one specific measurement seems to favor, correlate or stand in some kind of causal relationship with specific exogenous success factors.

With regard to the selection process of influencing factors, it seemed promising to combine established, commonly used and well-known success factors with controversially discussed ones, including their starting configuration, support

mechanism and product-market combination (O'Shea et al. 2008; Baum et al. 2000; Clarysse et al. 2005, 2011; Colombo and Grilli 2010; Mustar et al. 2006).

Drawing on a database of 177 spin-offs from publicly funded research institutes, the different performance constructs are used to identify well-performing spin-offs in the sample first and then the most distinct influencing variables are being defined via logistic regression.

2 Theory and model

2.1 Literature review

The literature shows that the evaluation and measurement of venture performance is one of the most discussed problems in entrepreneurship (Sapienza et al. 1988; Dess and Robinson 1984; Sandberg 1986; Knockaert et al. 2011; Hmieleski and Ensley 2007). There is, however, consensus on the so-called minimum criteria or criteria for surviving, for example the age of the venture, development of sales and number of employees (Brüderl et al. 1992; Cochran 1981; van Praag 2003; Andersson and Klepper 2012).

In the existing literature on venture performance, objective as well as subjective criteria are used to delineate the success of the company (Murphy et al. 1996; Brush and Vanderwerf 1992; Wall et al. 2004). Especially economic indicators, but also objectively ascertainable and unambiguously measurable parameters, such as the number of employees or the RoI, are reckoned among the objective criteria (Sapienza et al. 1988; Dess and Robinson 1984), whereas subjective criteria relate to the individual founder's success and thus imply the information and perspective of each respondent. While estimating their own business venture's success, they automatically base their judgments on their own set of objectives, or rather the degree of achievement of said objectives with the given resources (Dess and Robinson 1984).

Profit and growth variables are the most frequently used indicators to measure the performance of new firms (Brush and Vanderwerf 1992) and also the success assessment of spin-offs and other new firms in high dynamic industries is usually carried out by growth variables (Hölzl and Lobe 2014, as those companies focus primarily on customer acquisition and establishment (Scholten 2006; Tübke 2005). The most important growth variables are related to sales and employment growth. Other important aspects of venture performance are size, profit and other financial assets. The measurement of success by means of typical indicators like profit, is only partially suitable for measuring spin-off success, for newly founded ventures have to reach the break-even-point first (Delmar 1997; Sandberg 1986).

Commonly used subjective indicators like personal satisfaction with the spin-off development as well as self-realization through the venture complete the all-compassing picture of spin-off success (Kraus et al. 2012; Venkatraman and Ramanujam 1987). Dess and Robinson (1984) justify subjective performance measurement with the heterogeneity of commercial objectives and the augmented willingness to provide information of respondents if the specification and

composition of said objectives has not to be revealed. Sapienza et al. (1988), however, see subjective measures quite critically but are ready to use them as substitutes, if objective measures cannot readily be attained. In fact, Dess and Robinson (1984) as well as other studies (Menguc and Auh 2006; Doblinger et al. 2016; Lauer Schachter 2010) have found a high correlation between subjective, also referred to as perceptual or perceived, and objective performance measurers for new venture creations. Other authors basing their evaluations on similar measures (e.g. Matsuno et al. 2002) supports the adequacy of subjective measures.

For our research purpose, we define a spin-off as a new firm which is formed (1) by individuals who were former scientists in a parent research organization, and (2) around a technology that was invented at the parent organization and then transferred to the new firm (Carayannis et al. 1998). This description is based on the definition of Mahar and Coddington (1965) and is similar to the definition used by most scholars (Rogers 1986; Smilor et al. 1990; Helm and Mauroner 2011). Although a RBSO emanates from a non-university context, it shares this non-commercial environment with other academic spin-offs (Mustar et al. 2006).

2.2 Derivation of hypotheses

The new perspective we are offering is taking different performance measures into account at the same time and examining ex post whether one specific measurement seems to favor, correlate or stand in some kind of causal relationship with specific success factors. Consequently, we do not offer a theory whether or not a specific measure is influenced by an exogenous factor, sporting the idea that all examined exogenous factors are relevant to all performance measurements.

For the derivation of success factors, three popular and widely acknowledged theories stand out: resource-based view, competence-based view and market-based view (Penrose 1959; Prahalad and Hamel 1990; Porter 1980). Following and testing these aforementioned theories (for example Heirman and Clarysse 2004; Druilhe and Garnsey 2004; Chiesa and Piccaluga 2000; Mustar 2001; Carayannis et al. 1998; Clarysse et al. 2005; Lockett et al. 2005), empirical studies have produced a myriad of different success factors.

Gartner (1985) and Bygrave (2010) categorized the many success variables that all go back to said theories. For this reason we used their models as an antetype for our model.

Concentrating on a customization to the RBSO context, this threefold systematization serves as a reference for our categorization of influencing factors in our model, which we have differentiated as follows: founder personality, parent organization and starting conditions (Fig. 1) and which we will discuss in a more detailed way when deriving our hypotheses.

Our aim is to investigate the specifics of those firms with an above-average performance rate (so called best-performing spin-offs). Based on the factor score for each performance construct, we separated the two groups (best and worst fraction) and then compared them.

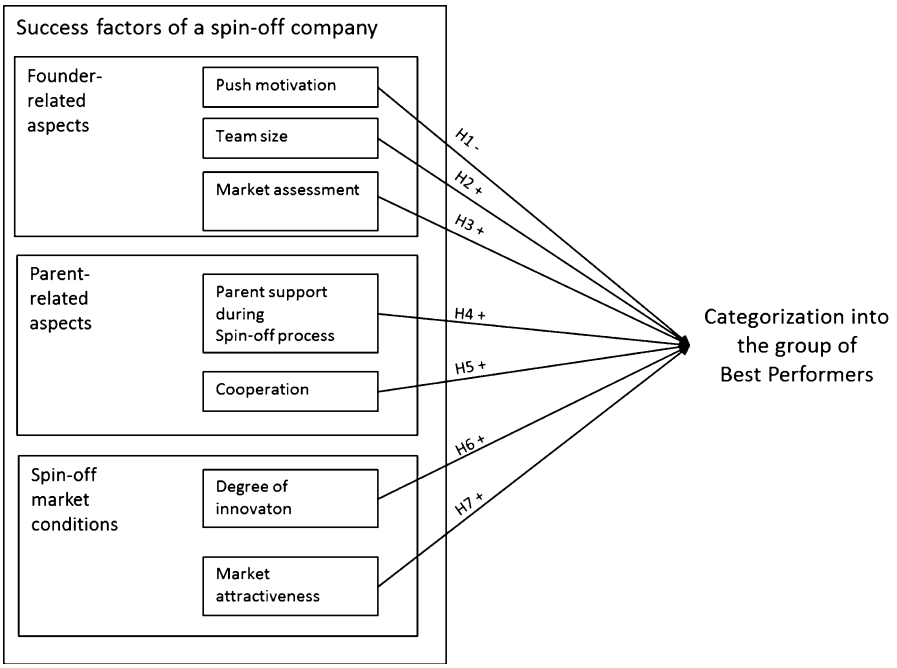

Fig. 1 Theoretical model

In the category of personal-related success factors, we wanted to test whether the founding team has entrepreneurial motivation and how ex- and intensive their commercial knowledge about the targeted market is, as well as the size of the founding team.

Since the motivation to found a business venture, or a spin-off to be more precise, is one of the fundamentally defining attributes of said venture, we included it in our study. Motivation can be classified into push and pull motivation (Lowe and Marriot 2006). Generally speaking, pull motives are said to have a positive influence and push motives a negative influence on success (Egeln et al. 2002; Roberts 1991; Smilor et al. 1990). Considering the case of spin-off foundations, push motivations, for example, could be the threat of losing employment, potentially due to reorganizational measures or severe limitations of the employment situation. Thus, the so-called Push spin-offs are often termed "restructuring-driven" spin-offs in the corresponding literature (Tübke 2005). Although there is a general consensus about interdependency, the exact direction and intensity is being discussed controversially (Dahlqvist and Davidsson 2000). This is why we aim to further examine the relation between motivation and success in our study and are thus led to our first hypothesis:

H1 The more distinctive the push motivation of a spin-off founder, the less likely the future classification of the venture into the category of best-performing spin-offs.

With the addendum, independent from the success variable, to each of the seven hypotheses, we want to convey that the studies upon which our hypotheses are built do not present any evidence that one success measure(s) produces different results than another. There also is no theory postulating that some influence factors are more prone to a special kind of performance measurement. This is why we decided to test commonly used and well-known success factors with controversially discussed ones.

Beside the aspect of motivation, the size of the spin-off team is also very important for the spin-off success. The collar bone of this argument is the competence-based view and consequently human capital (Colombo and Grilli 2010). Since RBSOs are more often than not located in the high-technology sector, it is essential to have extensive knowledge and competence available, both technical and economical (Brinckmann 2007; Colombo and Grilli 2005). Besides, big teams diversify risk, reduce uncertainties and pose the possibility of more equity capital, which is why they were also proven to be more successful than (the) foundations by one single founder, especially when it comes to young enterprises (Lechler 2001; West 2007). Recently, a special term has come up to denote the ability to search for creative solutions for problems via the so-called "collective mind" in big and diverse teams (Lechler 2001; West 2007). However, this phenomenon is contested. Some authors put forward that heterogeneity in a team has not only advantages but also poses some difficulties, especially when it comes to the potential of conflicts (Dautzenberg and Reger 2010). Contributing to the further examination of this phenomenon we postulate that big teams are more successful than small ones, which directly leads us to our second hypothesis:

H2 The more team members a spin-off has, the more likely its classification into the category of best-performing spin-offs.

The amount of knowledge concerning the target market and the prospective competitors, reflecting the team competence at the time of founding, is crucial for successfully commercializing an innovation. This active collection of information on the targeted market, the market assessment, needs to be adequately thorough, time-wise and in terms of profundity. As to choosing the optimal market entry strategy as well as allocating the resources, the better the planning has been figured out, the more successful the venture is going to be (Burke et al. 2010; Delmar and Shane 2003; Brinckmann et al. 2010; Gurău et al. 2015). Uncontested are the results that business planning enhances the prospect of every kind of entrepreneurial action which is also and especially true for RBSOs (Burke et al. 2010; Delmar and Shane 2003; Brinckmann et al. 2010). Since a best-performing RBSO is likely to produce a high degree of innovation, the level of market uncertainty for the implementation of said innovation is going to be high, too (Carbonell and Rodriguez 2006; Kessler and Bierly 2002). In order to counteract market uncertainty as best as possible, market assessment is essential. Therefore, we postulate:

H3 The more profound knowledge the spin-off founders gained assessing their future target market, the more likely (is) the classification of the venture into the category of best-performing spin-offs.

The second important set of success factors is related to the parent organization and according to Gübeli and Doloreux (2005) one of the most significant external factors within the spin-off process due to its role as transmitter and main source of starting ideas.

Incubation support can be considered as a special form of network, in which the spin-off venture is embedded, with a lot of different influences on the spin-off and its development (Soetanto and van Geenhuizen 2011). Introducing the network logic here can be seen as an extension of the possible resource-base. In most cases the parent research organization actively supports the spin-off with technologies, know-how, contacts and capital (Grimaldi and Grandi 2005). Beside this active form of support, there are also indirect effects at work, like reputation and experience-related effects (Nicolaou and Birley 2003). Suitable support may consist of e.g. access to relevant knowledge and providing technical facilities, laboratory space or other services, and raising capital (Lockett et al. 2003). Parent approval in particular enables the firms to overcome their liability of newness and liability of smallness and may raise their probability to grow (Baum et al. 2000; Clarysse et al. 2005). However, results are vague and some studies showed a significant impact of the strength of incubator networks on spin-off success (Walter et al. 2006), while others suggested a negative effect of tangible support and a positive effect of intangible support on early growth (Scholten 2006; Helm and Mauroner 2007), and other authors again detected no relationship between services provided by the parent and sales growth (Lendner 2003). Bearing all this in mind, we postulate a generally positive effect of incubation support by the parent:

H4 The more incubation support from the parent research organization a spin-off company gets during the spin-off process, the more likely is the future classification of the venture into the category of best-performing spin-offs.

The relationship between parent and spin-off varies from short-term contact to long-term cooperation. So parent support affects the spin-off process itself (Powers and McDougall 2005; Scholten 2006; Steffensen et al. 2000) as well as the development of the venture once it has entered the market. The so called post spin-off cooperation includes supportive measures after the market entry of the RBSO and are destined to exert a dominating influence through providing competitive advantages, (and) thus influencing the spin-off success positively (Nicolaou and Birley 2003). The duration and intensity of the support should in any case be balanced in order for the venture to still be able to develop a certain amount of independence (Scillitoe and Chakrabarti 2010). Apart from that, constancy of partnership featuring long and highly interactive involvement is positive for both sides. Especially from the RBSO perspective, the legitimization and network involvement are to be designated. Another positive side effect is the profiting from the good reputation form the parent research organization, which helps reducing uncertainties on the customer-side (Powers and McDougall 2005; Scholten 2006; Steffensen et al. 2000). Therefore we postulate:

H5 The more closely the parent research organization cooperates with the spin-off company, the more likely the future classification of the venture into the category of best-performing spin-offs.

In what we labeled starting conditions, two variables are included: One concerning the constitution of the spin-off venture itself, namely the degree of innovation, which can be seen as an important dimension of the spin-off idea and the other concerning the environment, e.g. the market conditions, or more precisely, whether the market the spin-off is about to enter is attractive or not.

The innovativeness of the core technology is a crucial aspect of the starting configuration and of outstanding importance for the founding process and firm performance (Heirman et al. 2003). Roberts (1991) found that a high-grade technology transfer confirms a positive correlation with spin-off performance. In order to transform the degree of innovation into a competitive advantage, it needs to meet the needs and expectations of the market, offer a USP and constitute an actual technological novelty in contrast to existing technologies known to the competition and thus the market. Only an adequate sense of improvement makes it lucrative for potential users or customers (Carbonell and Rodriguez 2006). In order to realize this competitive advantage, though, a sound resource base is needed: competence-wise and factually, too. There are also studies which doubt the positive correlation between a high degree of innovation and future venture success, putting forward the high level of uncertainty involved (Calantone et al. 1994). But the literature generally shows a positive impact of innovativeness on product implementation (Kleinschmidt and Cooper 1991). The general consensus highlights the importance of innovativeness for future spin-off success (Schoonhoven et al. 1990); particularly so when it comes to value creation (Gurău et al. 2015). A fit between starting resources and market requirement is essential (Heirman and Clarysse 2004). Resource based view meets market-based view here and the fit already postulated when developing our model is being brought into play again. The two following hypotheses are thus closely related:

H6 The higher the degree of innovation the spin-off represents, the more likely the future classification of the venture into the category of best-performing spin-offs.

H7 The more attractive the market conditions at the time of foundation, the more likely the future classification of the spin-off venture into the category of best-performing spin-offs.

3 Methods

3.1 Data and sample

The sample that has been used to conduct this study consists of research based spin-off companies from public research organizations in Germany.[1] In 2008, a total of

[1] Fraunhofer Gesellschaft, Max-Planck-Society, Helmholtz Association, Leibniz Association.

506 entrepreneurs, i.e. founders of spin-off companies from non-university public research organizations, were asked to participate. In order to be considered in the study, the spin-offs needed to be founded on the base of technology or knowledge developed within a research organization and at least one scientist from that institution had to be part of the founding team. The final sample consists of 177 usable questionnaires (response rate: 35.0 %).

We tried to get the information from persons who were one of the founders of the company as they were able to give valid information about the situation at the starting point of the venture. It was possible to identify and track down the actual founding members of each spin-off. Therefore, the questionnaires could be addressed to them directly.

Regarding the age of the firms, almost all of them were founded after the year 1990. The fact that more than 60 % of the firms were launched in the period of 1998–2003 indicates boom conditions for research based spin-offs during that time. This result is similar to other recent studies on research based spin-offs (Egeln et al. 2002). The starting size and the current number of employees in the firms are consistent with typical small- and medium-sized firms. Almost 60 % of the companies were launched as single-person firms and two-person firms. At the beginning, the companies have a typical lack of resources and suffer from liability of smallness. The data shows that the majority of the spin-offs remain small while less than 5 % become large- or medium-sized companies with more than 100 employees. This result is validated by other studies on research based firms (Autio 1994; Clarysse et al. 2005; Mustar 1997; Spielkamp et al. 2004).

The spin-offs can be classified into different industry sectors similar to other studies on innovative firms (Dowling and Helm 2006) and comparable to the overall structure of the knowledge intensive industries like software development, medical chemistry or optics and laser technology.

In order to see whether any sectoral effects existed regarding the industry sectors the spin-offs belonged to, we conducted an analysis of variance. The industry sectors were categorized into three comprehensive groups: IT (comprising Programming, Software, Technical and Media Services, and Information Technology), Microtechnology (consisting of Microsystems, Sensors and Optics, Laser Technology) and Medical (Medical, Chemistry).

The constructs of spin-off success based on general performance, technological application and financial performance fulfill the necessary criteria of homogeneity of variance and normal distribution for an analysis of variance, whose results indicate that there are no industry effects. Although the success construct based on growth does not comply with the aforementioned requirements, an additional Kruskal–Wallis test asserts that the mean values of the industry groups are not significantly different. For the construct based on long-term prospects however, this test indicates otherwise. By means of a pairwise comparison in the course of a Mann–Whitney-U-test the IT sector is singled out. This can be interpreted as follows: The IT industry sector has more promising long-term perspectives, because in general its perspective is very bright due to strong development and rising growth figures. These findings have to be taken into consideration when applying and

Table 1 *t* Test of the control variable 'age'

Success score (mean)	Constructs of spin-off success based on				
	General performance	Longterm prospects	Financial performance	Technological application	Growth
Young (<7 year)	4.22	4.53	4.54	2.96	177
Old (>7 year)	4.27	4.63	4.65	3.07	231
Sign. (*t* test 2-tailed)	.308	.530	.311	.674	.482

interpreting this success measure and are furthermore listed under the limitations section of this study.

In order to check whether the additional variable 'age' had supplementary explanatory power, a *t* test was conducted, with no significant results (Table 1). After splitting the spin-offs into two groups according to the median (younger/older than 7 years), we checked whether their success scores, the mean of the underlying success construct, differed significantly. As can be seen in Table 1, they do not. Therefore, the variable 'age' does not offer any further explanatory value.

Altogether, these facts suggest that the sample is suitable for our purpose.

3.2 Measurement

All constructs (Fig. 2) were measured using seven-point multi-item scales drawn from previous studies, which are indicated in the description of the respective

Fig. 2 Overview of constructs and variables

constructs.[2] First, the influencing factors will be illustrated, followed by the explanation and description of the different constructs of spin-off success based on various items. The influencing factors are multidimensional constructs measured with several indicator variables. Constructs were tested via confirmatory factor analysis in order to find out whether they really belonged to the presumed underlying constructs (further detail in chapter 4).

Push motivation the push motivation has been operationalized via the question about internal problems and reorganization. The latter variable contains information on whether the venture has been the result of a planned or already implemented reorganization measure within the research organization and would be considered as a restructuring-driven spin-off (Dahlqvist and Davidsson 2000; Delmar and Davidsson 2000; Solymossy 1997).

Team size respondents were asked to indicate the number of founders at the time of spin-off foundation.

Degree of innovation: in order to gain information about the degree of innovation of the spin-off company, three different variables were used. To measure the novelty of the spin-off idea the respondents were asked to range the degree to which the spin-off idea represented a novelty to the market in the scope between radical and incremental innovation (Kleinknecht et al. 1993; Pirnay et al. 2003; Roberts 1991; Romijn and Albu 2002). The degree of innovation specifies the extent of newness of the idea which is implemented in the course of the spin-off process compared to existing products and solutions (Clarysse et al. 2011). The data collection via the item technological competitive advantage is effected rather similarly (Tatikonda and Montoya-Weis 2001; Lynn and Akgün 2003; Tübke 2005).

Parent support during spin-off process as to measure the cooperation between spin-off firm and parent institution during the spin-off process we used four variables on the incubation support. Respondents were asked to assess the degree to which the utilization of infrastructure, information and intellectual property was possible. Furthermore, the respondents were asked to assess whether the parent organizations also served as a counsellor (Tübke 2005; Morrison and Wetzel 1991).

Cooperation in addition to the parent support during the initial phases of the spin-off process, other variables were used to measure the intensity of the long-term cooperation between spin-off and parent (Tübke 2005). The cooperation with the parent was measured using three items: intensity, impact and benefit of the collaboration with the parent institute (Schwartz and Hornych 2010; Scillitoe and Chakrabarti 2010; Hackett and Dilts 2004; Bøllingtoft and Ulhøi 2005). Intensity specifies the frequency of contact between the parent research organization and the spin-off company, whereas the type of contact, be it informal contacts or talks, contact within the framework of projects or exchange of employees, plays a subordinate role. As the name of the variable benefit of cooperation with parent already indicates, it explains the advantages the spin-off company secures by cooperating closely with its parent organization. Closely related is the impact or extent of cooperation between spin-off and parent organization. Furthermore, the indicator variable reference partnership with parent signifies the importance of said

[2] Summary statistics for the dependent and independent constructs can be found in Annex 1.

relationship and the standing inherent to the spin-off company and of course, the aspect of coordination, i.e. which party organizes and initiates contact, is also enclosed in this set of variables (Schwartz and Hornych 2010; Scillitoe and Chakrabarti 2010; Hackett and Dilts 2004; Bøllingtoft and Ulhøi 2005).

Market assessment in order to capture information on market assessment, the respondents were asked to rate the amount of knowledge concerning the target market and their prospect competitors as well as their competence at the time of founding (Clarysse et al. 2003; Delmar and Shane 2003).

Market attractiveness to collect information about the market attractiveness we used different variables. We asked about market growth and market potential (Cooper and Kleinschmidt 1994; Sandberg 1986). Market information focuses on the perceived market environment at the spin-off level rather than on the macroeconomic situation determined from secondary data. This permits an evaluation of different industries and market characteristics.

As far as our dependent constructs are concerned, the question of 'How to measure success?' is central. In this study, the dependent factor is spin-off performance or the classification into the group of well-performing spin-offs. After having discussed the various possibilities to measure spin-off success in the literature section, we have decided to use multiple measures in order to represent the full scope of performance measurement and be able to contrast their results with each other.

General performance the general venture performance was measured with four variables, (1) a general opinion of the business success and a differentiating assessment of (2) the sales growth, (3) the cash-flow and (4) the profitability. We used the items from previous studies (Lumpkin and Dess 1996; Roberts 1991; Scholten 2006). The fact that we used subjective measures to assess the spin-off success enabled us to compare dissimilar spin-off projects in very different industries (Dess and Robinson 1984).

Long-term prospects the construct of spin-off success based on long-term prospects, however, is represented by the explicit question about the long-term perspective of the founder and the amount of market share, also with a long-term background (Li 2001).

Technological application furthermore, we asked the spin-off founders to which degree they were able to achieve new intellectual property e.g. new patent applications after the firm formation (new patents) and licensing activity, respectively, since licensing constitutes the permission, attained by the license-holder via sale or rent agreements, to use said new patents or innovative technology (Zahra and Bogner 2000).

Financial performance this construct is based on the variables cash-flow and profitability, which are also part of the construct general performance, but need to be considered separately, as objective criteria like these are often used to measure success (Tübke 2005; Scholten 2006).

Growth the construct based on growth consists of two variables: employee growth per year and sales growth per year. Both variables have been calculated by the indications of numbers in the first year after firm formation and current numbers (Roberts 1991).

To control for recall bias, or more generally, for common method bias, we followed the recommendations by Podsakoff et al. (2003), who point out that the analysis should be conducted anonymously and the directive should be given that there are no wrong answers and that participants should simply answer as truthfully as possible. A pretest of the questionnaire furthermore helps to prevent problems of understanding and to ensure the clarity and neutral wording of the items respectively.

In addition, we used statistical techniques for controlling for common method bias: Harman's one-factor test (Podsakoff and Organ 1986). Significant common method variances would result in one general factor accounting for the majority of covariance in the variables. So we conducted an un-rotated explorative factor analysis with all the items of both independents and dependents entered. Nine factors were drawn out, and among them (cumulative value is 71.35 %) the largest factor explains 16.68 %, which indicates no threat of common method variance. Second, we used a confirmatory factor analysis approach to further test common method variance (Menon et al. 1996; Sabherwal and Becerra-Fernandez 2005). A model positing that a single factor underlies all the variables was assessed by linking all items of the dependent and independent factors to a single factor. This model does not fit the data well and is not acceptable. When the common factor was removed and all items were assigned to their theoretical factors, the model fit the data well, as can be seen in our result section. Therefore, the results of this CFA test show that no serious threat of common-method bias exists (Sabherwal and Becerra-Fernandez 2005).

In order to test whether the indicator variables fit the assumed constructs, a confirmatory factor analysis (a principal axis analysis with varimax rotation to be precise) was conducted, using the factor score, Cronbach's alpha and the Average Variance Extracted (AVE) as criteria as is common practice (Akgün and Lynn 2002; Churchill 1979; Yli-Renko et al. 2001). The criteria in Table 2 showed satisfactory results: The factor scores range from 0.423 to 0.969, the recommended minimum being 0.4. The Cronbach alphas are all above the recommended minimum of 0.4. The AVE ranges from 63 % to 78 %, the recommended minimum being 50 % (Fornell and Larcker 1981). Thus, all of the constructs display a satisfactory or good internal consistency and therefore reliability. Although the values for push motivation do not show the desired strength, there are studies accepting Cronbach Alphas and factor scores beneath the prevalent levels, especially for new constructs (Hulland 1999; Peterson 1994). In the case of only two or three indicators, the reliability measured through Cronbach's Alpha is often being underestimated, since the value for Cronbach's Alpha automatically rises with the number of indicators (Sproles and Kendall 1986; Cortina 1993). It also seems commonly acceptable to retain what is confirmed by at least one quality criterion (Bagozzi and Yi 1988, 2012). Based on these findings, we decided to keep push motivation in the study.

Table 2 Factor analysis for independent constructs

	Influencing factors	Factor score	Cronbach's α	Average variance extracted
Push motivation	Reorganization	0.423	0.459	65.25 %
	Problems	0.423		
Degree of innovation	Degree of novelty	0.969	0.736	65.89 %
	Novelty of the spin-off idea	0.736		
	Technological competitive advantage	0.419		
Parent support during spin-off process	Tangible support (infrastructure) from parent	0.808	0.785	63.05 %
		0.824		
	Support by intellectual property	0.787		
	Consultation	0.417		
Cooperation	Benefit of cooperation with parent	0.905	0.890	69.99 %
	Reference partnership with parent	0.841		
	Intensity of cooperation with parent	0.802		
	Coordination of cooperation with parent	0.782		
	Impact of cooperation with parent	0.616		
Market assessment	Market assessment	0.759	0.732	78.89 %
	Assessment of competition	0.759		
Market attractiveness	Market potential	0.726	0.691	76.42 %
	Market growth	0.726		

To test the accuracy of our selected success constructs another confirmatory factor analysis was conducted as well, see Table 3. Beside the more than satisfying results for four out of five constructs, technological application stands out. Unfortunately, this construct does not show the desired and required strength for being kept in the study. Although 'technological application' is a thematically logical supplement to the other constructs and accounts for a greater variety as well as enclosure of diverse success aspects into the set of success measures, we decided to eliminate it from this point onward.

Table 3 Factor analysis for dependent constructs

Constructs of spin-off success based on:	Factor score	Cronbach's α	Average variance extracted (%)
General performace			
General opinion of the business	0.796	0.830	66.67
Sales growth	0.746		
Cash flow	0.709		
Profitability	0.731		
Long-term prospects			
Market share	0.697	0.654	74.34
Long-term perspective	0.697		
Technological application			
Achievement of new patents	0.146	0.043	51.06
Licensing	0.146		
Financial performance			
Cash flow	0.764	0.737	79.22
Profitability	0.764		
Growth			
Employee growth p.a. (in %)	0.827	0.813	84.27
Sales growth p.a. (in %)	0.827		

4 Results

4.1 Contrasting different concepts of spin-off success

Since we wanted to investigate the specifics of those firms with an above-average performance rate (best-performing spin-offs), we first needed to identify best and worst performers. We decided to form an index out of the variables of a construct and aggregate them to an un-weighted index. Based on this index for each performance construct, we created two groups to compare the best and worst fraction in order to see whether the results would become clearer. First, we used the best and worst third, indicated as '1/3' and then the best and worst quarter, indicated as '1/4', to see whether any effects became more apparent (Table 4).

Using logistic regression, we are able to predict the likelihood of a spin-off being classified as best performer. Nagelkerke's R^2 and the percentage of right classification are used as goodness-of-fit measures. For four out of the five different models of measuring spin-off success, Nagelkerke's R^2 appears to be very good (Nagelkerke 1991), with values higher than 0.2. For the construct based on financial performance, Nagelkerke's R^2 unfortunately lies slightly below 0.2 as indicated in Table 4. The percentage of correct classification into the best performer group displays similar results. Each value is considerably higher than 50 %, which would be the stochastic likelihood of being sorted into one of the two groups (best and

Table 4 Results of logistic regressions

Constructs of spin-off success based on...

	General Performance				Longterm prospects			
group classification: best vs. worst performer	*1/3*		*1/4*		*1/3*		*1/4*	
N	*145*		*111*		*149*		*105*	
Nagelkerke R2	*.171*		*.250*		*.212*		*.365*	
right classification in %	*65.5*		*69.4*		*65.8*		*75.2*	

	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.
Push motivation	-.546	.098	-.118(.087)	-.136(.098)	-.890	.024	-.180(.013)	-.222(.023)	.313	.276			.755	.097	.133(.083)	.181(.094)
Team size	-.006	.718			-.011	.482			-.014	.840			.015	.870		
Degree of innovation	.227	.231			.220	.319			.757	.000	.151(.000)	.177(.000)	.956	.000	.168(.000)	.230(.000)
Support during process	-.048	.812			.212	.374			.008	.970			.148	.592		
Cooperation	.006	.977			-.114	.640			.181	.400			-.031	.909		
Market assessment	.888	.000	.193(.000)	.221(.000)	1063	.000	.215(.000)	.265(.000)	.309	.175	.061(.166)	.072(.174)	1.073	.001	.189(.000)	.258(.001)
Market attractiveness	-.168	.493			.147	.633			.217	0.210			-.403	.070	-.071(.198)	

	Financial performance				Growth			
group classification: best vs. worst performer	*1/3*		*1/4*		*1/3*		*1/4*	
N	*152*		*106*		*80*		*60*	
Nagelkerke R2	*.090*		*.168*		*.316*		*.316*	
right classification in %	*57.9*		*67.0*		*68.8*		*70.0*	

	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.
Push motivation	-.565	.047	-.129(.036)	-.138(.047)	-.425	.229			.609	.127			.730	.139		
Team size	-.001	.970			.003	.839			-.322	.034	.111(.021)	.151(.029)	-.392	.045	.101(.030)	.133(.035)
Degree of innovation	.053	.773			-.115	.621			.512	.076	.122(.060)	.141(.069)	.607	.088	.132(.087)	.133(.098)
Support during process	.153	.437			.083	.722			-.307	.266			-.016	.850		
Cooperation	.036	.437			-.144	.555			.421	.192			.496	.387		
Market assessment	.436	.041	.099(.031)	.106(.041)	.832	.003	.179(.000)	.205(.003)	.176	.593			.160	.602		
Market attractiveness	-.170	.449			.140	.641			.368	.308			.270	.390		

worst performer). Table 4 gives an overview of the most important results.[3] As a negative example, not delivering the desired results, the concept of spin-off success based on financial performance has to be singled out, however. In this case, Nagelkerke's R^2 is below 0.2. The correct classification however, is higher than 50 %. Since the financial performance cash-flow and profitability are also comprised in the construct of general performance, they are not completely left out of further interpretation.

4.2 Hypotheses testing

Our research design calls for a specification of when a hypothesis can be considered as accepted. Since we included different performance measures we only accept a hypothesis if the independent construct in question is shown to be significant by at least two out of four performance measurers. This principle leads us to the acceptance of the hypotheses H1 (push motivation), H6 (degree of innovation) and H3 (market assessment). So these three parameters can be regarded as important success factors detached from the underlying performance measurement. H2 (team size) only appears to be significant for the performance measurement based on growth, but with a negative sign and H7 (market attractiveness) is only to be confirmed for the performance measurement long-term prospects. H4 (parent support during spin-off process) and H5 (cooperation), however, have to be rejected.

5 Discussion

5.1 Success factors of RBSO

Since there is no theory postulating that some influence factors are more prone to a special kind of performance measurement, we decided not to formulate specific hypotheses but do an ex post interpretation of specific effects on various performance measures instead. Testing commonly used and well-known exogenous success factors with controversially discussed ones, we have seen that each performance measurement produces specific results and that they are featuring different success factors, although there are of course certain consistencies.

Our hypothesis concerning push motivation could be affirmed, even though pull motives have a far stronger positive influence on the future success of the business venture than push motives (Helm and Mauroner 2007). Since push motivation has not proven to be a convincingly reliable construct in itself and other studies had difficulties in (re-)producing the effects of entrepreneurial motivation on firm performance (Dahlqvist and Davidsson 2000), the interpretation has to be handled with care. But the negative stimuli like the threat of losing one's employment are certainly disadvantageous for successfully spinning-off a new venture, regardless of

[3] Av. M. E. are the average marginal effects. M.E.@m. are the marginal effects at means. All significance values are indicated. Having used directional hypothesis, the p values can be cut in halves. With regards to heteroscedasticity, we computed standard errors that are robust to heteroscedasticity. Results using robust standard errors confirmed the results given by the standard analyses.

the institutional context. Looking at the marginal effects we can see that beyond its statistical significance the higher the push motivation, the less likely the spin-off is going to be successful, with effect sizes from 12 up to 22 %.

Contrary to already existing empirical results (for example Baum et al. 2000), incubation support through the parent research organization could not be identified as significantly important for the classification of well-performing spin-offs: Neither the support during the spin-off phase nor the cooperation between spin-off and parent, once the spin-off phase has been completed and the venture has entered the market. Possible reasons could be the following: The benefits arising from alliances with the parent organization may not be direct effects but rather of a second-order or indirect nature and would thus have to be measured accordingly and could not be possibly captured in our research design. The longitudinal aspect, meaning that alliances take time to be established, had also not been considered properly (Baum et al. 2000; Bergek and Norrman 2008), although the distinction has been made between support during the spin-off process and cooperation between RBSO and parent research organization once the spin-off process has been completed.

Also Sapienza et al. (2004) explain the complexity of capturing incubation support: New ventures often rapidly establish relationships with other firms both vertically and horizontally and learning and support may take place simultaneously in several such relationships, potentially obscuring the predicted effects between RBSO and parents research organization. There need not be solely one dyadic relationship in which intense learning takes place, but there can be various. While an on-going relationship with the parent company can have technical benefit for the firm, any relationship clearly comes at a cost in terms of time energy and other resources dedicated to the relationship. Since these relational resources are limited, a strong on-going cooperation with the parent might reduce opportunities for new beneficial relationships and thus have a negative effect on performance.

Another argument is that the relatedness of a firm's knowledge base with that of any other firm is almost impossible to accurately assess. Other studies also had problems when trying to analyze incubation support: Walter et al. (2006) put the emphasis on the incubator network, while Scholten (2006) and Helm and Mauroner (2007) suggested a negative effect of tangible support and a positive effect of intangible support on early growth. Lendner (2003) on the other hand detected no relationship between services provided by the parent and sales growth. This shows that incubation support is a multi-faceted construct, not easily empirically controllable or reproducible. But this need not be discouragement for future research but rather an incentive to finally frame and capture this phenomenon successfully; especially given that from a theoretical perspective the case seems very clear.

The acceptance of the market assessment hypothesis confirms the centrality of competence-based view as an integral part of the resource-base of a new venture. This means that the starting configuration has to obligatorily include know-how about market assessment in order to align the core innovation to the needs of the market. The technology of a RBSO needs to meet the demands of the market and needs to have a fit to an existing opportunity independent from the context the spin-off emanates from. This is impressively underlined by the acceptance of the

hypothesis concerning the degree of innovation. Both influencing factors, market assessment and degree of innovation also display compelling marginal effects. RBSOs with a high degree of innovation are 12–23 % more likely to be successful and when they have strong competencies in assessing their targeted market they are around 10 % more likely to be successful when looking at the best thirds and even 18–27 % more likely to be successful when looking at the best quarter. The support of the parent organization however plays only a subordinate role and could unfortunately not be verified in this study.

5.2 Performance measurements

Taking a closer look at the individual performance measurements, it can be said that general performance is a comprehensive and recommendable measurement. It comprehends several aspects, such as general opinion of the business success, Sales growth, Cash Flow and Profitability, into one all-encompassing measurement. This mulitlayeredness is most certainly one of its assets. The fact that general performance and financial indicators show the same results is not surprising, since general performance already contains cash flow and profitability. Due to the low goodness-of-fit measures for financial performance with Nagelkerke's R^2 <0.2 and general performance being more multifaceted, this should rather be the performance measure of choice. The spin-off success measurements of growth and long-term prospects are also good measures but have to be handled with care, since growth may not always be the primary objective of newly founded ventures (Jaouen and Lasch 2015) and long-term prospects are prone to the IT industry sector. The long-term prospects are also an auspicious measurement since it does not merely provide a momentary snapshot but takes the future into account as well.

Our further analyses, see Annex 2 and 3, show that using a more fragmented sample the effects of exogenous factors on performance measures becomes a mere snapshot of that specific sample. In doing so, the goodness-of-fit measure of the Nagelkerke's R^2 and the right classification get better, indicating that in themselves the models are valid. Although there is some consistency in the results, market assessment and degree of innovation standing out as significant in most of the analyses, researchers have to keep in mind that the more heterogeneous the sample the less generalizable the result from a performance measurement. We also tried a different approach by contrasting the best third and best quarter respectively with all other RBSOs from the sample (see Annex 4). As expected, the results including the marginal effects did not differ greatly but the goodness-of-fit measures were not as good as our original approach's. Furthermore, a conditional logistic regression with industry-fixed effects has been carried out, which confirmed that the results were robust (see Annex 5), since it displayed the same significances as in Annex 4 with the addition of two more.

These further analyses also showed that typical control variables do have an impact. Age as well as industry sector do have an influence on which influencing factors are being put forward by the different performance measurements. In this respect each performance measure that we used seems to fit to a particular setting or particular analysis: The general performance measurements is suitable for the

analysis of market factors since our hypothesis concerning market assessment and its positive influence is confirmed in every further analyses, with split samples according to age and industry sector. The measurement longterm prospects puts forward degree of innovation and market assessment in both age groups but is not as conclusive when the sample is split into industry sectors. This implies that researchers should only use this measurement when looking at one specific field of industry. Looking at the financial performance clearly underlines the negative influence of push motivation especially when looking at young spin-offs. This effect vanishes however when looking at older firms. So for this measurement to work properly a homogenous sample regarding age is a prerequisite. We also give a similar advice when it comes to growth as a reliable performance measurement. Given our results it seems advisable to use this measurement only with a homogenous sample regarding age and industry sector.

Generally speaking, researchers have to be cautious when it comes to choosing a suitable performance measurement. Each of the constructs certainly has its merits but the individual objective of the ventures always has to be taken into consideration.

5.3 Conclusion

We asked ourselves whether different performance measures lead to different results in terms of success influencing factors. Trying to capture this phenomenon, we wanted to shed more light on differing effects when several performance measurements are used in an analysis.

A meta-analysis by Song et al. (2008) shows that the performance measure is a moderator on the antecedent performance relationship and recommends experimenting with different sets of performance measures. We therefore based our study on the most widely used performance measures (Li and Atuahene-Gima 2001; Zahra and Bogner 2000; Zahra et al. 2003; Tübke 2005) and chose the following five constructs: general performance, long-term prospects, financial performance and growth.

The contrasting of the different constructs of spin-off success shows that each of the performance measurements has its merits but in deciding which performance measure to choose the individual objective of the ventures always has to be taken into consideration. In order to derive clear implications, the sample should be as homogenous as possible.

Each construct shows slightly different results and thus highlights different independent variables as the most important influences. The originated differences over the separate constructs of spin-off success however vary only slightly, and they clearly present the influences of ‘push motivation’, ‘degree of innovation’ and ‘market assessment’ as the most articulately emerging ones. It is these three variable sets that are the most meaningful and reliable since they are pointed out by two to three out of four success measurements.

The results also show that RBSOs share certain characteristics with spin-offs in general but also have distinct attributes. Wanting to specify whether an aspect in question is of more general spin-off nature or is a distinct RBSO one, it can be stated

that as far as the degree of innovation is concerned, these aspects are very intricately embedded in the public research context, whereas team size and market assessment are of a more general nature.

5.4 Limitations and future research

In operationalizing the theoretical constructs into measurable ones and the respective data collection, the study relied on purely subjective data provided by spin-off founders. Although this method has its advantages, it most surely also has its limitations.

Furthermore, the limited number of RBSOs, ranging from 60 to 152 taken into the study, can be remarked. Starting with initially 177 usable questionnaires, only 60 to 152 could be used due to the distinction between best and worst performing third or quarter.

Our a posteriori analysis entails some limitations as well. The requested information about the time of the foundation of the spin-off, which lies in the more distant past, and the data about the spin-off success, which refers to the point in time the respondents were asked to fill out our questionnaire, have two different temporal reference points. So the time span between these two points in time can possibly account for a bias of some sort.

Besides eradicating the limitations from this study, future research can also start from one of the following points: As we have suggested, it might be important to develop more suitable research designs in the entrepreneurship context which take the implications of the time lag between the circumstances of the time of foundation of the venture with its overall business performance into account.

The definition of spin-offs as new companies in which both the founders and the core technology are transferred from a parent organization may be an oversimplification. Empirical work should include other resource-transfers and define research-based spin-offs more broadly as new firms which are established by transferring new technologies from a parent organization, like a government R&D laboratory, a research university, or even a private company.

Further, the spin-offs need external resources such as venture funding, business management advice, building space, or other necessary resources. Certain resources may come from the parent institution, while other resources may come from the external network in which the spin-off operates. Further research should examine how network contacts in the business environment, for instance, can provide access to resources that are necessary during the founding stage and the growth process.

Due to unsatisfying values in the factor analysis, we had to exclude the success construct of technological application. But this construct would constitute a valid and promising addendum to the set of chosen success factors, which should capture a preferably wide range of aspects influencing success in different ways. This is why future research endeavors should try to measure this construct differently and include it anew in a comparative overview of various success measures.

Acknowledgments We would like to thank the two anonymous reviewers for their suggestions and comments.

Annex 1: Summary statistics for dependent and independent constructs

	Median	Mean	SD	Min	Max
Influencing factors					
Push motivation					
Reorganization	7	6.44	1.360	1	7
Problems	7	6.08	1.697	1	7
Team size					
Size of founding team	2	4.15	11.192	1	120
Degree of innovation					
Degree of novelty	4	3.82	1.644	1	7
Novelty of the spin-off idea	4	3.82	1.598	1	7
Technological competitive advantage	5	4.81	1.476	1	7
Parent support during spin-off process					
Tangible support (infrastructure) from parent	3	3.31	2.218	1	7
Intangible support (information) from parent	2	2.42	1.814	1	7
Support by intellectual property	1	2.43	2.005	1	7
Consultation	5	4.54	2.309	1	7
Cooperation					
Benefit of cooperation with parent	5	4.56	1.789	1	7
Reference partnership with parent	5	4.51	1.800	1	7
Intensity of cooperation with parent	5	4.94	1.813	1	7
Coordination of cooperation with parent	3	3.27	1.866	1	7
Impact of cooperation with parent	4	4.27	1.966	1	7
Market assessment					
Market assessment	3	3.52	1.366	1	7
Assessment of competition	3	3.42	1.444	1	7
Market attractiveness					
Market potential	5	4.68	1.403	1	7
Market growth	5	4.98	1.463	1	7
Constructs of spin-off success based on					
General performance					
General opinion of the business success	5	5.12	1.231	1	7
Sales growth	5	4.51	1.235	1	7
Cash flow	4	4.41	1.428	1	7
Profitability	4	4.30	1.472	1	7
Long-term prospects					
Market share	4	4.19	1.312	1	7
Long-term perspective	5	4.97	1.229	1	7
Technological application					
Achievements of new patents	2	3.32	2.563	1	7
Licensing	1	2.70	2.383	0	7
Financial performance					

continued

	Median	Mean	SD	Min	Max
Cash flow	4	4.41	1.428	1	7
Profitability	4	4.30	1.472	1	7
Growth					
Employee growth p. a. (in %)	75	171	423.3	1	4818
Sales growth p. a. (in %)	102.2	294.9	433.8	10	3341
General performance index	4.5	4.585	1.095	1.5	7
Long-term prospects index	5	4.576	1.095	1.5	7
Technological application index	3	3.009	1.769	1	7
Financial performance index	4.5	4.356	1.290	1.5	7
Growth index	99.4	199.2	404.9	8.21	4079.5

Annex 2

See Table 5

Annex 3

See Table 6

Annex 4

See Table 7

Annex 5

See Table 8

Table 5 Results of the logistic regression for younger and older RBSOs

young' spin-offs < 7 years	General Performance				Longterm prospects				Financial performance				Growth			
group classification: best vs. worst performer	1/3		1/4		1/3		1/4		1/3		1/4		1/3		1/4	
N	75		58		74		53		75		55		39		28	
Nagelkerke R2	.233		.288		.252		.451		.260		.224		.703		.766	
right classification in %	69.3		74.1		70.3		77.4		76.0		70.9		87.2		92.9	
	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.
Push motivation	-1.322	.027	-1.280	.052	.135	.821	.830	.350	-1.912	.001	-1.355	.028	-1.857	.327	-1.474	.555
Team size	-.016	.608	-.036	.462	-.088	.360	.050	.660	.011	.727	-.010	.793	-1.449	.058	-5.335	.262
Degree of innovation	.241	.393	.235	.476	1.059	.001	1.585	.002	.222	.476	-.036	.921	.083	.905	-3.737	.267
Support during process	.093	.737	.189	.538	.048	.869	-.149	.720	.266	.380	.195	.559	-.478	.489	-2.711	.347
Cooperation	.068	.818	-.437	.259	-.102	.749	.106	.812	-.111	.723	-.356	.361	-1.284	.195	-2.264	.234
Market assessment	.660	.037	.874	.032	-.150	.619	.832	.085	-.034	.919	.289	.487	2.105	.064	6.377	.233
Market attractiveness	-.302	.384	-.008	.984	-.208	.530	-.944	.057	.237	.542	.170	.689	2.735	.056	12.299	.260

old' spin-offs > 7 years	General Performance				Longterm prospects				Financial performance				Growth			
group classification: best vs. worst performer	1/3		1/4		1/3		1/4		1/3		1/4		1/3		1/4	
N	70		53		75		52		77		51		41		32	
Nagelkerke R2	.230		.409		.414		.511		.164		.321		.344		.534	
right classification in %	62.9		75.5		70.7		78.8		70.1		74.5		70.7		81.3	
	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.
Push motivation	.015	.973	-.628	.269	.383	.317	.823	.176	.208	.588	.132	.821	.733	.142	.830	.292
Team size	.004	.846	-.005	.867	.099	.640	-.188	.570	.008	.689	.048	.654	-.810	.096	-.965	.178
Degree of innovation	.361	.212	.638	.109	.922	.009	1.043	.026	.277	.315	-.002	.996	.311	.446	1.285	.056
Support during process	-.122	.717	.424	.366	.137	.736	.836	.131	.113	.713	.084	.826	-.445	.425	-.676	.409
Cooperation	.142	.666	412	.305	.609	.086	.053	.910	.286	.312	-.003	.994	.337	.542	1.603	.137
Market assessment	1.229	.005	1.787	.004	.974	.036	1.756	.008	.864	.014	1.426	.007	-.754	.197	-1.119	.162
Market attractiveness	.020	.958	.482	.348	.764	.046	.173	.759	-.467	.156	.226	.660	.127	.848	-.650	.541

Table 6 Results of the logistic regression for IT and Medical RBSOs

industry sector: IT (N=79)	General Performance				Longterm prospects				Financial performance				Growth			
group classification: best vs. worst performer	1/3		1/4		1/3		1/4		1/3		1/4		1/3		1/4	
N	65		47		67		50		68		49		39		24	
Nagelkerke R2	.262		.378		.200		.172		.164		.411		.364		.547	
right categorization in %	67.3		76.6		67.2		72.0		61.8		75.5		64.1		70.8	
	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.
Push motivation	-.222	.659	-.579	.358	.995	.031	.668	.201	.017	.969	.099	.894	.608	.363	2.875	.095
Team size	.030	.400	.011	.637	.027	.745	.048	.590	.034	.296	.385	.025	-.330	.103	-1.091	.086
Degree of innovation	.296	.316	.612	.080	.321	.254	.266	.457	.141	.609	.186	.625	.036	.940	-.906	.341
Support during process	.065	.861	.640	.191	.193	.613	.187	.662	.191	.591	.022	.961	-.766	.158	.665	.561
Cooperation	-.098	.759	-.725	.080	.218	.463	.246	.519	-.042	.888	-.411	.286	.073	.881	-.974	.248
Market assessment	1.449	.003	1.915	.007	.336	.345	.556	.209	.887	.029	1.779	.006	.273	.608	.140	.846
Market attractiveness	-.207	.593	.056	.910	-.551	.125	-.726	.147	-.432	.223	-.008	.988	.464	.406	1.113	.217

industry sector: Medical (N=38)	General Performance				Longterm prospects				Financial performance				Growth			
group classification: best vs. worst performer	1/3		1/4		1/3		1/4		1/3		1/4		1/3		1/4	
N	31		28		33		21		34		24		13		10	
Nagelkerke R2	.319		.279		.646				.423		.427					
right categorization in %	67.7		57.1		87.9				76.5		75.0					
	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.	Coeff.	Sign.
Push motivation	-.910	.310	-.753	.416	-.664	.569	cannot be calculated		-.707	.397	.274	.780	cannot be calculated		cannot be calculated	
Team size	-.016	.777	-.016	.792	.418	.407			.006	.918	-.039	.764				
Degree of innovation	.243	.627	.081	.871	2.819	.014			.277	.610	-.224	.733				
Support during process	-.312	.492	-.201	.662	-1.047	.195			-.518	.294	-.261	.664				
Cooperation	.914	.150	.801	.213	1.900	.041			1.165	.081	.738	.416				
Market assessment	.755	.181	.501	.404	-.115	.857			.200	.694	.712	.322				
Market attractiveness	.769	.422	1.122	.293	.083	.919			1.541	.125	1.302	.251				

Table 7 Results of the logistic regression with a different set of coding used: 1 = BP, 0 = WP = ALL the rest

Constructs of spin-off success based on:	General Performance								Longterm prospects							
group classification: best vs. worst performer	1/3				1/4				1/3				1/4			
N	177				177				177				177			
Nagelkerke R2	.105				.144				.197				.269			
right classification in %	63.3				69.5				66.1				79.1			
	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.
Push motivation	-.036	.881			-.300	.236			.495	.061	.105(.052)	.123(.061)	.893	.021	.138(.016)	.138(.016)
Team size	.008	.573			.006	.646			-.055	.321			-.065	.429		
Degree of innovation	.057	.737			.116	.527			.653	.000	.139(.000)	.163(.000)	.648	.004	.100(.037)	.100(.004)
Support during process	-.025	.892			.151	.441			-.013	.945			.175	.423		
Cooperation	.077	.664			.054	.780			.191	.303			-.189	.399		
Market assessment	.674	.001	.151(.000)	.164 (.001)	.715	.001	.139 (.000)	.151(.001)	.155	.428			.979	.000	.152(.000)	.151(.000)
Market attractiveness	-.022	.913			.222	.329			.052	.798			-.561	.035	-.087(.028)	-.087(.031)

	Financial performance								Growth							
group classification: best vs. worst performer	1/3				1/4				1/3				1/4			
N	177				177				177				177			
Nagelkerke R2	.078				.094				.108				.087			
right classification in %	61.6				72.9				76.8				83.1			
	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.
Push motivation	-.413	.085	-.090(.076)	-.095(.086)	-.249	.332			.288	.356			.274	.432		
Team size	.005	.721			.009	.506			-.076	.384			-.120	.296		
Degree of innovation	.106	.541			-.197	.301			.257	.204			.193	.392		
Support during process	.154	.404			.079	.695			-.591	.015	-.096(.011)	-.092(.015)	-.430	.098	-.057(.094)	
Cooperation	-.011	.951			-.088	.651			.378	.082	.061(.075)	.059(.083)	.405	.098	.054(.094)	
Market assessment	.444	.024	.097(.017)	.103(.023)	.630	.004	.116(.002)	.120(.003)	-.258	.255			-.163	.512		
Market attractiveness	-.162	.431			.111	.629			-.193	.408			-.313	.225		

Table 8 Results of the conditional logistic regression with industry-fixed effects and the same set of coding as above (1 = BP, 0 = WP = ALL the rest)

Constructs of spin-off success based on:	**General Performance**								**Longterm prospects**							
group classification: best vs. worst performer	1/3				1/4				1/3				1/4			
N	177				177				177				177			
Nagelkerke R2	.981				.985				.998				1.000			
right classification in %	100				100				50.0				25.0			
	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.
Push motivation	-.065	.791			-.298	.238			.499	.057	.107(.048)		.861	.026	.163(.016)	
Team size	.010	.482			.008	.571			-.044	.355			-.061	.460		
Degree of innovation	.026	.877			.095	.609			.644	.000	.138(.000)		.638	.005	.121(.001)	
Support during process	-.002	.989			.119	.542			-.076	.694			.165	.450		
Cooperation	.087	.634			.037	.848			.165	.373			-.203	.368		
Market assessment	.701	.001	.159(.000)		.678	.001	.152(.000)		.144	.464			.958	.000	.182(.000)	
Market attractiveness	.058	.780			.203	.376			.017	.933			-.547	.041	-.104(.029)	

	Financial performance								**Growth**							
group classification: best vs. worst performer	1/3				1/4				1/3				1/4			
N	177				177				177				177			
Nagelkerke R2	.930				.956				.973				.926			
right classification in %	75.0				75.0				75.0				75.0			
	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.	Coeff.	Sign.	Av.M.E.	M.E.@m.
Push motivation	-.429	.074	-.101(.065)		-.246	.335			.345	.269			.328	.345		
Team size	.007	.620			.011	.437			-.081	.371			-.121	.310		
Degree of innovation	.081	.643			-.197	.305			.321	.123			.255	.274		
Support during process	.151	.419			.096	.637			-.591	.014	.070(.007)		-.445	.082	-.097(.070)	
Cooperation	-.016	.930			-.094	.631			.323	.141			.335	.179		
Market assessment	.445	.024	.104(.016)		.645	.003	.147(.001)		-.299	.196			-.217	.396		
Market attractiveness	-.121	.562			.146	.527			-.249	.297			-.379	.254		

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