

HOW AND WHY DO RESEARCH-BASED START-UPS DIFFER AT FOUNDING ?
A RESOURCE-BASED CONFIGURATIONAL PERSPECTIVE

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ABSTRACT

This paper studies the initial resources on which new organizations are based and how these resources interact with the institutional origin and market characteristics. Using a unique hand-collected dataset of research-based start-ups, we empirically test how technological, financial and human resources relate to each other to form distinct starting resource configurations. We find four different starting configurations: “Venture Capital-backed start-ups,” “Prospectors,” “Product start-ups” and “Transitional start-ups”. The results show that VC-backed start-ups are a minority while half of the firms start as prospectors. Market complexity and growth prospects influence the probability of starting with venture capital. The unclearness of the product market at founding characterizes prospectors, while product start-ups mostly have an almost market-ready product targeted at an international niche market. Transitional starters initially commercialize technical know-how through consulting and become product oriented later on. This discussion contributes to the debate concerning the interplay of environment and firm resources.

Key words: entrepreneurship; configuration; resource-based view; start-ups

INTRODUCTION

It is no accident that research-based start-ups (RBSUs), defined here as new business start-ups which develop and market new products or services based upon a proprietary technology or skill, have received a great deal of attention from academics in the last two decades (e.g.; Roberts, 1991; Shane, 2001; Utterback et al., 1988; Gartner, 1985; Hanks et al., 1993; Woo et al., 1994). RBSUs have been found to contribute significantly to an economy in terms of exports, employment, taxes paid, research and development, and innovations (Utterback et al., 1988) and play an important role in bringing new technologies to the market (Henderson, 1993; Christensen, 1997). The supporters of entrepreneurial development argue that in the long-run the formation of RBSUs can have an appreciable effect on regional job creation, technological change and innovation, and broader structural shift in a regional economy (Acs and Audretsch, 1990). However, the significance of small firms for regional development is still debated among researchers and policy makers. Some researchers argue that most new firms do not grow to any size, supply local rather than national or international markets, and are established by craftsmen entrepreneurs with strictly limited horizons and expertise rather than by entrepreneurs possessing managerial qualifications and a motivation for growth (Storey and Tether, 1998). Clearly, RBSUs are a heterogeneous group of firms but until today we lack a thorough understanding about how these firms differ at start-up. Without a better insight in the differences at founding it is difficult to explain which RBSUs are a source of economic wealth and new jobs in the future.

In this paper, we develop a multi-dimensional resource-based taxonomy of RBSUs. This research is important for entrepreneurship, strategy, as well as resource-based theory for several reasons. Firstly, the entrepreneurship literature shows that RBSUs vary considerably

in their starting resources. Once this diversity is recognized, the need to find a way to classify them becomes obvious (Gartner, 1985). The primary value of the framework we propose is that it provides a systematic mean of comparing and contrasting complex ventures and a way to conceptualize the variation and complexity in their starting resources. Secondly, one of the primary questions of interest in the field of entrepreneurship is how and why new ventures survive the start-up process and grow to become successful firms (Cooper et al., 1994; Gartner, 1985; Kazanijan & Drazin, 1990). Some argue that success is dependent on the characteristics of the firm's resource bundle (Barney, 1991; Chandler & Hanks, 1994; West & DeCastro, 2001) and that one of the new ventures' challenges is to identify and acquire an initial resource base (Penrose, 1959). Entrepreneurship literature has focused on the independent effects of resources on survival and success (Carter et al., 1994; Lee et al., 2001). This focus on independent direct effects provides a strong basis for identifying which are some of the relevant resources for a start-up but provides a limited understanding of complex business phenomena because it does not take into consideration the potential interactions between these variables (Lee et al., 2001). Thirdly, the focus on studying resources independently from each other is also contradictory to the Resource-Based View (RBV) of the firm. According to this theory, firms are "*bundles of resources*" and long-term competitive advantage lies in resource *configurations* that managers build using dynamic capabilities. Given this belief that it is resource configuration that matters, it is perturbing that resource-based configurational studies are still missing. Also from a theoretical perspective Resource Based View (RBV)-scholars face the key challenge to answer how resources interact and compare with other resources (Priem & Butler, 2001). A theory is not simply a description but should also possess explanatory and predictive power. Without an integrated perspective on resources and their interactions RBV-theory remains inconclusive or even leads to conflicting theories of firm performance. Fourthly, strategy scholars are debating the

interplay of environmental factors and firm resources (Nelson, 1991; Baum & Singh, 1994; Lewin & Volberda, 1999) and the interrelationship between motivation and resources (Wiklund & Shepherd, 2003). A resource-based configurational inquiry offers a holistic contribution to this debate. We argue that the link between resources and environmental and contextual factors cannot be understood by looking at resources in isolation but should be grounded in configurational thinking. In this paper, we study how different starting resource configurations of RBSUs are related to differences in technological domain, industry characteristics, organizational origin and entrepreneurial motivation.

In short, we believe that a resource-based taxonomy of RBSUs is important for at least four reasons: (1) to meaningfully capture the complexity and heterogeneity of these organizations; (2) because configurations will enhance our understanding of how resources interact with each other; (3) because configurations might better explain success and growth than independent resource¹; and (4) to study the interplay between resources and environment. The latter analyses are also a test for the external validity of the resource-based taxonomy. If the configurations do not differ on variables not used to group firms, they are unlikely to represent distinct empirical categories (Ketchen & Shook, 1996).

The above leads us to the following research questions. Which dominant starting resource configurations can we distinguish among RBSUs taking into account different types of resources? Is there a contingent relationship between starting resource configurations and environmental factors? Is there a contingent relationship between starting resource configuration and entrepreneurial motivation?

¹ Testing the predictive power of our taxonomy is part of our research program but is beyond the scope of this paper.

LITERATURE REVIEW

Starting Resource Configurations

Several scholars studied different resources of RBSUs such as the financial resources (Roberts, 1991; Manigart et al., 2002), personal characteristics of the founders or entrepreneurial team (Roberts, 1991; Feeser & Willard, 1990; Shane & Stuart, 2002), and the technology (Utterback et al., 1988). These studies have mainly focused on the independent direct effects of different types of resources on survival and success. However, RBV theorists acknowledge that resources may become specialized to others and evolve in a dynamic system (Mosakowski, 1993; Teece et al., 1997). Conner (1991) argues that the return to a resource is dependent on its relationship to other resources held by the firm so that, if a resource is more specialized to other resources, it may yield higher returns. The limited empirical evidence that exists indeed suggests that interaction effects between different types of resources are important antecedents of success of RBSUs (Roberts, 1991; Chandler & Hanks, 1998; Brush et al., 2001). Ignoring interaction between resources may be one explanation for the contradictory findings on the effect of starting resources on success of RBSUs.

Clearly “starting resources” is a multidimensional construct and RBSUs differ widely on each dimension. This multidimensionality creates a conceptual challenge in that a vast array of specific combinations could be developed along these dimensions to describe RBSUs. One popular response to this challenge has been to identify “organizational configurations”. Organizational configurations are groups of firms sharing a common profile of organizational characteristics (Miller & Mintzberg, 1984). Examination of organizational configurations has

been conducted under many labels, including strategic groups (Covin et al., 1990), organizational typologies (Miles and Snow, 1978), taxonomies (Galbraith and Schendel, 1983), and archetypes (Miller and Friesen, 1980). Regardless of the specific label, the underlying assumption is that configurations represent a way to meaningfully capture the complexity of organizational reality and to understand the relationship between organizations and their environments and performance outcomes. We argue that if resources are indeed linked to each other then one should be able to distinguish different types of resource configurations.

Our goal is to bring key differences in the starting resources of RBSUs into high relief and identify common patterns of relationships between starting resources. Hence, we position this study in the resource-based-view (RBV) of the firm (Wernerfelt, 1984; Barney, 1991; Teece et al., 1997), which argues that firm-specific resources and capabilities, which are both rare and valuable, determine the competitive advantage of a firm. When such resources are simultaneously *not imitable*, *not substitutable*, and *not transferable*, those resources may produce a competitive advantage that is long lived.

Critical Starting Resources for RBSUs

Barney (1991) classifies resources into 4 dimensions: financial, physical, human and organizational resources. The entrepreneurship literature clearly shows that RBSUs differ from the start in their financial, physical and human resources. *Organizational resources* are the systems, the routines and the relationships embedded in the company. They represent the ways in which firms combine and transform their other initial resources (Galunic & Rodan, 1998). Organizational resources are intangible, immobile and inherently difficult to imitate

and are therefore particularly important for providing competitive advantage. Organizational resources cannot easily be acquired by new ventures but are built over time. Thus, at the very beginning, i.e. when the new venture starts operations, organizational resources are not elaborated. In this paper we derive a taxonomy of RBSUs based on their *initial* resources, meaning the *resources during the first year*. Since RBSUs do not differ a lot in their organizational resources during their first years of operations, we don't take them into account to derive the taxonomy². We focus on the financial, physical and human resources.

Financial resources include all the different money resources that firms can use such as capital from the entrepreneurs, from equity investors and debtors. A start-up that invests disproportionately more financial resources early on is likely to accumulate a larger stock of strategic assets than peer ventures that lack the financial resources at founding (Lee et al., 2001). Several scholars argue that a lack of financial resources is a key component of the liability of newness (Stinchcombe, 1965) which starters face (Schoonhoven et al., 1990). Hence, the *amount* of financial resources at founding can be a source of competitive advantage for RBSUs. The total amount of financial resources used to finance operations comprises capital as well as debts. Next, we also distinguish between firms that raised capital from venture capital firms (VCs) during the first year and those that did not. Besides money, VCs also provide legitimacy, management know-how and financial expertise (Hellmann & Puri, 2000b). Hence, venture capital involvement at founding might be a source of competitive advantage.

² The RBSUs in our sample (see method section) are between 5 and 13 years old. One of the reviewers argued that this existence is long enough for organizational resources to be important. We agree. We stress, however, that we don't use the firms' resources at the age of 5 to 13 years old to derive the taxonomy. We use the firm's initial resources. That is, the resources they had during the first year of operations, which might be between 5 to 13 years ago. At that time, organizational resources are not built yet.

Physical resources include the physical technology used in the firm, a firm's plant and equipment, its geography and its access to raw materials. RBSUs are companies whose mission is to develop and market technologically new or improved products, services or processes. Technology is what distinguishes RBSUs from other start-ups and among RBSUs the technology resources vary widely. The other aspects of "physical" resources such as plant, equipment and raw materials are inferior for RBSUs in comparison to the technology underpinning the business. Further, we keep the geographic location constant in this study (see method section). Hence, in this study, we focus on the technology aspect of physical resources. RBSUs differ considerably along three dimensions of technology resources and RBV thinking indicates that these three dimensions might be important sources of competitive advantage. Firstly, RBSUs differ considerably in the newness or innovativeness of their core technology and innovativeness can be an important way for start-ups to differentiate themselves from incumbents and might be an important source for competitive advantage (Schumpeter, 1934). The innovativeness represents the intellectual component of the technology, which is largely intangible. Following Hellmann & Puri (2000a), we distinguish between innovators and imitators. An innovator is a firm that creates mainly new, proprietary knowledge. This new and proprietary knowledge could be licensed or sold on its own without translating it into products. An imitator, on the other hand, rather uses existing knowledge and focuses on making (minor) improvements to it or synthesizes several existing technologies in its own proprietary products. Secondly, RBSUs are not in the same stage of the product-development cycle at founding, because the extent of pre-founding efforts varies considerably among firms. Entrepreneurs may develop a technology/ product while working at a prior employer and transfer this technology/product to the start-up. These pre-founding efforts may give the start-up a competitive advantage over firms that start from scratch. Thirdly, RBSUs differ in the scope of their product-technology. Some firms develop one specific product,

while others develop broad platforms, which can serve as the base for several products (Meyer et al., 1997).

Human resources include the training, experience, judgment, intelligence, relationships, and insight of individual managers and workers in the firm. For new ventures, the entrepreneur(s) is/are the most critical – if not the only – human capital present in the firm (Van de Ven et al., 1984). The size of the teams and their experience and training seem to be key (Roberts, 1991; Shane & Stuart, 2002). Knowledge about the sector and management permits the RBSU to predict more accurately the nature and commercial potential of changes in the environment and the appropriateness of actions (Cohen & Levinthal, 1990). Entrepreneurs lacking such knowledge can hire experienced people to complement the management team. Therefore, we also take into account whether the firm attracted managers with more than 10 years of experience during the first year.

To summarize, the first research question we address in this paper is: “Can we distinguish different starting resource configurations based on financial, technology and human resources?”

Key Contingencies of Starting Resource Configurations of RBSUs

Stinchcombe (1965) argues that environmental conditions at time of founding strongly define the initial characteristics of an organization and that these influences were long lasting. Especially start-ups depend for their resources upon their environment. In this study, we want to go beyond the notion that environment matters and bring insights in ‘how’ environmental factors differ between different starting resource configurations. More specifically, we study heterogeneity in technological domain, organizational origin, and characteristics of the

industry that the firm targets at founding. By design, we control for non-measured macro-environmental factors such as the natural environment, demographic and social structure, and overall national and international economic conditions. Figure 1 gives an overview of the contingencies we address in this paper and in the following paragraphs we explain the rationale for studying each of them.

INSERT FIGURE 1 ABOUT HERE

Heterogeneity in technological domain

Many scholars study high tech start-ups in particular technological environments such as biotechnology (Stuart et al., 1999), semi-conductors (Schoonhoven et al., 1990), computers (Eisenhardt & Tabrizi, 1995), or software and dot-coms (Amit & Zott, 2001). The underlying rationale behind these technology specific studies is that the technological regime influences to a large extent the business model a start-up can follow and the resources needed to execute it. Hence, we expect to find different types of starting configurations in different technological domains

Heterogeneity in organizational origin

In the study of research-based start-ups, researchers often compile samples lumping together ventures from completely different parent institutes, without controlling for institutional level differences. Burton et al. (2002) show that career histories and characteristics of the prior employer influence the financing at start-up and the initial strategy of new ventures. This finding suggests that the organizational origin influences the ability to acquire certain types of

starting resources. We aim to test the influence of prior organizational context from which the firm emerges on starting resources. We distinguish between firms that spun-off from a parent organization and independent start-ups. Among the parent organizations, we make a distinction between “private corporations” and “universities”. We expect that we will find different starting configurations among the group of corporate spin-offs, academic spin-offs and independent start-ups.

Heterogeneity in industry and market characteristics

Differences among firms are assumed to reflect differences in the market environments that they face (Nelson, 1991; Chandler & Hanks, 1994; Covin & Slevin, 1990). Not all RBSUs develop a technology, which fits nicely into the existing industrial environment and for which all complementary assets are in place to commercialize it. RBSUs often have to create a new industry infrastructure and/or alter an existing industry infrastructure to commercialize their new technologies, products or services (Utterback & Suárez, 1993). Many authors have stressed the collective nature of innovative activity and pointed out that an organization is seldom solely responsible for, or has control over, the process of innovation (Aldrich & Fiol, 1994). Rarely does any firm possess all the necessary resources and capabilities to create a new industry infrastructure. Instead several actors shape the innovation process, for example through providing resources or blocking them (Collis, 1991, p. 51). The complexity in terms of different actors in the value added chain is therefore a first important item to characterize the industry environment of RBSUs. We could expect that RBSUs assess the complexity which they face in their business plan and, hence, in their starting resources. We explore then whether RBSUs with different starting configurations face a different industrial environment, worked out in terms of complexity of the value chain.

Next, Chandler and Hanks (1994; 1998) found that the requirements of the task environment or industry have a key impact on the amount of capital a business has at start-up. Especially, important is the resource-intensity of the selling process (Meyers & Athaide, 1991). If the RBSU targets a market of corporate clients, the decision to adopt its innovative product will usually be made jointly by numerous individuals representing various functions and departments (Lewin & Bello, 1997). The characteristics of such a buying center in terms of number and accessibility of decision makers, determine the complexity of the selling process. Start-ups might organize themselves in different ways to deal with these selling processes. In this paper, we explore whether start-ups adopt different starting resource configurations to deal with different degrees of complexity of the buying center of the initial targeted customers.

Finally, contingency fit theories suggest that the 'fit' between the served market and the firms' resources base and strategy is of outmost importance for success. Several studies showed that RBSUs differ considerably in the size and geographic dispersion of the markets they target at start-up. Some start-ups focus on a small niche market, others target a large mass-market from inception and other RBSUs focus initially on a niche market but have the specific intention of entering a large mass-market later on (Tiler et al., 1993). The venture capital literature (e.g. MacMillan et al., 1985) suggests that the ability of an RBSU to obtain risk capital is strongly related to the size and international scope of its targeted market. In addition the international management literature (Oviatt & McDougall, 1994; Chen, 2003) suggests that start-ups that target an international market from inception might need and have access to more and different resources than firms that do not (Autio, 1997; Autio & Lumme, 1998). Hence we explore whether firms that target different markets in terms of size and geographical scope adopt different starting configurations to do so.

To summarize: we explore how different starting resource configurations are linked with heterogeneity in four industry characteristics, namely the complexity of the value chain, the complexity of the customer's buying center, the size and geographic scope of the targeted market.

Heterogeneity in Entrepreneurial Motivation among Starting Resource Configurations

The reasons and motivations leading to start-up are considered important elements influencing not only the start-up of the new business but also its characteristics (Birley & Westhead, 1994; Hofer and Sandberg, 1987; Roberts, 1991, p. 149). Some RBSUs are founded mainly as a vehicle for self-employment, while other ventures are rather started because the entrepreneurs saw a unique opportunity that could not be pursued within their former work environment. This corresponds to two important dimensions of entrepreneurial orientation, namely proactiveness and autonomy (Lumpkin and Dess, 1996). In this paper, we explore how differences in those two important aspects of entrepreneurial orientation relate to different starting resource configurations.

METHODOLOGY

Population of RBSUs

We define “Research-Based Start-Ups” (RBSUs) as new business start-ups, which *develop and market* new products or services. “Start-up” points to the fact that firms under study are ‘young’. Previous research indicates that start-ups overcome their liability of newness not earlier than 3 to 5 years after creation, and more usually, not until the venture is 8 to 12 years old (Quinn & Cameron, 1983; Kananjian & Drazin, 1990). “Research-based” refers to firms that have their own R&D and develop their own products.

Environmental conditions such as the presence of top-level research institutes, the availability of venture capital, a strong entrepreneurial community and a massive influx of government funding impact the firms’ access to resources (Saxenian, 1994; Roberts, 1991; Schoonhoven et al., 1990; Deeds et al., 1999). To study how different types of resources relate to each other, it’s important to reduce the non-measured variance among firms resulting from the environmental conditions. Therefore, we study RBSUs in a homogeneous region and founded under comparable economic conditions. We choose Flanders, which is a small, export-intensive economy, located in the Northern part of Belgium. Flanders is considered as an emerging high tech region, experiencing a fast process of convergence between old and new technologies and thereby improving its competitive position (Cantwell & Iammarino, 2001). Next, we focus on RBSUs founded between 1991 and 1997³. The availability of seed money and venture capital for RBSUs increased during this period, but no great shocks occurred

³ These firms are between 5 and 13 years old at time of data collection. We want to stress that in this paper we focus on the resources these firms had during their first year of operations and not on the resources they had acquired at time of survey, i.e. when they are between 5 and 13 years old. Whilst these firms are likely to have established routines at time of data collection, we study how they were started, i.e. during the first years of operations when they did not have routines yet.

(such as the market drop in 2000) (Debackere et al., 1998; Manigart & Hyfte, 1999). The advantage of selecting companies founded in Flanders in the narrow time frame of 1991 to 1997 is that the impact of uncontrollable economic factors is limited⁴.

Sampling

To identify a unique set of Research Based Start-Ups (RBSUs), we took the listing of high tech sectors as defined by the OECD and Eurostat as a point of departure. Between 1991 and 1997, 7775 new high tech firms were started in Flanders, of which 5914 in service sectors and 1861 in manufacturing industries. Although high tech industries are argued to be R&D intensive and have a high incidence of new firms introducing new technologies and product in the market (Bower & Christensen, 1995; Hiltzik, 1999), it is intriguing that researchers have not found a sampling method, which captures only those companies that are in effect developing and commercializing new products and / or services. Thus, to address our research question in the particular population of our interest, we needed to overcome a sampling challenge.

There are two broad venues to identify the RBSUs in the broader population of high and medium tech companies. A first venue is to randomly sample in the high tech and medium tech industries as defined by the OECD and Eurostat (DSTI 1997/2). Adhering to this widely agreed upon methodology, we randomly sampled 720 firms and performed a phone survey of all these companies to discern to what extent these firms are active in developing and commercializing technological products and / or services. We found that only 27 (3.75%) of these firms are in effect RBSUs. Hence, we estimate that the total population of RBSU

⁴ Alternatively, we could have focused solely on the firms founded after 1997 to study their initial resources. However, this paper is part of larger research program. The next step will be to study the relationship between starting resources and firm performance. Therefore, we need RBSUs with a track record that is long enough.

founded between 1991 and 1997 in Flanders consists of 300 firms at most. The majority of the start-ups in high tech sectors has no own R&D activities and has no intentions to commercialize a proprietary new technology, product or service. Most firms are engaged in other activities such as distribution, software vending, building of web sites, specialized advice, etc. Further, the sample frame includes new divisions of established firms. To get a sample of about 100 RBSUs, it would be necessary to draw a random sample of about 2670 companies.

We found, however, that about half of the 27 RBSUs could also be identified by three other listings of high tech companies: (1) the academic spin outs generated in Flanders between 1991 and 1997, (2) the portfolio of Venture Capitalists (VCs) investing in early stage technology firms and (3) a database of SMEs requesting government support. These sources seems to be a more efficient way of identifying the population of interest. It is important to note that these sources are not mutually exclusive cases. Obviously, some firms received venture capital, government subsidies and turn out to be a spin out. What makes our database unique is that we performed a phone survey to each company in these listings to discern if they are in effect an RBSU. Table I gives an overview of our sampling method.

We identified 123 RBSUs, of which 27 were drawn from the random sampling and 96 from the three alternative listings. We have a response rate of 90%, ending up with 111 firms willing to cooperate in our research. Twelve of these companies appeared in more than one listing. After removing the duplicates from the sample, we ended with 99 unique cases for our analysis (of a total estimated population of 300 RBSUs founded in Flanders between 1991 and 1997).

INSERT TABLE I ABOUT HERE

At time of the data collection (2002 – 2003), the surviving RBSUs were between 5 and 13 years old. On average the RBSUs in our sample were 7 years old. Most of the 99 firms, namely 87 survived as independent entities. From the 12 RBSUs that dissolved by 2003, 5 went bankrupt and 7 were acquired. Only 3 RBSUs went public. During their first year of operations (the period we cover in this paper) the number of employees ranged between 1 and 25, with an average of 3. In 2002, the number of employees ranged between 1 and 520, with an average of 31.

Data Collection

The primary data source is a structured questionnaire. This questionnaire was conducted during face-to-face interviews with the founder of the company. The founders or CEOs were targeted because they typically possess the most comprehensive knowledge on the organization's history (Carter et al., 1994). The interviews typically lasted one to two hours and were conducted by two researchers. Immediately after the interview, the researchers crosschecked facts and impressions. Next to the collection of primary data, we double-checked the financial data with data available via the National Bank of Belgium and/ or company balance sheets. These audited data sources enhance the reliability of the measures and reduce common method bias problems. Finally, we collected additional information on each firm from secondary data sources such as web sites, company brochures, newsletters and press releases.

Starting Resources: Measures and Descriptive Statistics

In the theoretical section we argued that 10 variables along three resource dimensions, namely technology, financial and human resources, are appropriate to describe the resource-base of RBSUs at founding. The first question in the interviews was open-ended and asked the founder to tell in general terms about “How the firm was started?” Most founders spontaneously talked about their technology or product, the founding team and the financing. This enhances our confidence that these three resource dimensions are appropriate to explore starting resource configurations. Table II describes how these 10 variables are measured. All variables are based on specific questions in the questionnaire and are thus rated by the interviewee, except for the measures of technical scope and innovativeness. The two interviewers scored these variables based on the qualitative information obtained during the interview and additional information about products and technology from secondary sources. When consensus could not be reached a third experienced researcher was asked to read the interview reports and other information and score the variable. We choose to score these variables ourselves because these variables are less factual than the other items and founders lack a frame of reference when asked to evaluate the innovativeness and scope of their basic technology. We believe that researcher-based scoring improves the consistency of these measures. Table III provides an overview of the descriptive statistics of the resource variables.

INSERT TABLE II ABOUT HERE

INSERT TABLE III ABOUT HERE

Key Contingencies and Entrepreneurial Motivation: Measures and Descriptive Statistics

Table IV describes how the 6 contingency variables and entrepreneurial motivation are measured. Table V gives the descriptive statistics of these measures. Firstly, we look at the heterogeneity in the technological domain. Table V shows that our sample contains considerably more software firms (39%). This might limit our ability to pronounce upon the link between technology and starting configuration. Secondly, we study the heterogeneity in organizational origin. More specifically, we distinguish between RBSUs that spun-off from universities (24%), RBSUs that spun-off from private companies (28%) and firms without a link with a parent organization, i.e. independent start-ups (48%). Thirdly, we study the heterogeneity in industry characteristics. More specifically, we study the heterogeneity in the size and geographic scope of the target market at founding. These variables are scored by the founder during the interviews. Next, we developed measures for the complexity of the value added chain that the firm faces and the complexity of the selling process to the direct customer of the firm. The two researchers who interviewed all the firms scored these two variables using all the qualitative information from the interviews and secondary data and taking into account the other RBSUs as a frame of reference to code each individual firm. Finally, the entrepreneurial motivation to start the company is measured with two items, autonomy and proactiveness. These variables are scored by the founder on a 5-point scale in a telephone follow-up interview. Due to the lower response rate of these follow-up interviews, we also use a dummy, which measures the main motivation for founding the firm. This variable is scored by two researchers based on the answers to the first open-ended question in which the founder was asked to talk about how the firm was started.

INSERT TABLE IV ABOUT HERE

INSERT TABLE V ABOUT HERE

Cluster Analysis

We explore which different types of starting resource configurations can be distinguished among RBSUs by use of cluster analysis. Cluster analysis encompasses a number of different classification algorithms, which can be classified into two broad families: hierarchical and non-hierarchical clustering. Ketchen & Shook (1996) suggest using both procedures as complements to each other: first a hierarchical procedure can be used as an exploratory methodology to determine the desired number of clusters and as input to the non-hierarchical step. In this paper, we follow this two-step approach. To perform the hierarchical cluster analysis, we follow Ward's procedure with squared Euclidean distance as linkage measures (Hambrick, 1983). As inputs in the cluster analysis, we used the different measures of technological, financial and human resources described above. Following the criteria of Hair et al. (1992), we find a four clusters solution as the most appropriate for our data. Subsequently, we performed a k-means clustering with four as the predefined number of clusters and the same variables as inputs.

RESULTS AND DISCUSSION

Starting Resource Configurations

The F-statistic of the analysis of variance and the descriptive statistics for each cluster are given in table VI. We found that all variables were significant at the 0.05 level or better. The cluster characteristics are discussed below. For ease of interpretation, we have given each cluster a name, which reflects the starting resource configuration of the companies in the cluster.

INSERT TABLE VI ABOUT HERE

CLUSTER 1 (15 firms) corresponds to the *Venture Capital (VC) backed start-ups*. In contrast to all other categories, these RBSUs start up with external capital, either from institutional VCs, or corporations. They usually have a proprietary, innovative technology that can be used for different applications (platform), but at start up they are far from a market ready product. They usually have a large founding team, on average consisting of three founders. These founding teams have on average low management experience and low experience in the sector of the firm. However, during the first year after founding the management team is extended with highly experienced managers.

CLUSTER 2 (42 firms) represents the *prospectors*. Prospectors are in an early stage of product development at founding, but on average their technology base is more mature than VC-backed start-ups. Prospectors as a group seem however to be less innovative and less

involved with platform technologies than VC-backed start-ups. The founding team of prospectors is comparable to that of VC-backed start-ups in terms of size and experience, but none of the prospectors attracted experienced managers during the first year after founding. This seems to be related to the fact that prospectors start with much smaller amounts of starting capital than the VC-backed start-ups and none of the prospectors raised venture capital. Hence, it seems that prospectors lack the financial resources to attract experienced managers.

CLUSTER 3 (18 firms) represents the *product start-ups*. In contrast to the other groups, product start-ups usually have a product that is close to market in a first version. As a group they are less involved with platform and innovative technologies than VC-backed firms but more than the prospectors. The typical product start-up consists of one or two entrepreneurs, who have been working in the sector for a number of years. Only three product start-ups attract experienced managers during the first year, not accidentally the same three firms that raise venture capital at founding. Most product start-ups, however, do not look for external capital during the first year because they expect revenues from product sales shortly after founding and/or because they want to remain financially independent. Their working capital seems to be financed with a high degree of debts during the first year.

CLUSTER 4 (22 RBSUs) represents the *transitional start-ups*. These firms started as technical consultants without a concrete product idea. Typically, transitional start-ups started as one or two-person companies. The entrepreneurs have a lot of experience in a particular domain and founded the firm to commercialize their expertise. These companies are selected in our sample because later on they evolved into a product-oriented company. However, at start, these companies are focused upon the service aspect. Transitional start-ups are started

with small amounts of money and without venture capital and have high debt ratio during the first year.

The cluster analysis renders four different types of starting configurations among RBSUs. The first category, the VC-backed RBSUs are described extensively in the finance literature (e.g. Hellmann & Puri, 2000a). Whereas this literature takes the fact that VC-backed firms are a different category of companies as a point of departure, we find indeed that these companies also differ in terms of human and technical resources. Our analysis indicates that venture capital financing is related to broad and innovative technologies and larger founding teams. VC-backed firms are also more likely to attract experienced managers during the first year. The finance literature tends to treat the non-VC backed RBSUs as a homogeneous category. However, our analysis shows that the non-VC backed category is much more heterogeneous. We found three types of RBSUs that start without venture capital and also differ significantly in their other resources. We labeled these three types as the prospectors, the product start-ups and the transitional starters.

The transitional start-ups tend to be founded by entrepreneurs who commercialize their technical knowledge or skills rather than a proprietary technology or product. The founding characteristics of these start-ups correspond to those of the “life-style” oriented SMEs, the traditional SME and the family-owned SME described by other researchers (Birley & Westhead, 1994). This group of start-ups seems to grow very slowly over time or does not grow at all (Roberts, 1991). Maintaining ownership and creating income for the founder and its family are more important than growth for most of these companies (Lumpkin & Dess, 1996). Several researchers report that the technical consultants comprise the majority of high tech start-ups, spin-outs or new technology based firms. Roberts (1991, pp. 166 – 170) points

out that a large number of the technical consultant start-ups get stuck in their consulting mode and never evolve into a company with tangible products. We only selected the technical consultants that made the transition to a product-oriented company over the first 5 to 13 years of their life cycle. However, these transitional start-ups remain a large group in our sample (22%), which indicates that the technical consultancy business model is a prevalent starting resource configuration for RBSUs.

The prospectors and product start-ups can be seen as two hybrid types of starting resource configurations. The idea of a “hybrid” type of firm showing characteristics of VC-backed and technical consultants was first launched by Tiler et al. (1993). Tiler et al. (1993) observed a category of start-ups that did not grow in the first years, but started to grow later on. They also mentioned that although these companies did not show growth in the first years, they were started with a specific aim to grow later on. In this study we find two hybrid types of firms based on their starting resources. The starting configuration of the product start-ups is very similar to the one of transitional starters in terms of human, and financial resources but they differ considerably in their technical resources. Product start-ups have a close to market product, which they mostly commercialize in a small – but often international – niche market. Most product start-ups also prefer financial independence and maintaining ownership to fast growth.

The second hybrid group is the prospector group. As the typical VC-backed RBSU, prospectors start with a product in an early development stage and with entrepreneurial teams. However, prospectors do not (or are unable to) raise venture capital and start with a much smaller capital base. The interview notes reveal that at start-up most prospectors lack a clear idea about the potential of their technology and the market they will target. Hence, the

business plan lacks focus and their primary concern is to identify concrete product and market opportunities. Because of this, we label these firms as prospectors (cfr. Miles et al., 1978). The lack of capital forces prospectors to generate revenues through consulting, contract research, or other activities. Most prospectors start with customized consulting services using their early prototypes as a back office tool. The danger exists, however, that the consulting activities slow down the product development process and that the firm loses its first mover advantage or gets stuck in the consulting mode. Moreover, several entrepreneurs who started in the prospector mode complained that the lack of capital and the continuous struggle for revenues forces the firm into activities, which are not related to its core technology.

KEY CONTINGENCIES OF STARTING RESOURCE CONFIGURATIONS

Heterogeneity in technological domain

To test the association between the variation in technological segment and resource configurations, we perform chi-square tests (See Table VII). Overall, we find that technological segments do not differ significantly between clusters for software ($p=0.264$), telecom ($p=0.226$), and other domains ($p=0.377$). However, the prospector configuration seems especially appropriate for software firms. More than half (53%) of the software firms starts as a prospector. One explanation for this might be that early versions of software products are more appropriate to use as a back office tool for consulting activities than early versions of other technological products. We observed indeed that many software firms started with offering customized services but had the specific intention to move into repeated software sales (licensing) once the product was ready. Firms active in medical-related

technologies do differ significantly between clusters ($p=0.001$). In particular, the medical instrument companies are more represented among the product start-ups and the few biotech start-ups in our sample started as VC-backed start-ups. However, we should be cautious to draw strong conclusions based on these statistics because the number of medical related companies in our sample is too low (14%).

INSERT TABLE VII ABOUT HERE

Heterogeneity in organizational origin

To test the link between organizational origin and starting resource configuration, we calculate Pearson Chi-square statistics (See Table VIII). We find that academic spin-offs are more represented in the clusters of the VC-backed start-ups, but this result is not significant ($p=0.125$). The number of corporate spin-offs is higher among the product start-ups but again this distribution is not significant ($p=0.227$). The independent start-ups differ however significantly among the starting resource configurations ($p=0.031$). Independent start-ups tend to start in a service mode with or without the initial intention to move towards product sales (prospectors or transitional starters, respectively). Although not conclusive, our data give a first indication that the organizational origin influences the initial resource endowments of start-ups. Academic spin-offs are often based on a (patented) technology developed at the university, which is mostly formally transferred to the start-up. Hence, academic spin-outs mostly have a strong and proprietary technical base, which makes them interesting investment opportunities for venture capitalists. Corporate spin-outs often emerged from restructuring or outsourcing activities in the early and mid-nineties. These start-ups have a product or technology, which is closer to market than most university spin-outs. This might explain the

prevalence of corporate spin-outs among the product start-ups. Independent start-ups, on the other hand, more often start from scratch and these companies need some time to further develop their technology and convert their technical know-how into a product.

INSERT TABLE VIII ABOUT HERE

Heterogeneity in industry characteristics

To study the heterogeneity in industry characteristics among different starting configurations, we used the Kruskal-Wallis statistic (see Table IX). We found that the complexity of the value chain differs significantly between clusters ($p=0.003$). More specifically, we found that VC-backed start-ups face a significantly more complex value chain than the other three groups. One explanation may be that due to a complex value chain these firms need more resources to bridge the gap between product development and market sales. Alternatively, it might be that more complex value chains are associated with more ambitious projects with potential higher returns (and higher risk), which are more attractive to risk capital investors. In line with this, we observe that VC-backed start-ups face a more complex sales process than the three other groups of firms ($p=0.056$). They mostly sell complex and expensive products/services in a business-to-business context and have to deal with multiple decision makers inside the customer organization.

Estimated market size and geographic scope at start-up differ significantly among the four clusters ($p=0.06$ and 0.003 respectively). Especially the difference between VC-backed and product start-ups is noteworthy. Product start-ups tend to start in a specific small niche market, which is usually global or international. VC-backed start-ups on the other hand tend

to target large mainstream markets and are also global or international. This confirms that large mainstream and international markets are attractive to investors or alternatively that start-ups need sufficient financial resources in order to penetrate a large and international market. The transitional start-ups and prospectors target a small (niche) market, which is on average local.

INSERT TABLE IX ABOUT HERE

Heterogeneity in entrepreneurial motivation

Finally, we tested the difference of the entrepreneurial motivation between the different clusters. Firstly, we use our self-scored dummy, which indicates the main motivation to found the company based on our first interview question i.e. “Can you explain how the firm was started?” (see Table X). The Pearson Chi-square statistic shows that clusters differ significantly in their main motivation ($p=0.002$). Not surprisingly, the entrepreneurs that started a company mainly because they had recognized a concrete opportunity were most prevalent among the VC-backed start-ups and product start-ups. For prospectors and transitional start-ups, the product market opportunity is less clear at founding. In line with this, we find significantly more self-employment driven entrepreneurs among these groups. Next, we use the founder-coded scales for the importance of self-employment (autonomy) and anticipation of a concrete opportunity (proactiveness) to start the firm (see Table XI). The clusters do not differ significantly in the importance of self-employment to start the firm ($p=0.765$). Clearly, being independent is a main driver for almost every entrepreneur irrespective of the type of firm he starts. In line with our self-scored dummy, VC-backed

start-ups and product start-ups score higher on the pro-activeness scale than transitional starters and prospectors, but the difference is not significant ($p=0.715$).

INSERT TABLE X ABOUT HERE

INSERT TABLE XI ABOUT HERE

CONCLUSIONS AND RECOMMENDATIONS

Conclusions. RBSUs vary considerably in their starting resources. Moreover, limited empirical evidence suggests that financial, human and technology resources all tend to influence each other. Our thesis is that they do so in such a manner that gives rise to a small number of common resource configurations of RBSUs. Although resource-based theory argues that firms should be viewed as bundles of resources, a multidimensional resource-based taxonomy of RBSUs does not exist. The entrepreneurial finance literature distinguishes broadly between venture capital (VC)-backed and non-VC-backed RBSUs (Manigart & Struyf, 1996; Hellmann & Puri, 2000). This resource-based classification of RBSUs is based on one single variable (being VC-backed or not) along one resource dimension (finance) and thus captures only a small portion of the variation in starting resources of RBSUs. This literature tends to view all non-VC-backed starters as a homogeneous group. In this paper, we present a multivariate resource-based classification of RBSUs. Studying the underlying patterns in the financial, technical and human resources of RBSUs, we could distinguish four starting resource configurations: “VC-backed start-ups”, “prospectors”, “product start-ups”, and “transitional start-ups”. In line with the finance track, we find that VC-backed starters are a distinct type of RBSUs. However, our analysis shows that the non-VC-backed starters consist of three empirically distinct and conceptual comprehensible categories. These three types of non-VC-backed firms differ considerably in their human, technology and financing. Moreover, our analysis shows that the four dominant configurations are systematically related to non-resource factors. The proposed taxonomy offers a more fine-grained view diversity of RBSUs. We think that this taxonomy better captures the complexity and heterogeneity of RBSUs than the distinction between VC-backed and non-VC-backed firms.

The common patterns identified in the data give insights in how different types of resources relate to each other. Our results suggest that financial and human resources can reinforce or substitute each other depending on the maturity, innovativeness and scope of the product technology. More specifically, we found that RBSU who develop early stage, innovative and broad technologies are more likely to raise venture capital which goes hand in hand with larger founding teams and the ability to attract experienced managers during the first year. RBSUs focusing on a concrete product opportunity, on the contrary, are typically financed with debt rather than venture capital and don't attract professional management. The entrepreneurial teams have however more experience than VC-backed starters. Clearly, the relationships between different types of resources go beyond a simple correlation metric. Our results indicate that entrepreneurs with many years of experience prefer business models with short-term revenue streams (through consulting or product sales) and financial independence, i.e. without venture capital. Also Chandler and Hanks (1998) argue that founders with strong background experience may be able to start businesses that survive and thrive with less financial capital than their less experienced counterparts. Hence, it seems that experience and capital are substitutable to some degree. On the other hand, for firms developing early stage technologies, financial and human capital seems to reinforce each other. More of one leads to a higher probability of acquiring the other.

We also found that starting resources are systematically related to non-resource factors. More specifically, we found indications that the starting resource configurations are linked to the firms' history in terms of the parent institute that spun off the firm. The emergence of proactive technology transfer policies at universities is reflected in the prevalence of academic spin-outs among the VC-backed start-ups (Clarysse et al., 2001; Clarysse et al., 2003). Spin-outs from corporations seem to start differently from their academic equivalents, i.e. with a

less broad and innovative technology and more often with a close to market product. Independent start-ups are more likely to start in a consulting mode (as prospectors or transitional starters). Previous research looked at the effect of institutional structures and policies on the patenting and licensing of research organizations and laboratories, however the institutional imprinting of a parent institute on the venturing process and its starting configuration largely remains an unexplored theme. Our findings indicate that academic spin-outs penetrate the venture capital network more easily than independent start-ups and corporate spin-outs. The technological bases of academic spin-outs might be an important asset valued by VCs. Alternatively, the link with the university itself and the network of the technology transfer office might be the most important asset for securing venture financing (Lloyd & Royston, 1995; Lockett et al., 2003).

Next to the institutional link, heterogeneity in the characteristics of the industry that the firm targets at start-up is also linked to different starting resource configurations. This finding contributes to the ongoing debate in strategic management literature on this interplay. The study confirms the findings in the VC literature that VCs tend to invest in start-ups, which target mainstream, international or global markets of a significant size. Moreover, they invest in companies that face a complex sales process and an interrelated value chain. Product start-ups also target an international market, but in a specific niche. Our data show that these companies start without venture capital either because VCs do not want to invest in these companies (because the targeted market is too small) or because they simply do not look for external capital. Finally, transitional starters and prospectors start mostly with consulting activities, which are easier to sell and they often target the local market first.

Recommendations Venture capital is only important for a small group of RBSUs. Based on a list of firms in VC portfolios we identified 18 RBSUs. Fifteen of those are classified as VC-

backed starters, and only two of them are classified as product starters. Hence, our analysis shows that VC-backed starters are a distinct but small breed of RBSUs. As we used the VC-portfolios as one source to identify RBSUs and because we have response rate of 100% in this group, we are confident that we identified nearly all VC-backed RBSUs in Flanders started between 1991 and 1997. One could argue that our sample is biased towards VC-backed starters⁵. This bias has no implications for our findings, but we should be careful with extrapolations. More specifically, we think that VC-backed starters will represent a smaller percentage of the RBSUs on the population level in comparison to the representation in our sample. We estimate that the total population of RBSUs in Flanders comprises about 300 firms. Because we think that we identified almost all VC-backed starters in this population, we estimate that the percentage of VC-backed starters in total population of RBSUs in our time frame is about 6%. Policy measures to increase the availability of early stage venture capital are only useful for this small group of start-ups. All other RBSUs are not willing or able to attract venture capital. We found that these firms significantly differ in their human and technology resources and in the markets they enter. Only increasing the availability of venture capital will not benefit the majority of the RBSUs unless special funds are created which use other selection criteria than private early stage investment funds. The latter tend to prefer innovative, platform technologies and entrepreneurial teams complemented with experienced managers. Public seed or pre-seed funds, which do not impose the same requirements as private funds might be useful to finance RBSUs that face a market, which is too small for private funds or which need some incubation time before they are ready for VC-injection.

⁵ See limitation section for a discussion on this bias

VC-backed firms do not only have a high amount of capital, they also have substantial human and technological resources. Entrepreneurs trying to raise venture capital often face a chicken and egg problem: venture capital investors will not invest before an experienced team is in place and, experienced (expensive) managers are extremely difficult to attract without a strong financial basis. For practitioners, this implies that resource acquisition should be managed as a non-linear process in which different types of resources are built and acquired simultaneously. This means that VC-backed firms need an incubation period before they can attract VC money. Not surprisingly only a mere 7% of the RBSUs want and succeed in obtaining VC this during the first year. Because of the generally long incubation period within the university, it is not surprising that we find an overrepresentation of academic spin-outs in this group. Incubating and coaching initiatives that help entrepreneurs in working out their business plans and connect them to investors are needed to increase the success rate of RBSUs to attract finance and to survive the early growth path.

Forty-two out of the 99 companies started up as a prospector. This means that about 42% of the start-ups have no clear idea about its business model. They want to bring a product to market, and generate repetitive sales, but in fact they find out that they cannot attract the necessary financial resources and look for other ways to generate revenues. It is illustrative that such a large group of companies has an unclear product market at start-up. It is not surprising that the founders of these start-ups have relatively little sector and management experience. The availability of public seed capital (which uses other investment criteria than private funds) might help these companies to survive the financing gap they face. During their early growth they need to refine their business model, convince experienced people to join and further develop the technology or to start up with product. Also, subsidized advice could help these firms to bridge the knowledge gap they initially face. We think that an important

role for policy makers is to create and subsidize the supporting infrastructure to help entrepreneurs in setting up their business.

Eighteen companies start up as product oriented ones. Only few exceptions attract venture capital during the first years. The majority of the product start-ups finance their early growth with own savings and debts. In contrast to the first category of VC backed starters, they do not face a complex value chain or do not have an innovative technology. Mostly, the market they target is too small to attract venture capital. It is interesting that most of these companies are informal corporate spin-outs. Although it was difficult for product starters to attract venture capital in the early and mid-nineties, we have reason to believe that this has changed since the financial downturn on technology markets. Their concrete business plans with short break-even prospects tend to attract VCs nowadays.

Twenty-two percent of the RBSUs start as pure service organizations and changed their business model towards product development and commercialization later on. The venture capital community tends to reject business models based on services a priori because they lack exponential growth potential. The prevalence of transitional start-ups among the current product-oriented firms challenges this vision. Future research is needed to obtain more insights into the factors that lead to the transition from a service mode to product sales.

Finally, we found that one out of five companies that today bring a new product to the market or develop one originally started as a consulting company. These firms changed their business model during their early growth and we label them as transitional starters. They outnumber the amount of companies that start with venture capital. The consulting mode is less risky than the other starting profiles. Transitional starters do not need external capital and the

companies are mostly founded by one or maximum two persons. Unlike the prospectors, they do not do consulting to generate revenues and finance R&D but they have services as a clear and initial mission. An interesting domain for future research is to study the triggers for the transition towards product orientation. Since transitional start-ups seem to represent at least one fifth of the RBSUs, they are an important group of innovative firms. This type of start-ups tends to be overlooked by current technology transfer and R&D policies. For example, most technology transfer offices and spin-out policies of research institutes tend to favor those companies that have a large chance of becoming VC backed or at least product oriented (Clarysse et al., 2003). The firms that start as consultants often do not receive support. Next, transitional starters might also be a fertile ground for government subsidies in innovation and R&D. However, because they are consultants they are hardly approached by the different agencies. Too often, we depart from the idea that a business model cannot change.

LIMITATIONS AND RESEARCH DIRECTIONS

Limitations. The study has several limitations. Firstly, we have a limited population of 99 cases. Therefore, the results reported in this paper remain first indications, which should be tested in larger samples in the future. Secondly, our study only contains data on Flemish RBSUs. We deliberately choose a small geographic coverage in order to reduce the influence of non-measured variance in our study. The trade-off, however, is that one might question the external validity of this region and our findings. Future research in other regions is needed to test the existence and prevalence of the different starting resource configurations. However, we think that the Flemish region is comparable to most emerging and developing high tech regions and we believe that the external validity of this study is higher than studies focusing on highly developed and unique high tech environments such as Silicon Valley and Boston. A third limitation is that our study relies on retrospective data. Several scholars argue that such data can impose bias because the respondents' lack of trust-worthiness especially when the time lags between date of interview and the questioned period increases. This type of bias is one of the most difficult to overcome in entrepreneurship research. However, to reduce such problems, we crosschecked the information obtained from the founder(s) as much as possible with publicly available data (websites, company brochures, business plans, and database of the national bank of Belgium). Next, most of the founder-scored data are factual. The more qualitative, subjective measures (e.g. innovativeness) are rated by the researchers, which use the other firms in the sample as a frame of reference. Fourthly, we try to deal with survival bias by including survivors as well as dissolved firms in the sample. We study the resources of RBSUs during their first year of operations irrespective of the fact whether they survived as independent entities today. Finally, one could argue that we partly sampled on the dependent variable because one of our groups coincidences with one of sources to identify

RBSUs, namely the VC-backed starters. However, the purpose of this study is to pronounce upon how and why RBSUs differ in their starting resources. We find that RBSUs that raise venture capital represent only 6% of the total population. Relying on pure random sampling would result in too few VC-backed firms in order to draw any conclusions on this type of firms. By using 4 different (but overlapping) sources to identify RBSUs, we increase the heterogeneity of firms in our sample. The possible bias that might be introduced by relying on one source should be cancelled out mostly by the other sources.

Research directions. This study is a first step in a better understanding of how and why firms differ in their starting resources. Future research should study the validity of the four types of starting resource configurations under different regional and economic conditions. Next, future research should address the path dependencies of the RBV (David, 1985; Arthur, 1988). Stinchcombe (1965), Van de Ven et al. (1984) and others argue that the early development of organizations has profound influence on what they subsequently become. Shifts in the types and combination of resources are characteristic of the growth and development of new ventures (Penrose, 1959; Mosakowski, 1993; Galunic & Rodan, 1998). Hence, an interesting direction for future research would be to explore how these different types of firms evolve during their early growth path. The ultimate test of the proposed taxonomy will be to test its accuracy in the prediction of growth, evolution of resources and performance of firms. Finally, strategy scholars argue that the return of a resource is likely to be dependent on the environment, and the fit between the resource, environment and strategy (Friesen & Miller, 1986). Future research should explore this relationship in more detail.

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How and why do research-based start-ups differ at founding?
A resource-based configurational framework

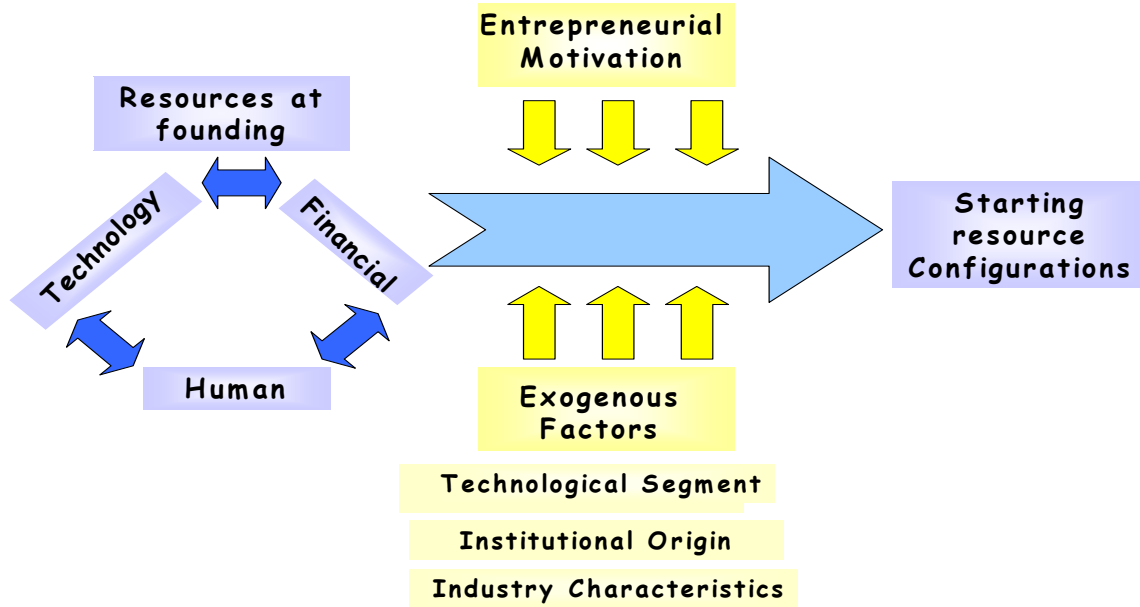


Figure 1: Hypothetical Framework

Table I: Overview of sampling method

Sampling sources of high tech companies set up between 1991 and 1997	Total Population	Sampled for phone survey	Non RBSU	RBSU	RBSUs willing to cooperate (Response Rate)
All new firms in high tech and medium high tech industries (DSTI/Eurostat)	7775	720 (9,3% of total population)	693	27 (3,75% of random sample)	27 (100%)
Number of companies in the portfolio of Venture Capitalists in Flanders, 2002	98	98	80	18	18 (100%)
SMEs that received R&D government support	114	114	67	47	42 (89.4%)
Academic Spin outs	40	40	9	31	24 (77.4%)
TOTAL				123	111 (90%)
Unique cases (after removing overlap)					99

Table II: Starting resource variables used to derive a resource-based taxonomy of RBSUs

Category	Description	Interpretation
Technology	Stage of development of core product (StageNPD)	Ranging from no α -prototype, over α -prototype, β -prototype to a market-ready product at founding (Scaled 0 – 3)
	Scope of product/ technology	Dummy: 1 indicating that the firm develops a platform serving as the base for several products; 0 otherwise
	Innovativeness	Dummy: 1 indicating that firm creates mainly new, proprietary knowledge (innovator); 0 firm rather uses existing knowledge and focuses on minor improvements to it or synthesizes several existing technologies (imitator)
Financial	Capital	Amount (Euro); For the cluster analysis the original capital variable is rescaled into 7 financial classes: <1k; 1k – 10k; 10k – 50k; 50k – 100k; 100k – 250k; 250k – 500k; and > 500k
	Debt Ratio	Ratio between loans plus other debts and capital (Log Amounts in Euro)
	VC	Dummy: 1 indicating that the firm raised capital from institutional risk capital investors during the first year; 0 otherwise
Human	Team size	Number of founders
	Management experience	Highest level of management experience of one of the founders ranging from low (less than 3 years); over medium (3 to 6 years) to high (more than 6 years) (Scaled 1 – 3)
	Sector experience	Highest level of sector experience of one of the founders ranging from low (less than 3 years); over medium (3 to 6 years) to high (more than 6 years) (Scaled 1 – 3)
	Hired Guns	Dummy: 1 indicating that professional managers with more than 10 years of experience were hired during the first year; 0 otherwise

Table III: Descriptive Statistics for the Resource Variables

Variables	N	Mean	Median	Minimum	Maximum	SD
<u>Technology</u>						
1. Stage NPD	99	1.071	1	0	3	1.154
2. Scope	99	0.182	0	0	1	0.388
3. Innovativeness	99	0.323	0	0	1	0.470
<u>Financial</u>						
4a. Capital	99	313 010	61 973	100	6 000 000	931 219
4b. Financial Class	99	3.82	4	1	7	1.631
5. Debt ratio	99	1.622	1.737	0	2.768	0.647
6. VC dummy	99	0.131	0	0	1	0.339
<u>Human</u>						
7. TeamSize	99	2.040	2	0	7	1.355
8. SectorExp	96	1.990	2	1	3	0.923
9. ManagementExp	96	1.833	1	1	3	0.948
10. Hired Guns	99	0.091	0	0	1	0.289

Table IV: Variables measuring key contingencies and entrepreneurial motivation

Category	Description	Interpretation
Technological Domain	Technological segment in which the firm is active	Following the International Patent Classification System and aggregating firms into 4 main classes: Software, Telecom, Medical-related and Others*
Organizational Origin	Academic Spin-off, Corporate Spin-off or Independent Start-Up	Three dummies with 1 indicating that the firm is an academic or corporate spin-off of independent start-up; 0 otherwise
Industry Characteristics	Complexity of value chain	The firms dependence on other players to develop complementary products or services so that the focal firm's product or service has value for the end customer (Scaled 1 to 4; with 4 = munificent value chain; 3 = all technology and complementary assets are available in house or can be built up at a relative low cost; 2 = the company does not have all technology or complementary assets to bring a product to the market but its negotiation strength is equal to that of the other parties; 1 = the company needs to deal with several large and complicated parties such as large organizations or government firms in order to further develop and commercialize its technology)
	Complexity of buying center	Complexity of selling process to the firm's direct customer taking into account the number of decision makers and the difficulty of locating and accessing them; scored as easy, moderate and difficult (Scaled 0 – 2, with 0 = one decision maker, whom the focal firm can easily approach. 1 = different decision makers but they are rather easy to locate and approach; 2 = different decision makers which are difficult to identify (e.g. because the customers organization is very complex) or approach (e.g. at a high hierarchical level or located in corporate headquarters abroad)
	Market Size	Size of the targeted market at founding ranging from niche, over temporary niche with specific intention to penetrate larger market later on, to large market (Scaled 1 – 3)
	Geographic Scope	Geographic coverage of market

		ranging from local focus, over European/ international to worldwide/global (Scaled 1 – 3)
Entrepreneurial Motivation	Autonomy	Importance of being self-employed (urge for autonomy) in the decision to start this company (Scaled 1 – 5, with 1 = not important at all and 5 = very important)
	Proactiveness	Importance of the anticipation of a concrete new opportunity in the decision to start this firm (Scaled 1 – 5, with 1 = not important at all and 5 = very important)
	Main motivation for starting the company	Dummy: 0 indicating that self-employment related arguments (i.e. loss of job, willingness to work independently...) were the most important reason; 1 if recognition of a concrete opportunity was more important to start the company

* A detailed description of the classification procedure can be obtained from the first author upon request.

Table V: Descriptive statistics for key contingency variables and entrepreneurial motivation

Variables	N	Mean	Median	Minimum	Maximum	SD
<u>Technology Domain</u>						
Software	99	0.394	0	0	1	0.491
Telecom	99	0.111	0	0	1	0.316
Medical related	99	0.141	0	0	1	0.350
Other	99	0.354	0	0	1	0.481
<u>Organizational Origin</u>						
Academic Spin-Out	99	0.242	0	0	1	0.431
Corporate Spin-Out	99	0.283	0	0	1	0.453
Independent Start-Up	99	0.475	0	0	1	0.502
<u>Industry Characteristics</u>						
Value Chain	98	2.643	3	1	4	0.722
Buying Center	96	0.979	1	0	2	0.808
Market Size	99	1.556	1	1	3	0.785
Geographic Scope	99	1.970	2	1	3	0.801
<u>Entrepreneurial Motivation</u>						
Autonomy	79	3.709	4	1	5	1.200
Proactiveness	79	3.810	4	1	5	1.167
Main Motivation	99	0.515	1	0	1	0.502

Table VI: Profile of Starting Resource Clusters (Means and Standard Deviations): Results of Cluster Analysis

Dimension	VC-backed start-ups	Prospectors	Product start-ups	Transitional start-ups	F (sig.)
<u>Technology</u>					
Stage NPD	0.467 (0.640)	1.167 (1.167)	2.500 (0.707)	0.182 (0.395)	25.362**** (<0.001)
Scope	0.400 (0.507)	0.095 (0.297)	0.278 (0.461)	0.091 (0.294)	3.363** (0.022)
Innovativeness	0.733 (0.458)	0.167 (0.377)	0.556 (0.511)	0.182 (0.395)	9.327**** (<0.001)
<u>Financial</u>					
Financial class	6.400 (0.910)	3.071 (0.894)	4.722 (1.320)	2.864 (0.889)	54.101**** (<0.001)
Debt ratio	1.259 (0.558)	1.598 (0.665)	1.624 (0.613)	1.879 (0.571)	2.993** (0.035)
VC dummy	0.667 (0.488)	0.000 (0.000)	0.167 (0.383)	0.000 (0.000)	28.827**** (<0.001)
<u>Human</u>					
Team Size	3.533 (1.767)	2.095 (1.246)	1.556 (0.705)	1.409 (0.734)	11.344**** (<0.001)
Sector Exp	1.600 (0.910)	1.333 (0.570)	2.833 (0.383)	2.955 (0.213)	58.500**** (<0.001)
Management Exp	1.533 (0.915)	1.143 (0.417)	2.722 (0.575)	2.773 (0.612)	52.614**** (<0.001)
Hired Guns	0.333 (0.488)	0.000 (0.000)	0.167 (0.383)	0.045 (0.213)	6.289**** (<0.001)
Cluster Size	15	42	18	22	97

Levels of significance: * = .10; ** = .05 ; *** = .01 ; **** = .001

Table VII: Heterogeneity in technological domain in the different clusters: Observed minus expected frequencies and Pearson Chi-square test of significance

Technological domain	VC-backed start-ups (N=15)	Prospectors (N=42)	Product start-ups (N=18)	Transitional start-ups (N=22)	Pearson Chi-square (sig)
Software	-2.031	4.113	-2.237	0.155	3.981 (0.264)
Telecom	2,299	-0.763	-1.041	-0.495	4.352 (0.226)
Medical related	0.990	-2.629	4.588	-2.948	15.460**** (0.001)
Other	-1.258	-0.722	-1.309	3.289	3.096 (0.377)

Levels of significance: * = .10; ** = .05 ; *** = .01 ; **** = .001

Table VIII: Heterogeneity in organizational origin in the different clusters: Observed minus expected frequencies and Pearson Chi-square test of significance

Origin	VC-backed start-ups (N=15)	Prospectors (N=42)	Product start-ups (N=18)	Transitional start-ups (N=22)	Pearson Chi-square (sig)
Academic spin-out	3.443	-0.959	-0.268	-2.216	5.747 (0.125)
Independent start-up	-4.113	5.082	-2.536	1.567	8.872** (0.031)
Corporate spin-out	0.670	-4.124	2.804	0.649	4.338 (0.227)

Levels of significance: *=.10; ** = .05 ; *** = .01 ; **** = .001

Table IX: Means and standard deviations for the business environment variables in each cluster and the Kruskal-Wallis test of significance

Variables	VC-backed start-ups (N=15)	Prospectors (N=42)	Product start-ups (N=18)	Transitional start-ups (N=22)	Kruskal-Wallis (sig)
Value Chain	1.867 (0.915)	2.929 (0.407)	2.778 (0.548)	2.476 (0.814)	14.095*** (0.003)
Buying Center	1.400 (0.632)	0.750 (0.809)	1.176 (0.728)	1.000 (0.873)	7.545* (0.056)
Market Size	2.067 (0.884)	1.405 (0.665)	1.611 (0.916)	1.455 (0.739)	7.400* (0.060)
Geographic Scope	2.600 (0.632)	1.690 (0.749)	2.222 (0.808)	1.818 (0.733)	13.857*** (0.003)

Levels of significance: *=.10; ** = .05 ; *** = .01 ; **** = .001

Table X: Heterogeneity in main motivation to start the firm: Observed minus expected frequencies and Pearson Chi-square test of significance

Variable	VC-backed start-ups (N=15)	Prospectors (N=42)	Product start-ups (N=18)	Transitional start-ups (N=22)	Pearson Chi-square (sig)
Main Motivation = pursue concrete opportunity	4.423	-8.216	3.907	-0.113	15.042*** (0.002)

Levels of significance: *=.10; ** = .05 ; *** = .01 ; **** = .001

Table XI: Means and standard deviations for two measures of the entrepreneurial motivation at start-up – autonomy and proactiveness – in each cluster and the Kruskal-Wallis test of significance

Variables	VC-backed start-ups (N=13)	Prospectors (N=32)	Product start-ups (N=16)	Transitional start-ups (N=16)	Kruskal-Wallis (sig)
Autonomy	3.538 (1.050)	3.750 (1.244)	3.438 (1.413)	3.875 (1.310)	1.149 (0.765)
Proactiveness	4.000 (0.707)	3.594 (1.388)	4.063 (0.854)	3.625 (1.360)	1.358 (0.715)

Levels of significance: *=.10; ** = .05 ; *** = .01 ; **** = .001