STARTING RESOURCE CONFIGURATIONS OF RESEARCH-BASED START-UPS AND THE INTERACTION WITH TECHNOLOGY, INSTITUTIONAL BACKGROUND, AND INDUSTRIAL DYNAMICS [1]

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ABSTRACT

We study the starting resources of start-ups, which develop and market new products or services based upon a proprietary technology or skill. We define these companies as research-based start-ups (RBSUs). We study how technological, financial and human resources at founding cluster together to form different starting resource configurations. Using a unique hand-collected dataset of RBSUs in Belgium, we find four different types of starting configurations: “Venture Capital-backed start-ups,” “Prospectors,” “Product start-ups” and “Transitional start-ups”. Further, this study shows that these different types of starting resource configurations are not only empirically distinct but can also be conceptually explained by internal factors such as the entrepreneurial orientation at start-up and external factors such as the origin of the firm and the characteristics of the industry in which the firm competes.

INTRODUCTION

Research-based start-ups (RBSUs) are new business start-ups, which develop and market new products or services based upon a proprietary technology or skill. RBSUs have received a great deal of attention from academics in the last two decades (e.g. Utterback et al., 1988; Roberts, 1991; Shane, 2001). These studies revealed that RBSUs, or New Technology-Based Firms (NTBFs) in more general, 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 (Christensen, 1997).

In this study, we explore whether we can distinguish dominant starting resource configurations among RBSUs. This research is attractive from a practical and a theoretical viewpoint. Firstly, there is a clear need for a multi-dimensional resource-based typology of RBSUs. Roberts (1991) found that different types of resources of RBSUs are linked and that the interrelationship alters the relationship between individual resources and firm performance. Chandler & Hanks (1998) found that human and financial capital appear to be substitutable. Most researchers, however, do not control for possible interaction effects between different types of resources. Without a deep understanding about resource typologies, it is difficult to draw meaningful conclusions and recommendations from research on RBSUs. Secondly, we want to contribute to the Resource-Based View (RBV) theory. A future challenge for RBV-scholars is to answer 'how' questions such as "How do resources interact/ compare with other resources?" (Priem & Butler, 2001).

In order to examine how different types of resources relate to each other, we use cluster analysis to distinguish dominant patterns in starting resources and to develop a resource-based taxonomy of RBSUs. Implicit in this line of thinking is a belief that the search for a

resource-based explanation of firm performance without an understanding of how resources relate to each other leads to conflicting theories of firm performance. Next, we analyze how different starting resource configurations are related to differences in technological domain, industry characteristics, organizational origin and entrepreneurial orientation. These analyses can also be seen as testing the external validity of the clusters. If the clusters do not differ on variables not used in the cluster analysis, they are unlikely to represent distinct empirical categories (Ketchen & Shook, 1996).

LITERATURE REVIEW

Starting Resource Configurations

Several scholars studied different characteristics of RBSUs at start-up such as the financial resources (Roberts, 1991; Hellmann & Puri, 2000ab; Manigart et al., 2002), personal characteristics of the founders (Roberts, 1991, p. 47 – 99; Burton et al. 2002), and the technology (Utterback et al., 1988). These studies show that "starting resources" is a multidimensional construct and RBSUs differ considerably along different resource dimensions. The next step towards a better understanding of starting resources is to capture major patterns in this variation while making abstraction of other factors. One popular response to this challenge has been to identify "organizational configurations": groups of firms sharing a common profile of organizational characteristics (Meyer et al., 1993). 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 (Ketchen et al., 1997).

We position this study in the resource-based-view (RBV) of the firm (Wernerfelt, 1984; Barney, 1991). The RBV tradition argues that firm-specific resources and capabilities, which are both rare and valuable, determine the competitive advantage of a firm. Most empirical research has studied one or more types of resources at one point in time and independently from each other and analyzed the relation between one type of resources and performance. Such a static approach fails to appreciate the interaction effects of different types of resources and overlooks the dynamism of the system. However, RBV theorists acknowledge that resources may become specialized to others and evolve in a dynamic system (Mosakowski, 1993; Teece et al., 1997). Recently, resource-based scholars have begun thinking about methods to study resources as a dynamic system (Brush et al., 2001; Chandler & Hanks,

1998). We argue that if resources are indeed linked to each other then one should be able to distinguish different types of resource configurations. In order to explore this, we use cluster analysis procedures to develop a starting resource-based taxonomy of RBSUs.

Critical Starting Resources for RBSUs

The most fundamental step in cluster analysis is the selection of variables along which to group firms. We use a combination of a deductive and cognitive approach to identify the appropriate variables for this study. Firstly, we follow the RBV theory to select a framework of different types of resources. Secondly, we use the perceptions of expert informants, i.e. founders of RBSUs, to select the cluster variables.

To examine the variation in starting resources, we adopt the general, often used classification of Barney (1991). Barney classifies resources into 4 dimensions: financial, physical, human and organizational resources. In order to focus on the most important resources for RBSUs and select the specific measures for each type of resource, we use insights from our field study. 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. To derive a resource-based taxonomy, we don't take into account organizational resources, because founders almost never talked spontaneously about them and RBV theory argues that this type of resources is not elaborated at start-up.

In the following paragraphs we briefly discuss the financial, physical and human resources and give a RBV explanation for the specific aspects we use to develop a resource-based taxonomy of RBSUs. F*inancial 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). Therefore, we argue that the amount of financial resources at founding can be a source of competitive advantage for RBSUs. We take into account the total amount of starting capital and the debt ratio of the firm during the first year. Next, we also distinguish between firms that raised capital form 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.

Physical resources include the physical technology used in the firm, a firm's plant and equipment, its geography and its access to raw materials. By definition RBSUs are companies whose mission is to develop and market technologically new or improved products, services or processes. Hence, the technical resources are mostly the most important aspect of physical resources compared to access to raw materials and plant and manufacturing. Empirically, we found that 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 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. Next, 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 at al.,

1997). Thirdly, 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; Lee et al, 2001). Following Hellmann & Puri (2000a) and Burton (1996), we distinguish between innovators and imitators. An innovator is a firm that creates mainly new, proprietary knowledge. 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.

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; Shane & Stuart, 2002). Hence, we focus on the size of the entrepreneurial team and the experience in the sector of the firm and the management experience. Next, we also take into account whether the firm attracted professional managers with more than 10 years of experience during the first year.

Key Contingencies of Starting Resource Configurations of RBSUs

Stinchcombe (1965) was one of the first to argue that environmental conditions at time of founding strongly define the initial characteristics of an organization and that these influences were long-lasting. 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 (Figure 1).

Heterogeneity in technological domain

Many scholars study high tech start-ups in particular technological environments such as biotechnology (Zahra, 1996). Others focus on semi-conductors (Schoonhoven et al., 1990), 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

Burton et al. (2002) showed 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 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 characteristics

RBSUs often have to create a new industry infrastructure and/or alter an existing industry infrastructure to commercialize their new technologies, products or services (Aldrich & Fiol, 1994). 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). Therefore, we think that the complexity in terms of different actors in the value added chain is 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.

The marketing literature indicates that the final part of the value added chain – the buyer-seller relationship – is of outmost importance for RBSUs (Loftus & Meyers, 1994). 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. 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.

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) 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. Hence we explore whether firms that target different markets in terms of size and geographical scope adopt different starting configurations to do so.

Heterogeneity in Entrepreneurial Orientation 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; Roberts, 1991, p. 149). Our field study revealed that 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'. We focus on RBSUs that are between 5 and 11 years old, which is presumably the time it takes for a new venture to mature and to overcome its liability of newness (Stinchcombe, 1965). "Research-based" refers to firms that have their own R&D and/or develop their own products (Utterback and Reitberger, 1982).

Sampling

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. 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 (Cantwell & Iammarino, 2001).

We adopt a guided sampling technique to construct the sample frame of RBSUs in Flanders, founded between 1991 and 1997. Three specific subgroups of the RBSU population are identified to construct the sample frame. It is important to highlight that the subgroups are not mutually exclusive, i.e. a firm can belong to one or more subgroups. We first select the subgroup of academic spin-offs. In previous research, Clarysse et al. (2001) identified all academic spin-offs in Belgium. Twenty-five companies in the sample frame are academic spin-offs, which all met the profile of RBSUs. Secondly, we select the subpopulation of start-ups that have received risk capital from Venture Capitalists and Business Angel Funds located in Flanders. Fifty-seven firms in these portfolios were founded between 1991 and

1997, and 18 of them met the definition of RBSUs. Only 8 of these were "new" RBSUs that did not appear as academic spin-offs. Thirdly, we identify the group of RBSUs that have received innovation or R&D grants from the Flemish government. One hundred eighty-two (182) start-ups in the period 1991-1997 had received such grants. Forty-seven (47) firms met the profile of RBSUs and 4 of these companies were already identified via other ways. Finally, we complemented the three groups with a random sample of 480 firms, drawn from the entire population of companies that were founded in Flanders between 1991 and 1997 and have a NACE-code that is classified in high-tech and medium-high-tech industries according to the OECD classification. Only seven new RBSUs could by identified using this random sampling. This confirms our intuition that the three subgroups, which we identified before represent a large part of the total population of RBSUs and that purely relying on random sampling would be a slow and cumbersome process to identify RBSUs.

Eighty-three (83) RBSUs[2] participated in our study. At time of the data collection (2002), the surviving RBSUs are between 5 and 11 years old. On average the RBSUs in our sample are 7 years old. Most of the 83 firms, namely 86%, survived as independent entities. The other 12 RBSUs (14%) dissolved, i.e. failed to exist as independent entities, by 2002. Half of these were acquired by other firms and the other half went bankrupt.

Data Collection

The primary data source is a structured questionnaire with mainly closed questions. This questionnaire is conducted during interviews with the founder. The founders or CEO's were targeted because they typically possess the most comprehensive knowledge on the organization's history, the firm's strategy, and its performance. Next to the collection of

[2] Due to missing data, only 76 firms are used in the cluster analysis

primary data, we double-check the financial data (e.g. revenues, capital, subsidies, loans, profits) with data available via the National Bank of Belgium and/ or company balance sheets. 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

Table 1 describes how the 10 resource 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 review 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 2 provides an overview of the descriptive statistics of the resource variables.

Key Contingencies and Entrepreneurial Orientation: Measures and Descriptive Statistics

Table 3 describes how the 6 contingency variables and entrepreneurial orientation are measured. Table 4 gives the descriptive statistics of these measures. Firstly, we look at the heterogeneity in the technological domain. Our sample contains considerably more software firms (49%). This might limit our ability to pronounce upon the link between technology and starting configuration. Secondly, we study the heterogeneity in organizational origin. Academic and corporate spin-outs and independent start-ups are equally represented in our

sample. 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 the qualitative information from the interviews and taking into account the other RBSUs as a frame of reference to code each individual firm. Finally, the entrepreneurial orientation 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 present low response rate[3] 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.

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. 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.

[3] At time of writing, the telephone follow-up is ongoing and more data points are forthcoming

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 5. 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.

CLUSTER 1 (14 firms or 18.4%) represents 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 VC-backed start-ups have high management experience but low experience in the sector. VC-backed start-ups often attract experienced managers during the first year after founding.

CLUSTER 2 (15 firm or 19.7%) represents the *prospectors.* As the VC-backed start-ups prospectors are in an early stage of product development at founding, on average in the α-prototype stage or earlier. Prospectors as a group seem however to be less innovative and less involved with platform technologies than VC-backed start-ups. The average size of the founding team is comparable to that of VC-backed start-ups, but prospectors have less management experience and none of them attracted experienced managers during the first year after founding. Prospectors are on average started with smaller amounts of starting capital than the VC-backed start-ups and none of these firms received venture capital at start-up, neither from an institutional VC nor a corporate one.

CLUSTER 3 (18 firms or 23.7%) 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 at time of founding. As a group the product start-ups 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. The management experience of the founding team is low and only few product start-ups attract experienced managerd during the first year. At start-up, most product start-ups do not look for external capital because they either expect revenues from product sales shortly after founding or they use the product back office and realize consulting sales (e.g. customized projects using an IT tool back office). Their working capital seems to be financed with a high degree of debts during the first year.

CLUSTER 4 (29 RBSUs or 38.2%) 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, most of these companies concentrated themselves purely on 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 (Manigart et al., 2002; 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 with more management experience. 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. 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 do 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 11 years of their life cycle. However, these transitional start-ups remain the largest group in our sample (33%), which indicates that the technical consultancy business model is a prevalent starting resource configuration for RBSUs.

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 either commercialize in a small niche or use as a back office tool for customized consulting services. The second hybrid group is the prospector group. As the typical VC-backed RBSU, prospectors start with a product in a very early development stage. However, the qualitative insights from the interviews teach us that prospectors have a less clear idea about the market they want to address than VC-backed start-ups. At founding the base technology of prospectors is less clear and, as a group, prospectors seem to be involved with less broad and less innovative technologies. As a result prospectors do not (or are unable to) raise venture capital and start on a smaller scale than VC-backed companies. They have, however, the intention to fasten their growth later on.

KEY CONTINGENCIES OF STARTING RESOURCE CONFIGURATIONS

Heterogeneity in technological domain

To test the association between the variation in technological segment and resource configurations, we performed chi-square tests. Overall, we find that technological segments do not differ significantly between clusters for software (p=0.183), telecom (p=0.722), and other domains (p=0.661). Only among the transitional start-ups we observe 3.9 times more software start-ups than would be expected. One explanation for this might be that in the early- and mid-nineties large companies started to outsource their IT departments. As a result, a number of start-ups were created which provided services to these large firms. Firms active in medical-related technologies do differ significantly between clusters (p=0.006). These companies are less represented in the transitional starters and more in the product start-ups. However, the number of medical related companies in our sample is too low (13%) to draw strong conclusions based on these statistics.

Heterogeneity in organizational origin

To test the link between organizational origin, i.e. academic or corporate spin-out or independent start-up, and starting resource configuration, we calculated again Pearson Chi-square statistics. We found that academic spin-offs are significantly more represented among the VC-backed start-ups, prospectors and product start-ups. The number of corporate spin-offs, on the other hand, was significantly higher among the transitional starters. Hence, our data indicate that the organizational origin differs significantly between different types of starting resource configurations. Employees that work in a large corporation are more likely to start up as technical consulting firm, which may make the transition to product-oriented companies later on. This might be partly explained by the fact that in the early and mid-nineties, corporate venturing in Flanders was not known at all. Instead, corporate spin-offs

most often resulted from restructuring or outsourcing activities. Most of the corporate spin-offs are based on personal technical skills or know-how of the entrepreneur(s). Academic spin-offs are more often based on a (patented) technology developed at the university, which is mostly formerly transferred to the start-up. In the early and mid-nineties the technology transfer offices in the Flemish universities did not offer extensive support to finance, structure and professionalize its spin-out companies. As a result many academic spin-outs in this period started as prospectors, i.e. firms that start with limited amounts of financing and with an early stage technology for which the product market was not clear at founding but which have the specific intention to become a high growth company later on.

Heterogeneity in industry characteristics

To study the heterogeneity in industry characteristics among different starting configurations, we used the Kruskal-Wallis statistic (see Table 6). We found that the complexity of the value chain differs significantly between clusters (p=0.002). 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.

Next, we find no significant differences in the complexity of the buying center between the four clusters (p=0.237). Box-plots reveal, however, that VC-backed start-ups face a more complex sales process than the three other groups of firms. 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 considerably among the four clusters ($p<0.001$ for both). 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 at least European. VC-backed start-ups on the other hand tend to target mainstream markets of a much larger size and are international from the start. This confirms that large 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 target a small and local market.

Heterogeneity in entrepreneurial orientation

Finally, we tested the difference of the entrepreneurial orientation between the different clusters. Firstly, we use our self-scored dummy, which indicates the main motivation to found the company. The Pearson Chi-square statistic shows that clusters differ significantly in their main motivation ($p<0.001$). Not surprisingly, entrepreneurs who started a company mainly because they had recognized a concrete opportunity were most prevalent among the VC-backed start-ups. In line with this, we find significantly more self-employment driven entrepreneurs among the transitional starters. 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 (KW-tests see table 7). The clusters do not differ significantly in the importance of self-employment to start the firm ($p=0.312$). Clearly, being independent is a main driver for almost every entrepreneur irrespective of the type of firm he starts. The importance of the recognition of a concrete opportunity as a main driver to start the firm does differ significantly among the clusters ($p=0.004$). More specifically, we found that VC-backed start-ups score significantly higher on the proactiveness scale than the other groups and transitional start-ups score significantly lower.

CONCLUSIONS, LIMITATIONS AND RESEARCH DIRECTIONS

Conclusions. Most prior research on RBSUs does not control for possible interaction effects between different types of resources in studying the link between resources and firm performance. Conner (1991) argues, however, 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. Hence, without a deep understanding about resource typologies, it is difficult to draw meaningful conclusions and recommendations from research on RBSUs.

In this paper, we studied the financial, technical and human resources of RBSUs. Our cluster analysis indicates that based on these resources, we can distinguish four types of RBSUs. We labeled these different types of starting resource configurations as "VC-backed start-ups", "prospectors", "product start-ups", and "transitional start-ups". These different types of starting resource configurations are empirically distinct and conceptually comprehensible. Hence, this study shows that there is no such thing as the typical RBSUs. Rather, there are different types of RBSUs with different starting resource configurations. We found that raising venture capital goes hand in hand with a broad and innovative technology and larger founding teams with more management experience. VC-backed start-ups are also more likely to attract experienced managers during the first year. This indicates that more of one type of resources leads to more of another and vice versa. We also found that start-ups with a concrete market-ready product typically start with average amounts of capital and more debts and rarely with venture capital. Hence, the relationships between different types of resources go beyond the simple correlation metric. Not only leads more of one to more of another type, but also a different composition of one type of resources is linked to a different composition

of the other. We think that the insights in starting resources and our typology are a first step towards a better understanding starting resources and the relationships between them.

We also found that starting resources are systematically related to non-resource factors. This enhances our confidence in the distinct empirically configurations we found. More specifically, we found that the starting resource configurations are linked to the firms' history in terms of the parent institute that spun off the firm. Next, also heterogeneity in the characteristics of the industry that the firm targets at start-up is linked to different starting resource configurations. This finding contributes to the ongoing debate in strategic management literature on this interplay.

Limitations. The study has several limitations. Firstly, we have a limited population of 76 useful responses. Hence, 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 very comparable to most emerging and developing high tech regions. 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. 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, who use the other firms in the sample as a frame of reference. Finally, we try to deal with survival bias by including survivors as well as dissolved firms in the sample and by studying firms that are between 5 and 11 years old, which is a much earlier stage than do most other databases.

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 in different regional environments and in larger samples. 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. 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. Future research should explore this relationship in more detail.

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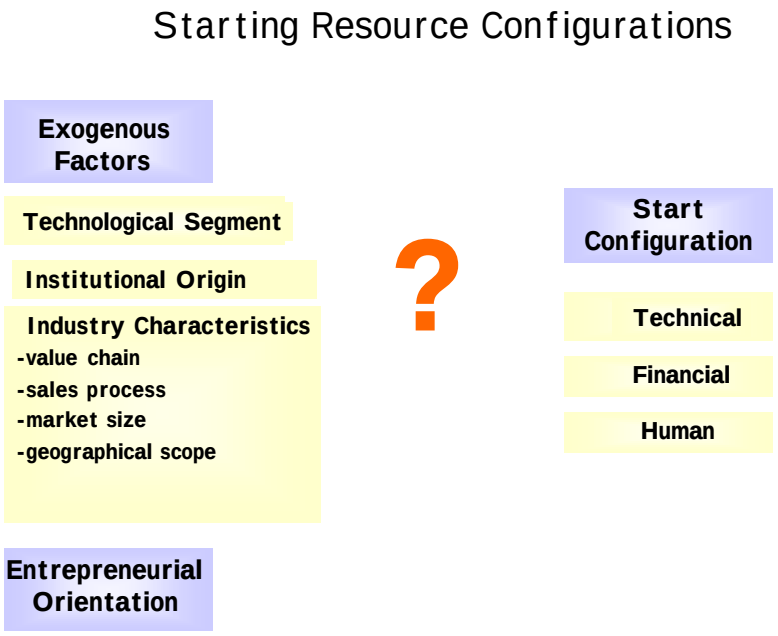

Figure 1: Hypothetical Framework

Table 1:Starting resource variables used to derive a resource-based taxonomy of RBSUs

Category	Description	Interpretation
Technology	Stage of development of product (StageNPD)	Ranging from no α-prototype, over α-prototype, β-prototype to a market-ready product at founding (Scaled 0 – 3)
	Scope of 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 2: Descriptive Statistics for the Resource Variables

Variables	N	Mean	Median	Minimum	Maximum	SD
Technology						
1. Stage NPD	80	1.062	1	0	3	1.173
2. Scope	79	0.190	0	0	1	0.395
3. Innovativeness	79	0.367	0	0	1	0.485
Financial						
4a. Capital	79	358 328	51 973	100	6 000 000	1 012 899
4b. Financial Class	80	3.95	4	1	7	1.713
5. Debt ratio	79	1.678	1.775	0	2.739	0.622
6. VC dummy	80	0.150	0	0	1	0.359
Human						
7. TeamSize	80	2.200	2	0	7	1.436
8. SectorExp	77	1.948	2	1	3	0.944
9. ManagExp	77	1.416	1	1	3	0.767
10. Hired Guns	80	0.088	0	0	1	0.284

Table 3: Variables measuring key contingencies and entrepreneurial orientation

Category	Description	Interpretation
Technological Domain	Technological segment in which the firm is active	Four dummies indicating whether the firm is active in Software, Telecom, Medical-related or Other domains
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 +2; with -1 = munificent value chain; 0 = all technology and complementary assets are available in house or can be built up at a relative low cost; +1 = 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; +2 = 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 Orientation	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

Table 4: Descriptive statistics for key contingency variables and entrepreneurial orientation

Variables	N	Mean	Median	Minimum	Maximum	SD
Technology Domain						
Software	80	0.488	0	0	1	0.503
Telecom	80	0.150	0	0	1	0.359
Medical related	80	0.125	0	0	1	0.333
Other	80	0.238	0	0	1	0.428
Organizational Origin						
Academic Spin-Out	80	0.313	0	0	1	0.466
Corporate Spin-Out	80	0.313	0	0	1	0.466
Independent Start-Up	80	0.375	0	0	1	0.487
Industry Characteristics						
Value Chain	79	0.380	0	-1	2	0.756
Buying Center	79	1.013	1	0	2	0.810
Market Size	79	1.557	1	1	3	0.780
Geographic Scope	79	1.873	2	1	3	0.774
Entrepreneurial Orientation						
Autonomy	53	3.660	4	1	5	1.255
Proactiveness	53	3.755	4	1	5	1.191
Main Motivation dummy	80	0.466	0	0	1	0.502

Table 5: 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.)
Technology					
Stage NPD	0.714	0.733	2.667	0.345	40.398****
	(0.914)	(0.961)	(0.594)	(0.553)	(<0.001)
Scope	0.500	0.067	0.278	0.069	5.167***
	(0.519)	(0.258)	(0.461)	(0.258)	(0.002)
Innovativeness	0.786	0.200	0.444	0.172	7.320****
	(0.426)	(0.414)	(0.511)	(0.384)	(<0.001)
Financial					
Financial class	6.714	3.133	4.111	2.862	53.689****
	(0.469)	(1.061)	(1.231)	(0.915)	(<0.001)
Debt ratio	1.284	1.577	1.614	1.918	3.809**
	(0.570)	(0.675)	(0.561)	(0.585)	(0.014)
VC dummy	0.786	0.000	0.056	0.000	49.457****
	(0.426)	(0.000)	(0.236)	(0.000)	(<0.001)
Human					
Team Size	3.143	3.867	1.556	1.379	27.495****
	(1.791)	(0.915)	(0.784)	(0.494)	(<0.001)
Sector Exp	1.571	1.533	2.278	2.138	3.016**
	(0.937)	(0.743)	(0.958)	(0.953)	(0.035)
Management Exp	2.000	1.133	1.222	1.414	4.212***
	(1.038)	(0.516)	(0.548)	(0.733)	(0.008)
Hired Guns	0.357	0.000	0.111	0.000	6.554****
	(0.497)	(0.000)	(0.323)	(0.000)	(0.001)
Cluster Size	14	15	18	29	76

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

Table 6: Kruskal-Wallis test of significance for differences in the business environment variables between the four clusters

Variables	VC-backed start-ups	Prospectors	Product start-ups	Transitional start-ups	Kruskal-Wallis (sig)
Value Chain	1.07	0.20	0.17	0.27	15.321***
	(0.497)	(0.774)	(0.514)	(0.648)	(0.002)
Buying Center	1.42	0.80	1.05	1.10	4.241
	(0.646)	(0.774)	(0.872)	(0.859)	(0.237)
Market Size	2.29	1.33	1.38	1.38	17.300****
	(0.726)	(0.617)	(0.777)	(0.676)	(<0.001)
Geographic Scope	2.64	1.80	1.94	1.52	19.677 ****
	(0.497)	(0.774)	(0.725)	(0.687)	(<0.001)

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

Table 7: Kruskal-Wallis test of significance for differences in entrepreneurial orientation, worked out as importance of autonomy and proactiveness to start the firm

Variables	VC-backed start-ups	Prospectors	Product start-ups	Transitional start-ups	Kruskal-Wallis (sig)
Autonomy	3.64	3.15	3.75	3.94	3.569
	(1.03)	(1.28)	(1.35)	(1.34)	(0.312)
Proactiveness	4.09	4.54	3.67	2.94	13.466***
	(0.83)	(0.87)	(1.07)	(1.34)	(0.004)

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