



Identifying financially successful start-up profiles with data mining

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ABSTRACT

Start-ups are crucial in the modern economy as they provide dynamism and growth. Research on the performance of new ventures increasingly investigates initial resources as determinants of success. Initial resources are said to be important because they imprint the firm at start-up, limit its strategic choices, and continue to impact its performance in the long run. The purpose of this paper is to identify configurations of initial resource bundles, strategy and environment that lead to superior performance in start-ups. To date, interdependencies between resources on the one hand and between resources, strategy and environment on the other hand have been neglected in empirical research. We rely on data mining for the analysis because it accounts for premises of configurational theory, including reversed causality, intradimensional interactions, multidimensional dependencies, and equifinality. We apply advanced data mining techniques, in the form of rule extraction from non-linear support vector machines, to induce accurate and comprehensible configurations of resource bundles, strategy and environment. We base our analysis on an extensive survey among 218 Flemish start-ups. Our experiments indicate the good performance of rule extraction technique ALBA. Finally, for comprehensibility, intuitiveness and implementation reasons, the tree is transformed into a decision table.

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1. Introduction

Start-up companies are very important for economic dynamism and growth but often have difficulties to stay in the market (Davidsson, Lindmark, & Olofsson, 2006). In order to understand this high failure rate among start-ups, researchers within the entrepreneurship research domain have focused on identifying the determinants of new venture performance in the last couple of decades. Thus far, initial resources have been designated as important determinants of new venture performance (see e.g. the work of Bamford, Dean, & McDougall (2000), Cooper, Gimeno-Gascon, & Woo (1994)).

Resources, defined as “all tangible and intangible assets that are tied to the firm in a relatively permanent fashion” (Wernerfelt, 1984), are not only indispensable for the basic functioning of a firm, they can also serve as sources of competitive advantage. This is the key idea of the resource-based view (RBV) in which it is posited that resources can only be sources of (sustained) competitive advantage if they are valuable, rare, costly to imitate and properly exploited by the organization (Barney, 1991). Moreover, initial

resources, i.e., the firm’s resources present at the point of inception, imprint the firm at start-up and thus affect its future competitive position (Bamford, Dean, & Douglas, 2004; Boeker, 1989).

Previous research has mainly focused on the identification of resources leading to superior performance. The majority of these studies concentrated on testing universalistic (independent of other resources and context) or contingency (independent of other resources, dependent on the organizational or the environmental context) models. Despite providing useful insights, both perspectives neglect two important issues. Firstly, resources interact with each other. This means that the strategic value of a resource is dependent on other resources. Therefore, one should assess the strategic value of resources at the resource bundle level (Black & Boal, 1994). Existing research, however, has been restricted to the analysis of additive effects of resources on the overall performance. Secondly, organizations face multiple contingencies at the same time. The value of a firm’s resources needs to be evaluated within the context of the firm’s strategy, as well as the specific market environment.

Existing studies neglect this multivariate dependency of a firm’s performance on resources, organizational and environmental factors. In this paper, we address both of these concerns by taking an inductive (data mining) approach, based on survey and financial data, to identify configurations of resource bundles, strategy and environment that yield good start-up performance. The remainder

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of the paper is structured as follows. The next section further describes the problem setting: identifying resource combinations that impact new venture performance. In Section 3, the data gathering process, experimental setup and data mining techniques are elaborated on. Section 4 provides the results of our analysis, while Section 5 concludes the paper.

2. Resources and new venture performance

2.1. Initial resource bundles

New venture performance research increasingly takes a resource-based view and investigates initial resources as determinants of success. Initial resources are said to be important because they imprint the firm at start-up, limit its strategic choices, and continue to impact its performance in the long run (Bamford et al., 2000; Boeker, 1989; Cooper et al., 1994). Even though firms are presented as 'bundles of resources' in the RBV, the majority of studies in this area treat resources as isolated elements. Yet, it can be argued that the strategic value of resources resides at the resource bundle level because interdependencies might exist between them.

Black and Boal (1994) identify three different types of interactive relationships. First, resources may compensate for each other implying that a change in the level of one resource is offset by a change in the level of another resource. Chandler and Hanks (1998), for example, show that for start-up companies human and financial capital compensate each other. Second, resources may enhance each other. This implies that the 'combination' of resources improves performance. Barney's organizational resources (e.g. compensation policy) for example, are by themselves limited in creating a competitive advantage, but enable a firm to exploit its other resources that do carry the potential for a competitive advantage (such as knowledge workers). And finally, resources may suppress each other. In this case, the presence of one resource diminishes the impact of another. Organizations that have such resources are better off with only one type or none of the resources. A very centralized, hierarchical firm structure, for example, might hinder the firm's capability for innovation.

To conclude, the successful implementation of a competitive strategy is not only dependent on the suitability of the individual resources to achieve a specific goal, but also on the relationships among them.

2.2. Resource, strategy and environment interactions

In searching for initial resources that confer success to start-ups, researchers should take into account that resources alone do not create value. Only when they are used to implement a strategy that creates valuable products or services for customers, they can be deemed valuable. Contingency theory puts forward that the need for resources differs across strategies. For example, innovation strategies require highly creative employees whereas cost strategies rather require low-cost labor.

Furthermore, the competitiveness of a strategy highly depends on the environment in which the company operates. Dynamic and uncertain environments generally require more innovation than do stable environments.

Given that *resources* are only valuable when they support a certain *strategy* that exploits opportunities (or neutralizes threats) in the company's environment, Barney and Clark (2007) argue that the value of a company's resources is not only contingent upon the strategy of the firm, but also upon its environmental context. Hence, firms should simultaneously align their resources, strategy and environment in order to achieve a competitive advantage. This

in essence is a configurational view on competitive advantage, in which a configuration is defined as a multivariate combination of firm characteristics and in which an ideal configuration is defined as a configuration in which the key attributes are tightly interrelated and mutually reinforcing.

From the above, we can conclude that research on the initial resource-performance relationship should move beyond universalistic and contingency perspectives. It should take into account that a competitive advantage will most likely lie in the complexity of resource bundles and the capability of simultaneously aligning a firm's internal and external attributes: its resources, its strategic orientation, and its environment. In this study, we investigate which configurations of initial resource bundles, strategy and environment are associated with financially healthy start-ups. We do so by means of classification trees (Martens, Van Gestel, & Baesens, 2009; Quinlan, 1993). Rules are thus formed indicating how different combinations lead to financially healthy start-ups. Consequently, tree analysis provides an assessment of the most discriminating resources (as well as strategy and environment characteristics) with respect to performance, in sequence and in combination, and an indication of how extensively these resources should be present. The principal advantage of tree analysis is that it allows for a direct search of optimal resource configurations as opposed to cluster analysis. In addition, this technique is easily interpretable and applicable to practice.

3. Experimental setup

3.1. Data collection process

The dataset on which to apply the tree induction technique was obtained via the procedure illustrated in Fig. 1. All independent resource-based variables were taken from the START 2003 survey. The target variable (Y2) was obtained by applying a start-up specific failure prediction model to the 2004 financial data of the START 2003 companies. This failure prediction model (with target variable Y1, indicating whether the company survived or not), was built using data obtained from the BELFIRST database. The final target variable Y2 was obtained by dummy-encoding the predicted probability p with the sector trimmed average. As such, Y2 is an indication of the global financial health of the firm. More details on the procedure are described next.

3.1.1. Data sources

The data on resources, strategy and environment were collected by the Flemish Policy Research Center for Entrepreneurship, Enterprises and Innovation in 2003 (START). The START 2003 survey targeted incorporated Flemish firms in all economic sectors founded between September 1st 2001 and September 1st 2002 and employing 1–49 people. Of the 2679 start-ups, 512 could not be reached and 637 filled in the questionnaire after two reminders (one by mail and one by telephone in October–November 2003). Because of item non-response and the removal of non-independent firms, the analyses are based on 218 observations.

Financial data on all starters during the same time period as the START 2003 companies (data set 1) were retrieved from the BELFIRST database which contains the annual accounts of 320,000 Belgian and 4000 Luxembourg incorporated firms. Using annual accounts for performance measurement offers the advantage of a broad spectrum of audited performance measures that are comparable across organizations.

3.1.2. Target variable definition and measurement

Our target variable is a measure for the competitive advantage of a firm in terms of global financial condition, i.e., the

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