DEVELOPMENT OF A HEURISTIC RATING MODEL FOR THE CLASSIFICATION OF KNOW-HOW-INTENSIVE AND TECHNOLOGY-ORIENTED START-UPS (KITSS) IN AUSTRIA

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ABSTRACT

The paper provides an insight into a doctoral thesis at the Vienna University of Economics and Business. Objective of this work was to analyse the reasons for success of know-how-intensive and technology-oriented Start-ups (KITSs) and to assess the potential for success at an early point of time in the companies' life cycle development. By demonstrating factors for success and failure and using them for the categorisation of start-ups, information asymmetries should be reduced and the success rate of these companies increased.

First, an explanatory model of the success of KITSs was developed, describing success factors as a cause for subsequent company success (effect). Success factors, relevance systems and interactions were identified in expert interviews, providing empirical cause-effect relationships based on experience. Second, a descriptive decision model (rating model) was derived which enables the categorisation ("Stars", "High potential for success", "Low potential for success") of a single case (specific KITS) through the application of the "general rules" identified in the success factors analysis. Success factors research (strategic management theory), rating theory (and practice) as well as model theory (heuristics) provide the theoretical framework for this work. A qualitative research design allowed the generation of a deeper understanding of the complex problem area. Furthermore, the lack of studies focusing on KITSs providing an up to date variable pool lead to a qualitative-explorative approach. 36 poblem-centered interviews were conducted with founders of young, established but also failed know-how-intensive and technology-oriented companies from different industry fields and experts of technology-intensive markets and companies (venture capitalists, business angels, representatives of funding agencies and incubators, start-up coaches, serial entrepreneurs). Factors for success and failure were identified in the domains of "team", "finance" and "market-technology-fit". For the rating model, the success factors are viewed as the "rating criteria", factors for failure as "warning signals". The weight of each rating criteria relates to the respective relevance identified in the success factors model and varies in dependence of the distinguishing features applicable to the specific KITS. For the evaluation of the KITS, the classification heuristics for evaluation and selection of alternatives "tallying" and "take-the-best" were identified. As one further result of the interviews, a "rating heuristic" was developed for the evaluation (rating) of a specific KITS.

KEYWORDS: heuristic rating model, classification, know-how-intensive, technology-oriented, start-ups, KITSS, Austria

1. OBJECTIVES

Many studies refer to the positive effects from foundation and growth of KITSs on a dynamic economic development[1]. Nevertheless, these companies face specific problems in fundraising on the (Austrian) capital market due to the high risk resulting from the lack of marketable securities, company history and company key figures as well as the high technical risk and information asymmetries[2]. Objective of this work is to analyse the reasons of the success of KITSs and to assess the potential for success at an early point of time in the companies' life cycle development[3]. By demonstrating factors for success and failure and using them for the categorisation of start-ups ("Stars", "High po-

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[1] Vetschera & Gillesberger, 2007, S.12, Meka et al., 2005, S.21, Metzger et al., 2008, S.1, Lueghammer et al, 2005

[2] Machart et al, 2008, S. 39, Jörg, Schibany, Nones, & Gassler, 2006, S. 11, 89, Carpenter & Petersen, 2002, S. 54ff, Engelen, 2007, S. 35ff

[3] in the seed and start-up pase according to the life cycle deleopment modell (Grabherr 2000)

tential for success", "Low potential for success"), information asymmetries should be reduced and the success rate of these companies increased[4].

In this thesis first, an explanatory model of the success of KITSs was developed, describing success factors as a cause for subsequent company success (effect). Success factors, relevance systems and interactions were identified in expert interviews, providing empirical cause-effect relationships based on experience. Second, a descriptive decision model (rating model) was derived which enables the categorisation of a single case (specific KITS) through the application of the "general rules" identified in the success factors analysis.

2. LITERATURE REVIEW

Success factors research (strategic management theory), rating theory (and practice) as well as model theory (heuristics) provide the theoretical framework for this work.

The neo-institutional finance theory emanates from information asymmetries, diverging interests and uncertainty and thus emphasizes the necessity of ratings in order to increase transparency and to reduce information costs[5]. „Rating is a method for the categorisation of facts, objects or individuals. Usually, rating is understood as the result of an assessment procedure. Ratings are applied, among others, in finance and banking, sociology, psychology and marketing."[6] Rating systems consist of rating criteria (weighted), warning signals, a rating scale and a rating result[7]. A distinction can be made between internal and external ratings, depending on which data is being used for the rating (public versus internal data). Furthermore, quantitative ("hard facts") and qualitative ("soft facts") rating criteria are used in existing rating systems, aiming at maximum transparency of strengths and weaknesses of a company.[8] This study does not differentiate between internal and external data. Success and thus rating factors were identified on a meta-level in expert interviews, not limiting possible results by predetermining categories (internal vs. external, quantitative vs. qualitative data) in advance. As start-ups cannot provide key figures (quantitative data) usually gathered from well established companies, the rating is rather based on "soft factors" (qualitative data)[9].

Banks do not develop specific rating models for start-ups but modify existing models according to practicability[10]. Heuristic models in particular are considered appropriate for the rating of start-ups [11].

Success factors theory is based on the assumption of few essential influencing variables, which significantly determine success or failure of a company[12]. Only few studies focus on the success of young technology-oriented companies. Due to the restrictions of this paper, a detailed literature review cannot be provided here. Relevant points of criticism address the methodological approach of studies in success factors theory. It is claimed that many studies neglect the multi-causal and multi-dimensional character of the phenomenon "success" in their analytical approach[13]. Nicolai & Kieser (2002) and Homburg & Krohmer (2004) postulate a lack of qualitative analyses in the success factors research. These points of criticism are taken into account in this study through the application of qualitative methods and heuristic procedures.

Due to the high complexity (multicausality, multidimensionality, and dynamic transformation of success factors) this work deals with poorly structured decision problems which lead to the application of heuristic procedures for the development of open models. The concept of „bounded rationality" has found widespread acceptance in the analysis of human decision-making[14]. According to Simon (1976), human behaviour is „intendedly rational, but only limitedly so". Consequently individuals want to act rational, but are limited in their capability to make objectively rational decisions due to cognitive limitations (limited information procurement and information processing capacities), incomplete information etc[15]. This study is based on the assumption, that the assessment of KITSs' potential for success is necessary for some stakeholder groups (start-up coaches, investors, funding agencies, incubators) in spite of limited information (lack of company history and key figures). Business angels are viewed as a particularly relevant stakeholder group as they provide capital in the early stage phase and they depend on the accurateness of their evaluation of KITSs personally (otherwise they could not be active over a longer period of time).

Heuristic models methodologically try to gain new insights based on experience values[16], which have their origins in [17,18]:

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[4] This paper summarizes the work conducted in the doctoral thesis of the author.

[5] Boué, 2005, S.86 und Prigge, 2004, F.179

[6] http://wirtschaftslexikon.gabler.de/Definition/credit-rating.html, translated from german into english by the author

[7] Lorenz, 2004, S.61ff

[8] Karglmayer/ Böhm, 2004, S. 113

[9] Binevitch, 2009, S.2f

[10] OENB, 2004, S.20

[11] OENB, 2004, S.21

[12] Fritz, 1995, S.594, Jünger, 2008, S. 18

[13] Werner, 2000, S.17

[14] Descriptive decision theory

[15] March / Simon 1958, S. 136; Simon 1976, S.39f

[16] Gigerenzer, 2011

[17] OENB, 2004, S.33

[18] Newell et al. 1962, S.78, Minsky 1963, S. 407 Anm. 1, Feigenbaum und Feldman 1963, S. 7ff, Reitman 1965, S.153ff, Kirsch, 1970, S. 94

- subjective practical experience and observations
- presumed economic relationships
- economic theories for specific partial aspects

The selection and application of a specific heuristic principle is based on the context-dependent degree of value proof (indicated by frequent use in context-dependent areas)[19], not the logical character of the problem area[20]. Therefore, application examples of heuristics in similar areas of study (heuristic procedures for stock valuation) as well as different areas of study with similar problem structure (e.g. medical diagnosis) were identified. Based on these considerations, heuristics were selected and used as a reference framework for the qualitative interviews with investors.

3. APPROACH/METHOD

A qualitative research design allows generating a deeper understanding of the complex problem area. Furthermore, the lack of studies focusing on KITSs, providing an up to date variable pool requires a qualitative-explorative approach[21,22]:

1. Literature search: findings from „success factors theory", „entrepreneurship theory", „model theory" and „rating theory" were used to integrate the work into a theoretical framework. It supported the development of the research design, the conceptualization of the empirical study and the development of the interview guide (inductive-deductive theory construction).

2. Development of the success factors model (explanatory model): in order to gather success factors of KITSs empirically and to illustrate them in a general success factors model, problem-centred interviews with relevant stakeholders were conducted. Through the involvement of different perspectives on the problem area, the validity of the survey was ensured[23]:

   a. Operative practical knowledge about factors for success and failure was gathered in 14 interviews with founders of young, established but also failed know-how-intensive and technology-oriented companies from different industry fields, focusing on company-specific promoting and hindering factors for success.

   b. Knowledge on a meta-level about factors critical for success and their interaction was raised in 11 problem-centred interviews with experts of technology-intensive markets and companies (venture capitalists, business angels, representatives of funding agencies and incubators, start-up coaches, serial entrepreneurs).

   c. The gathered data was analysed (qualitative content analysis[24]) and described in an explanatory model.

4. Development of the rating model (decision model):

   a. Objective of this survey phase was the identification of methods and models used in practice for selecting and rating KITSs. Furthermore, the success factors model was validated in the interviews. Additionally, interrelationships between the identified factors as well as their relevance (in dependence of life cycle development stage[25] and technology/industry sector) of each factor were collected. This was achieved in the course of 11 problem-centred interviews with Business Angels investing in Austrian KITSs.[26]

   b. Results and findings from literature analysis and interviews were brought together and resulted in the development of the heuristic rating model.

   c. A final validation of the rating model is achieved through a retrospective rating of former companies of an Austrian public incubator[27].

4. RESULTS/FINDINGS

1. Success factors model (explanatory model)

Distinguishing features:

Distinguishing features influence the relevance of success factors. As a result of the qualitative interviews, the following distinguishing features lead to different characteristics and relevance of specific success factors. A categorization in technology/industry fields did not approve of major importance. To a greater degree, the following categories were perceived as relevant distinguishing factors:

- Life cycle development stage
- High versus low technology intensity/-complexity

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[19] Dt.: „Bewährungsgrad"
[20] Scheuch, 1977, S. 48
[21] Schmalen, Kunert, & Weindlmaier, 2006, S. 5
[22] 20-30 qualitative interviews need to be conducted for the development of a typology (Lueger, 2000, S.53)
[23] The selection of interview partners was based on the „snowball system" (recommendations) as well as internet research (Przyborski/ Wohlrab-Sahr, 2008, S. 72).
[24] Mayring, 1990
[25] Grabherr 2000
[26] Selection of this stakeholder group: in Austria mainly business angels act as potential investors for KITS in the Early Stage Phase apart from family&friends, incubators and public funding. Unlike the other stakeholder groups, Business angels have long-time experience on a meta-level, could not be active over a longer time period if they are not able to assess the success potential accurately and have a personal interest in the success of KITS they invest in.
[27] Work in progress

- Basic research versus applied research
- Market-driven versus technology-driven development
- B2B versus B2C
- Experience of the team (first timer versus serial entrepreneur)
- Teamleader versus no teamleader
- Support from a business Angel / Smart Money versus no support

Success factors:

Factors for success and failure were identified in the domains of "team", "finance" and "market-technology-fit". Within these domains different critical factors exist which influence the success or failure of KITSs at a later point of time. They were illustrated in a table together with the factor-specific relevance (relevance of factors varies according to distinguishing features – see above) and interdependencies between different factors (this table cannot be displayed here due to restrictions of words in the present paper). Under specific circumstances some of the factors can be compensated.

2. Rating model (decision model)

The rating model provides an application of the general rules developed in the "success factors model" for the classification of one single case (one specific KITS).
The success factors are viewed as the "rating criteria", factors for failure as "warning signals". The weight of each rating criteria relates to the respective relevance identified in the success factors model and varies in dependence of the distinguishing features applicable to the specific KITS. For the evaluation of the KITS, the classification heuristics for evaluation and selection of alternatives "tallying" and "take-the-best" were identified. As a result of the interviews, the following "rating heuristic" was developed for the evaluation (rating) of a specific KITS:

	Starting-situation	Search rule / rating rule	Stop rule	Decision
Ratingheuristic	Choose an object (KITS), whose potential of success should be estimated	Assign the estimated value between 1 and 0 (1; 0,8; 0,6; 0,4; 0,2; 0) to each weighted rating criteria	Finalize the assignment after estimation/evaluation of all rating criteria and assess the sum of all positive values multiplied with each weight for the object (start-up).	Predict, to which of the following categories (rating scale) the object (KITS) belongs to, according to the rules below this table: "Star", "High potential for success" or "Low potential for success"

The assignment (rating result) of one specific KITS to a category of the rating scale depends on the following rules derived from the interviews:

1. "Star": all rating criteria apply fully to the rated KITS.
2. "High potential for success": all rating criteria with high weight apply to a great extent (1-0,8) to the rated KITS. Low values are allowed if compensated according to the rules identified in the success factors model or if the respective rating criterion has a low weight (relevance).
3. "Low potential for success": one (or more) rating criterion with high weight (relevance) shows a low value and cannot be compensated.

5. IMPLICATIONS AND VALUE

- Scientific interest
Results of this work help to cover the research gap in success factors research with regards to KITSs in Austria. The methodological criticism (no consideration of multicausality, multidimensionality and dynamic transformation of success factors) is taken into account by use of qualitative methods and application of heuristic procedures. With regards to rating theories, there are no scientific models for the categorization of KITS. Conventional methods are based on key facts that are not applicable to start-ups without company history. Also this research gap should be covered in this study by revealing practice of company selection and the development of a rating model. The separate consideration of KITSs seems appropriate due to the lack of company history and key figures as well as information asymmetries and the innovative character, high initial investments, high knowledge requirements, short technology cycles and the dynamic market development.

- Economic interest
High uncertainty with regards to technological and thus commercial success leads to a market failure for KITSs in Austria[28]. This is why a widespread governmental funding system was established. Through an early identification of factors critical for success and the categorization of start-ups through a rating model:
- Information asymmetries between investors and parties seeking capital (KITSs) can be diminished and thus the provision of higher capital availability could be achieved.
- A decision support for potential investors could be provided which helps to recognize problems and risks at an early point in time and to prepare against them accurately timed.
- Could support KITSs, start-up coaches, business angels, venture capitalists etc. to take early measures for the diminishment of error rates and the increase of the probability of success.

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[28] Jörg, Schibany, Nones, & Gassler, 2006, S. 13

Limitations and outlook:

- Biases due to a lack of awareness (experts are not aware of all factors that lead to success) as well as the possibility of intentional withholding of information cannot be excluded but reduced in the survey[29]. In order to consider these threats, a lot of different perspectives were taken into account. The impression of authenticity of the interviewees was gained in the personal interviews (authentic behaviour, high interest in the results of the study, provision of additional information per mail after the interviews, disposition for additional interviews, long duration of the interviews).
- The descriptive models developed in this survey are based on experience and knowledge of experts. Therefore, statistical causal relationships need to be tested in a quantitative survey. This is seen as an im-

portant follow-up work. Nevertheless, problems may arise with regards to the operationalization of the factors identified.
- The validation of the rating model should be conducted in a long-term study, observing the accurateness of the model over time. Due to time restrictions, a retrospective validation of the rating model was chosen.
- Regional focus of the study lies on Austria. Therefore, results mainly apply to Austrian KITSs active in the Austrian innovation system with its political, socio-cultural, legal and funding framework. Nevertheless, results may apply - to a certain extent - to KITSs in other countries as well.
- The study is not completely finalised.

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