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André Presse
Orestis Terzidis *Editors*

Technology Entrepreneurship

Insights in New Technology-Based Firms, Research Spin-Offs and Corporate Environments

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Foreword

The quality of life that is taken for granted in developed countries has not simply come about. It is the result of decades and, in certain cases, centuries of focus on inclusive development and creating products that created the greatest value and institutionalising the skills and knowledge into teachable competences. The greater value, or perception of value, was reflected in the higher amounts that customers were willing to pay for goods of services. This value in turn resulted in a virtuous cycle of improving quality of life. With time, this created societies that began to focus on the higher levels of the value chain, since these provided ever-increasing revenue per hour of effort. The increased productivity and quality of life also came at a price. It became clear that growth had limits, in the resources but even more in the environment. Our atmosphere is too small to absorb all the greenhouse gases, and our oceans are limited if it comes to pollution. The constraints in many cases led to new regulations, but again hard work in innovation was necessary to square the circle and allow for sustainable growth.

Over the past few decades, the world has become interconnected as never before. Goods and services found markets around the world, as ever more countries opened their markets to international trade and commerce. This further spurred the specialisation that had earlier given rise to products with higher perceived value, since the number of consumers who had the wherewithal to purchase them increased.

Commoditisation of manufacturing capabilities made the world more flat and smaller, since specialisation could be automated if the demand was high enough. This resulted in the West outsourcing to Japan, then South Korea and Taiwan, and ultimately to China. The result of this was that product manufacturing went to the cheapest location in the world. There was a belated realisation that with the outsourcing of manufacturing, the raison d'être of manufacturing that could be done in lower-cost countries was not adequate to sustain the wealthier Western economies.

The only way to sustain the existing quality of life was by way of innovation that countered commoditisation with higher perceived value. This innovation had to find its way from technology research and development to established companies as well

as startups. It is this technology transfer and commercialisation, its impact, challenges and bottlenecks that the authors have captured.

The efforts by the authors in capturing the relevance of, and challenges in, sustainable technology management in this context are both topical and highly relevant. Technology management is relevant in established firms since over time, all existing technology can become replicable, resulting in price-based competition. With developing countries having the lowest cost of manufacture, companies in developed countries cannot compete on cost. A focus on technology management can enable established companies to continue competing on value, resulting in a value-driven, rather cost-based, competitive advantage. The topic is also on the agenda for universities and research centres: the traditional mission of research and teaching is complemented in many institutions by the third pillar of innovation.

The different perspectives of entrepreneurship from researchers from across the globe provide fascinating insights on what afflicts startups and reasons why technologies succeed, or more importantly, fail, en route to commercialisation.

Technology startups fail because of many reasons. Chief among them include low-value recognition from customers, delivery failure resulting from underestimating the logistics of manufacturing and delivery, the inability to monetise since competing solutions are 'free' like e-mail or simply the inability to identify and focus on beachhead customers.

The authors have elegantly encapsulated the challenges that young technology firms face, have theorised on business models for technology ventures and have showcased how to convert value to sustained revenue, which ultimately ensures scale and profitability. Intellectual property (IP), which includes patents and trademarks, is an important method to provide competitive advantage, which ultimately results in impressive profits. The impact of student densities on IP creation and subsequent venture capital availability, which is a critical requirement for successful entrepreneurship, has also been discussed.

In particular, the authors have evaluated new technology-based firms (NTBFs) across Europe and analysed the impact of grants. The negative implications of state grants, in contrast to private funding, are that grants are often not 'smart', where they open doors to the market or prepare the ground for the next round of funding. These are critical to the subsequent success of NTBFs. Another impact of grants and other forms of state funding is that NTBFs continue to do more of the same; instead of focusing on go-to-market strategy that results in quick and replicable revenue and reaching scale, they focus on technology. These startups use the funds to do what they're already good at, rather than developing the business and sales channels.

In spite of the limitations of state funds and grants, it is undeniable that this funding is much needed and can have a huge positive impact at a time when there is a paucity of other funding sources due to the early stage of the NTBFs. The greatest impact of such funding is that it enables NTBFs to align closely to markets, so that their solutions become more driven by market pull rather than technology push. These have been extensively discussed and provide a valuable perspective, not only to NTBFs but also as cornerstones to state policymakers, to maximise impact of state funding.

Since the authors are primarily academicians from premier institutions in Europe, their perspective on important elements such as the impact of the eminent role that entrepreneurship programs play in universities is driven by objective analysis of large and comprehensive data sets. Indeed, this is distilled from their involvement in such programmes, providing a unique insight into the role that these programmes play. Further, and more importantly, these authors are actively involved in supporting entrepreneurship much before the startup comes into being—they help evolve the thinking of the would-be entrepreneurs. The book reflects several of their learnings as they continue to hand-hold and drive the future of entrepreneurship and competitive advantage of Europe.

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Part I
Business Models, Business Architecture and Business Planning of NTBFs

The Semantics of Entrepreneurial Learning in New Technology-Based Firms

Evaluating NTBFs' Entrepreneurial Progress Using Content Analysis of Business Plans

Marc König, Christina Ungerer, and Guido Baltes

Abstract New Technology-Based Firms (NTBFs) learn their business in the early-stages of their life-cycle. As a central element of the entrepreneurial learning process, the business model describes the value-creation functions that are conceptualized in different stages of the NTBF's life-cycle. Transaction relations connect the model with the business reality and ideally mature in strength over time to a functioning value-network. This chapter describes the development of a research design that determines, extracts, and evaluates semantics constructs of this entrepreneurial learning out of a convenient sample and three cohorts of business plans submitted to a business plan award between 2008 and 2010. The analysis shows empirical evidence for the survival and growth of those NTBFs that exhibit a balanced status of entrepreneurial learning in the maturity of the value-network that can be characterized as early startup-stage. The empirical findings of the network theory based business plan analysis will allow for a better explanation of the performance in the entrepreneurial process that is discussed for NTBFs based on theory of organizational learning.

Keywords New Technology-Based Firms (NTBFs) · Network theory · Organizational learning · Value network · Transaction relations · Business plan

1 Introduction: Relevance of the Entrepreneurial Status

NTBFs are of specific relevance when it comes to solving the problems of our modern society. They are seen as the carrier to bring new knowledge to the market that solves a certain problem in an innovative manner (Ferguson & Olofsson, 2004). NTBFs get started based on technologies that are underestimated or ignored as

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business opportunities by incumbent companies (Fontes & Coombs, 1996). Due to their liability of newness, however, they evince a high possibility of failure (Aaboen, Lindelof, & Lofsten, 2008).

In order to successfully manage the transition towards growth, NTBFs undergo massive changes in their early life-cycle (Sexton, Upton, Wacholtz, & McDougall, 1997). This especially due to the fact that they represent a new organization with a new product, which requires NTBFs to gain legitimacy (Ferguson & Olofsson, 2004). Failures in developing NTBFs through these transition stages are mainly due to the human factor and not due to technology or system failures (Longbotham & Longbotham, 2006). Many NTBFs simply do not manage to survive as they do not know what they are doing (Wille & Schulte, 2011). Particularly in their early life-cycle stages, they need to bring in immense knowledge into the organization (Franco & Haase, 2009; Øystein Widding 2005).

During this process NTBFs are embedded in an innovation system that helps them to learn their business and which highly impacts their survival and growth. In the inter-organizational environment of the innovation system, NTBFs gain information from intermediaries such as investors, institutionalized networks and consultants (von Nell & Lichtenthaler, 2011). They gain further distinctive resources to build up their business (Katzy, Sailer, Holzmann, & Turgut, 2011) which in the early-stage of the NTBFs' life-cycles in particular requires the facilitation of the ego centric value-network (McAdam & Marlow, 2008; Vanderstraeten & Matthyssens, 2012).

Stakeholders and intermediaries can help NTBFs and thus often represent parts of their early information-network. In their interactions, NTBFs rely on the business plan or presentations thereof to communicate their innovative business and receive education (Honig & Karlsson, 2004). This presentation of the business model represents the first "barrier" for NTBFs to get access to needed resources, since groups such as banks, corporates (investing money and often offer early business relations) and venture capital investors as well as incubators use it to prioritize the allocation of their scarce resources (Doganova & Eyquem-Renault, 2009; Karlsson & Honig, 2009; Kirsch, Goldfarb, & Gera, 2009; Mason & Stark, 2004). Although the business plan is commonly used as an education tool and selection document in the NTBF innovation process, little is known about predictive performance indicators and their empirical proof (Castrogiovanni, 1996; Simón-moya & Revuelto-taboada, 2016; Simon, 2012).

Therefore this article contributes to the understanding of the entrepreneurial process embedded into the innovation system based on analyzing the artifact 'business plan' from a network theory perspective and discussing the empirical findings in the context of organizational learning (Hoang & Antoncic, 2003; Tam & Gray, 2016). Transaction relations described in the text of NTBFs' business plans are discussed as indicators providing insight into the organizational learning status. As measurement instrument and an analyzing process are provided, which allow the status of entrepreneurial learning to be related to the NTBF performance. In the context of entrepreneurial learning the discussed findings will help practitioners of an innovation system to improve their evaluation and decision making process for prioritizing their support measures based on analyzing NTBFs' business plans.

2 Literature Review: Organizational Learning in the Early-Stages

Organizational learning (OL) has been discussed in the context of existing companies by many scholars since the early 1990s (Franco & Haase, 2009; Tam & Gray, 2016). The theory of organizational learning describes the interaction between the individual, the organization and its environment (Tam & Gray, 2016). It further tries to capture the dynamic process of creating, retaining, and transferring knowledge in the context of the organization in order to achieve a positive impact on the organization as a whole (Zgrzywa-Ziemak, 2015).

Thereby, the impact of organizational learning on the performance of the organization is specifically discussed in many studies. Against expectations, learning is not always positively related to an organization's performance, which leads to the assumption that learning may leads to specific results, as nonproductive learning also accrue (Zgrzywa-Ziemak, 2015). This necessitates an understanding of the concrete result of organizational learning to measure organizational performance.

As the NTBF creation is built on the identification and exploitation of a new technology-based business opportunity, it becomes crucial that the funding entrepreneur accumulates relevant knowledge within the NTBF (Fontes & Coombs, 1996). In this knowledge acquisition process the identification of the business opportunity requires explorative learning in the beginning of the NTBF's lifecycle, which enables acquiring new competences and technologies as well as extending relevant existing ones. Exploitative learning on the other hand aims at continuously improving the value creation system that caters to the respective opportunity. Keeping the balance of exploitation and experimentation is the key to system survival and growth (March, 1991; Tam & Gray, 2016; Zgrzywa-Ziemak, 2015).

Based on the innovative nature of NTBFs, learning in such NTBFs requires the involvement of many sources and interveners rather than a single process. In this context, the learning process depends on the surrounding innovation system that moderates the performance of the organization (Fontes & Coombs, 1996). Accordingly, Tam and Gray identified that inter-organizational learning plays a vital role during the early-stages characterizing NTBFs (Tam & Gray, 2016). Only constant inter-organizational learning will allow the NTBF and the surrounding innovation system to learn the innovative business model (Fontes & Coombs, 1996).

Inter-organizational learning can create knowledge that represents a competitive advantage (Graham & Muyia Nafukho, 2007). Following Chrisman and McMullan, NTBFs show knowledge gaps in four categories: know-why, know-what, know-how, and know-who. Know-why represents scientific knowledge, and know-what certain techniques and facts. Both are typically explicit knowledge and thus may not form the basis for competitive advantage. Tactical knowledge of know-who and know-how may be regarded as more heterogeneously spread and thus likely to enable a competitive advantage. Know-how usually integrates know-what and know-why into a process of "learning by doing". Know-who represents the

development of business relations emerging from this process (Chrisman & McMullan, 2004; Widding, 2007). Successful tactics of NTBFs are usually based on experience from prior startups, management or industry specific experience (Huovinen & Tihula, 2008).

Developing successful tactics stemming from know-how and know-who is characterized as entrepreneurial knowledge in literature (Franco & Haase, 2009). Entrepreneurial knowledge in a certain sector allows NTBFs in the entrepreneurial functions of a business to convert resources from the market place to a higher yield by combining (innovation) and marketing them in a new value combination. Entrepreneurial knowledge leads to new ways of managing NTBFs. Therefore, the ventures need to interact with their partners surrounding the envisioned business model (Widding, 2007; Xiu-qing & Li, 2013).

Strategies for learning a new business—such as the widely used discovery driven planning, critical assumption planning, and the lean startup approach—describe adaptive learning strategies as fundamental for entrepreneurial survival and success (Hart, 2012; Mcgrath & Macmillan, 1995; Sykes & Dunham, 1995): NTBFs in their very early-stage sort through their ideas in an experimental attempt to adapt to outside needs. In the course of these attempts the NTBF learns which relations to build and which to avoid (Greve, 1995; Sullivan & Ford, 2014).

For NTBFs, business models play a vital role in the inter-organizational learning process. They are used in different steps during the early-stages of NTBFs' business life-cycles. The presentation is often done in the form of one-pagers, pitch decks and business plans describing the business model. Business models are used to explore the respective business opportunity and to build the value network, i.e. documents help NTBFs to get feedback on the core assumptions of their business case and at the same time to convince external partners (Danna & Porche, 2008; Doganova & Eyquem-Renault, 2009; George & Bock, 2011).

3 Research Question: Determining the Status of Entrepreneurial Learning

Despite the broad theoretical understanding of inter-organizational learning necessities, little is known about the entrepreneurial learning patterns of NTBFs. Even more, there is little understanding of NTBF interactions (when? with whom?) in the innovation system from a life-cycle perspective. This is in particular due to the integral challenge of lacking methodologies to investigate NTBFs in a sufficiently large number and in different life-cycle stages (Hoang & Antoncic, 2003; Tam & Gray, 2016). In this context the most frequently available and semantically rich artifact of NTBFs' entrepreneurial learning about their business model is the business plan (Honig & Karlsson, 2004; Karlsson & Honig, 2009).

Despite its vital role, neither the innovation systems practices (Hindle & Mainprize, 2006; Mason & Stark, 2004) nor academic discussion offer commonly

accepted and reliable methods to objectively evaluate NTBFs' status of entrepreneurial learning that is relating to performance (Castrogiovanni, 1996; Fernández-Guerrero, Revuelto-Taboada, & Simón-Moya, 2012; Simon, 2012). No research is found that looks at the semantic of business plan texts. This chapter aims to shed light on the sematic of NTBFs' business plans by answering the following research question:

> *Can the semantic constructs of entrepreneurial learning extracted from NTBFs' business plans allow for an empirical analysis and evaluation of the NTBF performance as well as the chance for survival and growth?*

The business plan provides a snapshot model of the NTBFs' status of entrepreneurial learning in the form of described transaction relations. Using a network theory lens to look at the NTBF merging, these transaction relations are considered an indicator for the extent to which this snapshot model of the NTBF—distorted by inaccuracy and uncertainty—is anchored into the business reality of the NTBF's business environment. Validity of this indicator is assumedly based on principal agent theory and the assumption that NTBFs are unlikely to "cheat" or lie with respect to the transaction relations described in their business plan, due to the high risk of ruining the relationship building process, if discovered (Kang & Zheng, 2009)—thereby losing trust of and access to their innovation system's closed network (Dewatripont, Legros, & Matthews, 2003; Yan & Lu, 2008).

Proposition 1 NTBFs' business plans represent snapshot models of the business reality with high validity in the described relationships.

Network theory explains the relationship building by investigating the NTBF's interaction with the external environment (Carpenter, 2011; Kilkenny & Love, 2014; Trimi & Berbegal-Mirabent, 2012). Here, it is argued that around the "ego," the business entity of interest, transaction relations are accumulated to human resources, financial resources, and suppliers on the input as well as to customers on the output-side (Carnovale & Yeniyurt, 2015). These transaction relations determine the NTBFs' integration into a broader value network (Carnovale & Yeniyurt, 2015; Kilkenny & Love, 2014). The ego thus represents a focal point of the NTBF's value-creation function as complemented by a broader value network that produces an output for satisfying customer needs (Carnovale & Yeniyurt, 2015; Elfring & Hulsink, 2007; Greve, 1995).

Proposition 2 Transaction relations determining the value network of an NTBF can be identified and classified from the business plan text in which they are described.

Taking a longitudinal perspective on NTBFs, network theory argues that transaction relations are changing significantly in type, strength and motivation over the NTBF's life-cycle stages. Initially, transaction relations may be more identity-based, which is strongly related to the founder(s) of the NTBF: the motivation to commit to the relation focuses more on committing to interact with the individual person than on committing to the economics of the NTBF's current business stage (Hite & Hesterly, 2001; Oksanen, Hallikas, & Sissonen, 2010; Ostgaard & Birley, 1996;

Sullivan & Ford, 2014; Witt, Schroeter, & Merz, 2008). In later stages, in particular for setting the NTBF on a growth path, transaction relations need to be built more on an economic rational and benefit in order to reliably provide access to increasingly needed resources, a growing number of customers etc. (Hite, 2005; Hite & Hesterly, 2001; Sullivan & Ford, 2014). Such maturing relations lead to an intensified and increasingly stable embedding of the NTBF into the broader value network, which reduces the NTBF's risk of failure (Katsamakas, 2014; Lusch, Vargo, & Tanniru, 2010; Oksanen et al., 2010).

Proposition 3 Well-performing NTBFs' transaction relation based embedded value network increases in strength over time.

The context in which a NTBF is born results in specific patterns in the described transaction relations that relate to NTBF performance. These patterns are fingerprints of the process an innovation system learned to support NTBFs in its regional context. They are defining the path performing NTBFs follow in order to become successful (Fontes & Coombs, 1996; Tam & Gray, 2016). Initial research on transaction relations in business plans shows clear empirical evidence on different patterns connected to the performance of NTBFs (Konig, Baltes, & Katzy, 2015).

Proposition 4 NTBFs can be clustered based on the patterns in the transaction relations and their performance.

4 Research Design Development: A Multistage Purification Process

We applied a multistage process to develop a research design that allows accessing and empirically comparing NTBF performance based on business plan texts following our propositions. The research technique of content analysis enables objective, systematical, and empirical research on business plans (Bos & Tarnai, 1999; Kassarjian, 1977; Murphy & Ciszewska-carr, 2005; Rourke & Anderson, 2004). Symbols can be interpreted in intersubjective comprehensible cultural forms, while the text in business plans describes our social reality to some extent. Research using content analysis requires the classification of text through counting and accessing words, symbols, themes, characters, paragraphs, sentences, grammatical units, etc. by certain value concepts (Bos & Tarnai, 1999).

Analyzing a quantity of business plans based on our propositions required the combination of qualitative and quantitative content analysis techniques to ensure empirical and theoretical grounding (Bailey, Johnson, & Daniels, 2000; Elo & Kyngäs, 2008). The resulting research design aims at identifying, categorizing and evaluating transaction relations described in NTBF business plan text. Following this multi-step procedure allowed us to build an infrastructure for coding large numbers of business plans in the long run.

Content analysis, whether quantitative or qualitative, is always based on an imperfect data basis and thus can never be considered as being fully reliable (Kassarjian, 1977; Krippendorff, 2004). Research designs such as the one used for our research building on a measurement instrument can only deliver trustable results in qualitative study approaches, when the underlying measurement instrument is purified by conducting a rigorous test and measurement series based on coder reliability (Bailey et al., 2000; Kemal Avkiran, 1994; Murphy & Ciszewska-carr, 2005).

The Sample

The research team has access to a database containing a total of 837 business plans that had been submitted to the most prominent technology-oriented business plan award of southwestern Germany (CyberOne) between 2000 and 2016. bwcon, leading business association for fostering high-tech and innovation in the region, organizes the CyberOne award. The sample of 837 business plans was supposed to be investigated with a research design allowing for qualitative scalability. Consequently, an infrastructure has been developed that enables applying the research design to further business plan samples in later research stages.

Starting at the core of the research sample, the CyberOne data, a network sampling technique was used. Network sampling is particularly helpful for the identification of hard-to-reach populations (Johnston & Sabin, 2010). Collecting data through network sampling adheres to the idea that some organizations can be referred to peers with certain characteristics (Biernacki & Waldorf, 1981). Since properties of the network affect the sample, and the referred peers may ask for an unlimited number of companies (Johnston & Sabin, 2010), the generalizability of the population of NTBFs in the state of Baden-Württemberg is limited. However, comparing the data with a study of the Centre for European Economic Research (Egeln et al., 2012), an average of 300 F&E intensive companies were founded between 2001 and 2010. Looking at the founding hotspots in both data samples, most companies were clustered around cities with universities engaging in research. Furthermore, due to the high-tech focus of the CyberOne (the award represents a central platform for venture capital in the region), our data seems highly comparable to the ZEW data. Thus, representativeness for the population of NTBFs in the state of Baden-Württemberg can be assumed to some extent.

This assumption is not delimited by the fact that the plans were submitted in various stages of the NTBFs' business life-cycle and not only once when they were founded: the planning for innovative business concepts is not necessarily connected to the legal foundation of a NTBF. Rather, this is elementary for our research as business plans submitted in different stages that are defined as the early-stages in the life-cycle of NTBFs will enable identifying specific semantic constructs relating to the respective life-cycle stages.

In order to statistically analyze the sampled NTBFs' performance, external information has been added using secondary data sources. The aim was to allocate NTBFs to the categories 'non-survived', 'survived' and 'growth'. For this purpose, we defined a structured process to identify the NTBFs described in the business

plans in the internet and subsequently in the official German commercial register. To further validate and enrich performance data with information such as the development of staff and turnover as well as the industry, a data service provider has been involved.

To guarantee comparability, only one provider has been selected. Analyzing a subsample, the company bisnode has been identified as the provider with the best data quality. Turnover data and the number of staff are information companies often do not want to make public. Bisnode attempts to access this data through official sources such as the German Federal Register, then contacts the companies directly and asks for the data. If no information is found, an estimation is made based on scientific modeling using the most reliable data that is available in the respective case.

Although the categories of non-survivor, survivor and growth are applied in several research projects related to NTBF performance, quite heterogeneous definitions with respect to the time period and the growth of turnover as well as employees are found in literature (Coad, Daunfeldt, Hölzl, Johansson, & Nightingale, 2014; Moreno & Casillas, 2007; Parker, Storey, & van Witteloostuijn, 2010). We defined survived startups as firms documented in the official registers for more than 5 years after the submission of the business plan. We allocated firms to the category growth when their turnover (as specified in the business plan) reached at least 100,000 euros and had been tripled when below and doubled when above 500,000 euros within 5 years after submission.

Research Design Development

First, a convenience sample of business plans encompassing 20 survivors and 20 non-survivors was used to operationalize the network theory based semantic construct "transaction relations" for early-stage NTBFs' business plans using qualitative structured content analysis. The subsequent quantitative analysis showed that the business plans of survivors exhibit a significantly higher number of (described) transaction relations. Furthermore, survivors evince transaction relations in several dimensions of outside markets and in different strength (scores) levels (Konig et al., 2015).

The results of the convenience sample analysis have been used to develop a multidimensional measurement instrument that identifies transaction relations by employing a well-structured, formalized method of content analysis. Transactions relations are categorized into market dimensions of suppliers, financiers, human resources and customers. Theoretical and empirical findings support the instrument that is based on the following equation describing value network maturity and thus the status in the entrepreneurial learning process:

$$\text{Maturity} = (\text{customers}; \text{financiers}; \text{human resources}; \text{suppliers})$$

In each of the four dimensions, transaction relations are classified according to their strength (maturity) using a 5-point-scale referring to the business-life-cycle stages early-seed, late-seed, early-startup, late-startup, and growth. An example for a

transaction relation template in the dimension customer growth stage could be the following: *"We sold 20 products for 500,000 euros to the following customers. . ."* This transaction relation is significantly stronger than the transaction relation: "*We got positive feedback from 3 potential customers. . .*" which we classified as late-seed stage in the customer dimension.

To achieve quality of the research design in terms of objectivity, reliability and validity, a well-structured purification has been applied for employing the recommended "expert judging" (Kassarjian, 1977; Krippendorff, 2004; Zhou, Yim, & Tse, 2005). This purification was conducted using two tryout cycles: the first tryout was designed to identify interpretative differences in the application of the multi-dimensional instrument by the researchers with in-depth expert knowledge in comparison to interchangeable, non-expert coders. For this purpose, each business plan of the convenient sample was coded by students 25 times on average.

The second tryout builds on the first tryout's results and was designed to improve the overall research design and quality based on inter-coder agreement as an indicator. In this tryout, 136 additional business plans from the years 2008 to 2010 including new types of transaction relations were coded. For the new research design, the complexity of the measurement instrument application process was reduced by breaking it down into two steps: first identifying and categorizing transaction relations, then evaluating them according to their strength in a separate procedure. Moreover, the workload per coder was reduced to increase motivation and the coding was conducted in an organized, supervised setting to provide maximum assistance.

Breaking down the coding process into these stages allowed for the reduction of the complexity inherent in the coding process for the judges, and in addition for classifying the identified transaction relations based on single sentences as semantic units. Consequently, one sentence could be evaluated separately by two non-expert coders (students) plus an expert coder's judgment. This further offered the possibility to adapt the research instrument in a later step based on the learnings gained from identified and analyzed sentences and to scale such improvement over the entire sample.

Quality and Data Preparation of the Sample 2008–2010

High reliability of quantitative content analysis is assumed if coding by trained coders results in a reliability of 66–95% (Kassarjian, 1977). Thus, although coders producing systematic errors have not been excluded from our coding, the resulting agreement of 64.69% in the highest classification across all dimensions suggest a nearly acceptable quality. Looking at each dimension, the following agreement was reached: customer 69.66%, supplier 45.52%, financier 48.28%, and human resources 73.79%. The systematic process produced an absolute agreement of 56% for the total of all described transaction relations and allowed to identify poor coding performance ("systematic errors") as well as misinterpretations that could be traced back to the research design and in particular to the code book (König, Ungerer, Büchele, & Baltes, 2016).

Additional data enhancement was realized by conducting researchers' judgments in order to obtain a data sample with trustable results (Murphy & Ciszewska-carr, 2005). For the planned cluster analysis, we decided to consider only the highest-rated transaction relations per dimension the coders agreed upon in each business plan. We further looked at each single transaction relation with disagreement. To reduce context-related misjudgment of the coders—who had to evaluate sentences without knowing the whole business plan context in the second process step—we further investigated the transaction relations in each business plan with a context perspective. This also allowed the identification of outliers in the highest classification. Because of these adjustments, 33.75% of the business plan ratings (highest classification per dimension) were changed. The judgment made by the researchers only led to moderate changes: in the majority of cases, the difference between ratings was only ± 1. Therefore, it is assumed that the final coding of the sample evinces sufficient quality for further analysis. It is thus used as input data in the cluster analysis: the four dimension represent independent variables determined by the expert-adjusted highest rating.

5 Results: Seven Clusters of NTBFs' Learning Patterns

To examine the 2008–2010 sample in a first explorative approach, a cluster analysis has been performed. Cluster analysis summarizes different methodologies that allow grouping cases based on independent data structures (Backhaus, Erichson, Plinke, & Weiber, 2011). With this suggestive segmentation task, we aimed at grouping NTBFs based on the strength of transaction relations described in their business plans. Distinguishing between the three performance categories, the analysis has the potential to provide insights and directions for further research on venture survivability.

Hierarchical clustering is considered suitable for the relatively low sample size of 136 observations. Since we aim at obtaining homogenous clusters, the "Complete Linkage" algorithm is utilized. As usual, the optimal number of clusters is associated with the last clustering step before two highly dissimilar clusters are merged. Moreover, we divided the analysis into the performance categories of survived, non-survived, and growth, as we are searching for patterns regarding the level of transaction relations that characterize a successful NTBF and patterns within the NTBFs that failed. We further assessed the clusters in the context of the firms' industry.

When looking at the survived NTBFs as depicted in Table 1, the optimal number of clusters turns out to be three. The first cluster achieves a high score in all categories and more than half of the NTBFs assigned to the first cluster are growth NTBFs. The second cluster is characterized by NTBFs having low scores in every dimension, and only 18% of them can be labeled as growth. Concerning the industry, we cannot draw a clear conclusion, as it seems as if all kinds of NTBFs are represented in that cluster. The NTBFs in cluster three are similar to the first cluster

Table 1 Survived NTBFs

Complete linkage		HC customers	HC financier	HC human resources	HC suppliers	Growth
1	Average	3.838	3.000	3.405	3.081	0.568
	N	37	37	37	37	37
	Deviation	0.8665	0.9718	0.6855	0.7593	0.5022
2	Average	1.353	2.000	2.529	1.941	0.176
	N	17	17	17	17	17
	Deviation	0.6063	0.7071	0.6243	1.2485	0.3930
3	Average	4.154	2.692	3.462	0.538	0.462
	N	13	13	13	13	13
	Deviation	0.8006	1.4367	0.9674	0.7763	0.5189
Total	Average	3.269	2.687	3.194	2.299	0.448
	N	67	67	67	67	67
	Deviation	1.3771	1.0900	0.8209	1.3373	0.5010

regarding the percentage of growth NTBFs, the financiers score, and the human resources score. However, they are characterized by an extremely high customer and an extremely low suppliers score. The NTBFs of the third cluster are mainly from the chemical industry.

Since the scores of the second cluster are significantly lower (mostly at the 1% level) than the scores from the first and third cluster, and due to the fact that they survived, the NTBFs from the second cluster seem to have submitted their business plan in quite an early stage. Further investigation of cluster two will be necessary to understand the performance.

When analyzing the non-survived NTBFs, the optimal number of clusters is two, which is illustrated in Table 2 below. In the table we see that to the first cluster (4), the algorithm assigns 13 NTBFs, which obtain mediocre scores for financiers and suppliers, but very high scores for customers and human resources. These NTBFs are mostly rooted in the software industry. The remaining question is: Did they achieve too little of scores in financiers and suppliers, or did other reasons cause their failure?

Further analysis of the data provided by bisnode, combined with additional secondary research, a typical exit scenario (merger with a larger company) was identified in 5 of the 13 cases. Consequently, these NTBFs showed decent performance, as an exit is a frequent objective in high-tech industries. In the other cases we were not able to identify the reasons for non-survival, i.e. a deeper case analysis would allow for a better understanding. Hence, the analysis strengthens the quality of our elaborated model of value network maturity as an indicator for entrepreneurial learning.

Regarding the second cluster of the non-survivors (5), their failure appears to be well explained by the low scores in each dimension. For every dimension except that of suppliers, the first cluster achieves significantly higher scores at the 1% level. The NTBFs in the second cluster stem from different industries and no clear cut can be drawn.

Table 2 Non-survived NTBFs

Complete linkage		HC customers	HC financier	HC human resources	HC suppliers	Growth
4	Average	4.769	2.923	3.923	2.308	0.077
	N	13	13	13	13	13
	Deviation	0.4385	0.9541	0.7596	1.2506	0.2774
5	Average	1.982	2.125	2.661	2.196	0.054
	N	56	56	56	56	56
	Deviation	1.0356	0.6892	0.7693	1.1508	0.2272
Total	Average	2.507	2.275	2.899	2.217	0.058
	N	69	69	69	69	69
	Deviation	1.4514	0.8023	0.9098	1.1615	0.2354

Table 3 Growth NTBFs

Complete linkage		HC customers	HC financier	HC human resources	HC suppliers
6	Average	3.882	3.176	3.529	3.471
	N	17	17	17	17
	Deviation	0.9275	1.0146	0.7174	0.6243
7	Average	3.231	2.538	3.385	1.385
	N	13	13	13	13
	Deviation	1.4233	1.1266	0.7679	0.8697
Total	Average	3.600	2.900	3.467	2.567
	N	30	30	30	30
	Deviation	1.1919	1.0939	0.7303	1.2780

Exploring the growth NTBFs as a sub-sample of the survived ones, we can again identify two clusters as shown in Table 3. In the first cluster (6), relatively high scores are reached in all categories, whereas in the second cluster (7) the partner dimension is rated significantly lower and the average financier score is lower as well. Nearly half of the NTBFs from this cluster are located in the software industry; all of them provide services rather than physical products. The low partner and financier rating could be explained by the fact that software companies can potentially realize turnovers relatively quickly, and typically do not need many partners to realize their product or service: the development is rather human resources intensive.

6 Discussion, Limitations, and Conclusion

Inter-organizational learning is the key for successfully transferring new knowledge from research to the market in an entrepreneurial learning process. Described transaction relations in NTBFs' business plans, which are an expression of the status of entrepreneurial learning, have been analyzed in an explorative approach based on

cluster analyses. Discussing the results, one NTBF cluster among the survivors exhibits a balanced status in each transaction relation dimension, scoring on average the learning status we defined as early-startup. These firms did not only survive, but also showed a good chance for growth with 57%. Only in the business plans of seven non-survived NTBFs (cluster 4), could a similar pattern be detected. Hence, one could hypothesize that ventures crossing the maturity stage of an early startup have learned the essentials of the functionality of their business and thus survive with a high potential for growth.

This result suggests that the entrepreneurial learning status of early-startups, as described in the business plan in terms of the value network maturity, is characterized by addressing an initial pilot market or having pre-contracts for the supply of their product or service. Furthermore, these NTBFs usually realize first turnovers of up to 20,000 euros. Regarding financiers, they are funded by a third-party investor, such as a business development bank or an initial business angel. Looking at the human resources dimension, the NTBFs on average evinced a functional team of more than four founders. Moreover, they implemented first professional partnerships to suppliers.

In cluster 3, we identified a group of NTBFs that grounded their survival on strong transaction relations on the customer side, while being significantly weaker on the partner and financiers interface. The data leads to the assumption that these companies learned, in particular from the market, how to create sustainable value for their customers and consequently were able to survive. Circa 46% of these even generated growth. The average score derived from their business plans implies that the firms realized a turnover exceeding 20,000 euros and were already cooperating with a distribution partner. Hence, we assume that these clusters primarily represent NTBFs that are focused on internal growth, based on own cash flows. An explanation for the low partner rating could be that the mere existence of a cooperation does not imply the quality or supportive power of the relation.

Exploring cluster 2 and 5, we hypothesize that there is only a small number of NTBFs scoring as early and late-seed stage that can survive and grow. This finding is congruent with life-cycle research suggesting that failure rates for NTBFs are higher the earlier they are in the life-cycle (Eloranta, 2014). When showing such a low level of entrepreneurial learning in a business plan, the probability of survival is quite low. One alternatively, one could assume that some founders fail in entrepreneurial learning from the beginning.

Attempting to contribute to a better understanding of the entrepreneurial learning status, the results of this research are subject to limitations. These are primarily a consequence of the content analysis research design. Quality could be improved by further developing and standardizing the analysis process and by constantly adding new knowledge on new transaction relationships in the coding manual. Moreover, data quality improvements could be reached by detecting coders that produce systematic errors in the coding process, as well as by applying computer-assisted coding procedures.

A further source of limitation lies in the business plan sample data collection. Objectivity could have been distorted by the network sampling approach. Moreover,

environmental factors of the innovation system may greatly influence the success of NTBFs. Sample representativeness may be further limited by failures in identifying successful startups that are not found in the bisnode database. Comparing the results to similar data from other regions and applying the research design to larger samples could add to concluding on the sample representativeness.

The results seem quite promising for conducting analyses to predict survival and growth based on the status of entrepreneurial learning with a larger sample. A follow-up study will use either discriminant analysis or artificial neuronal networks (ANN) as structure testing procedures for predicting performance group allocation (Backhaus et al., 2011). Once the model is estimated based on a large dataset, new business plans can be allocated to the predefined groups. Qualitative analysis of the clusters could identify more detailed reasons for performance by looking at individual characteristics. Finally, management recommendation on how to support NTBFs in different stages could be derived.

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