On the role of value-network strength as an indicator of technology-based venture's survival and growth

Increasing innovation system efficiency by leveraging transaction relations to prioritize venture support

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***Abstract* — Technology-based ventures provide an important route for successful technology transfer** [1], [2]**. Their founders are supported in successful technology commercialization by innovation intermediaries** [3]**. Accordingly, the performance of an innovation system, at least to some extent, depends on the efficiency of these intermediaries in terms of the impact of their scarce resources on the survival and growth of technology-based ventures. To increase their efficiency, intermediaries typically optimize their "intake" by requesting a formal business plan to base their selection on as a hygiene factor** [4]–[7]**. Thus, some scholars argue that written business plans show significant distortion as being produced only to attract support from innovation intermediaries** [6], [8]**. Accordingly, they rarely serve for these addressees as a source of information for analyzing the strengths and weaknesses of ventures, in order to derive actionable conclusions and more effectively support ventures** [9], [10]**. Addressees search for different indicators in business plans for their evaluation** [11]**. The descriptions of these indicators only evince little empirical proof for the performance of technology-based venture's** [8], [12]**. This gap is herein addressed, in contrast to the lacking empirical insight, as the most frequently produced artifact of early-stage technology ventures is at the same time a written business plan** [10], [13]**. This paper addresses this gap by conceptualizing transaction relations described in the written business plan as a means for working around the inevitable inaccuracies and uncertainties that delimit the explanatory abilities** [14] **of the snapshot model** [10] **presented by a business plan. Using a qualitative content analysis, we derive from the descriptions of transaction relations in a written business plan valid indicators for the maturity of the venture's value-network in different dimensions** [15]**. To this extent, this paper presents the findings from a pre-study that was conducted based on a sample of forty business plans from an overall population of 800 business plans in a longitudinal sample from one of Europe's most active innovation systems, the regional State of Baden-Württemberg. Such findings may be used by innovation intermediaries to enhance their efficiency, by enabling these to not only derive individual support strategies for business acceleration but also to analyze the impact of support measures by reliably monitoring maturity progress in venture activities.**

Keywords— technology venturing; business plan; technology transfer; innovation intermediary; business life-cycle; value-network (keywords)

I. Introduction: Improving Innovation System's Efficiency in Technology Transfer

In the past century, numerous technologies in Europe have been invented that display a global market impact today. However, this successful commercialization of technologies has been driven elsewhere in the world, most frequently by US-based firms [16], [17]. This lagging behind in economic exploitation of technology capabilities, commonly called "Europe's innovation gap," is believed to be caused, among other things, by a lower efficiency of Europe's innovation system in supporting technology transfer [18]. Thus, increasing this efficiency is crucial for improving the economic impact of public spending into research institutes and enhancing Europe's economic competitiveness.

Technology transfer encompasses the process of turning technology-based capabilities, from e.g. research institutions, into a growing business [19]. To achieve this, different strategies are discussed; amongst those, the transfer of technology via the founding and developing of technology-based ventures [20], [21]. In the core of this process, researchers perform the transfer of technology know-how into the new business venturing activity [22].

Here, for successful technology transfer, the newly built venture has to be supported in developing business expertise: Richly equipped with technology know-how, technology-based

ventures need to quickly build up this knowledge in order to survive and grow in their respective markets [23]–[25]. Their surrounding innovation system aims to support them accordingly. This support is typically provided by innovation intermediaries as part of the innovations system. These innovation intermediaries, e.g. consultants, investors, incubators, and the like, assist early-stage, technology-based ventures with supporting services and know-how [26], [27].

However, their resources are scarce and moreover, innovation intermediaries in Europe's innovation system seem to be relatively under-financed, at least when compared to the US [16]. Hence, improving the efficiency in spending their scarce (financial) resources may provide a viable way to increase the efficiency of an innovation system. Thus, this research aims to gain insight on how the support process [18] of innovation intermediaries can be improved to prioritize the use of available resources effectively, in order to increase their impact on the survival and growth of technology-based ventures.

Today, as a means for prioritizing their support, innovation intermediaries most frequently request technology-based ventures to present a written business plan as a form of application [5], [6], [10]. However, in regards to prioritizing support, the business plan represents a rather digital instrument: The business plan is a hygiene for the entry in the process [5]. This may, at least in part, be caused by the relatively limited empirical research on indicators for the strengths and weaknesses of a technology-based start-up, solely on the basis of their business plan descriptions, [12] and a difference in the indicators which stakeholders search for with the hope of coming to a conclusion about business performance [11].

This paper researches descriptions of transaction relations as such indicators. Better empirical evidence would enable innovation intermediaries to focus their support activities, not only in terms of supporting "the right ventures," but also by supporting a venture individually with the "right" scheme, i.e. high impact fields. This improved understanding of transaction relations as maturity indicators of the value-network of early-stage, technology-based ventures would thus be beneficial to improve the support schemes of innovation intermediaries in the innovation system. The development of a common understanding of transaction relations, as indicators would also improve the process between innovation intermediaries and therefore the efficiency of the innovation system.

This paper presents the findings of a qualitative pre-study of a research project that addresses this gap. It outlines the theoretical foundation for the subsequent quantitative analysis on a sample of 800 business plans of technology-based ventures from one of Europe's most active innovations systems, the region of Baden-Württemberg in Germany. The findings indicate that business plan descriptions of transaction relations in various dimensions may serve as reliable indicators of the maturity status of technology-based ventures. The research contributes to the stream of literature that discusses business-planning activity in early-stage technology ventures, life cycle literature, as well as the literature on the success and failure of early-stage business-venturing activities.

The findings are derived from a structured content analysis of a sub-sample (40) of a total population of 800 business plans of technology-based ventures, stemming from the innovation system of one of Europe's economically and technology-wise most active regions, Germany's regional state of Baden-Württemberg. This sub-sample, representing candidates from both groups (failing & surviving), is used to derive categorizations for descriptions of transaction relations found in written business plans and to characterize these according to their type and strength.

II. Literature Review: Business Plan as a Means of Focusing Intermediary Support in Technology Transfer

Technology transfer is discussed as knowledge spillover from research institutions to business organizations, which leads to economic growth [28] by commercial application[19]. Here, two established associations are crucial for success: the transferring organization with the technology resources and the technology adopter [29]. For this, various technology transfer strategies are described such as R&D cooperation, licensing, reverse engineering, and the like [20].

As a model, differing from that described above, a technology based venture [2] is described "… as an effort by an entrepreneur or team to create a new independent organization" [30]. Here, actors of the transferring organization (i.e. researchers) themselves form the core of a (new) technology adopting entity (i.e. the venture). Thereby, knowledge transfer into the new venture is secured in person by the founding researchers [22].

In order to survive on the market, these researchers need to transition into a management team that embeds and transforms their technology knowledge into business expertise [31]. This requires structuring knowledge into business development [23] in order to successfully tackle the challenges of economic survival [32]. Maturity models discuss such transitions and characteristics of respective maturity levels to evaluate strengths and weaknesses for deriving conclusions on further development [33], [34]. Accordingly, early-stage technology ventures follow foreseeable patterns in their development. Depending on the model, the phases of this pattern may be defined as the seed, start-up, and early growth phase [24], [35], [36].

The survival of early-stage, technology based ventures is highly impacted by the surrounding innovation system [37]. This system includes the network of an environment of different actors and their links [38], which may reach regionally, nationally, and/or globally [39], [40]. The impact of the innovation system on the survival of technology-based ventures results from its financial, organizational, and moral support abilities [41], [42].

This support is provided by innovation intermediaries such as incubators, investors, consultants, and the like [3]. These provide a variety of services [21] and distinctive resources to accelerate the growth of technology-based ventures [38]. The efficiency of the innovation system thus largely depends on the impact innovation intermediaries achieve when leveraging their scarce resources of public and/or private funding into venture survival and growth [17], [18], [21]. A crucial part of this process, in particular in the early-stage, is facilitating the development of the value-network of a venture [43], [44].

In interacting with technology-based ventures, intermediaries typically rely on business plans for selection and, in part, as an educational tool [6]. In particular, intermediaries endow business plan competitions in teaching entrepreneurship. For other intermediaries, i.e. investors and incubators, the business plan is an initial barrier for access to the intermediary's support resources [5], [9]. Hence, the business plan may typically be attributed a critical role, yet it is used only in selecting, and not for prioritizing support activities for the acceleration of ventures [5], [10], [11].

The concept of such an enterprise plan, being implicitly or explicitly developed by any venture management team [14], [45], is broadly discussed [46], [47]. In a broad sense, it is "each document that is produced by startups to express a venturing activity" [10]. Herein, we refer to a business plan as a document presenting relevant managerial aspects for implementing and operating the venture's business [48], which includes the business model and its implementation over time [10], [46], [49], [50].

The business model describes the value creation of a venturing activity [45]. The business model looks at the venture's commercialization of technology at a particular point in time, as a snapshot model. It abstracts the business in its core dimensions and narrows the ideation towards a tangible opportunity [46]. Typically, the dimensions are used for description: product idea, need description, market, competition, strategy, organization, financial statement, capital, time plan [46], [48], [49].

Despite the "plan"-part of the business plan term [7], [46], this "plan" documents the intent of the venture team in terms of what to do and what to learn in which order [52], rather than presenting the outcome of an elaborated planning activity. This adaptive conduct aims to test the team's assumptions at bearable costs, in order to achieve convex learning and adjust future activities based on that [53]. Such strategic iterations seem particularly fruitful in identifying and connecting to transaction partners [8]. When updated over time, the business plan matures along with the maturing of the venture activities during its life-cycle phases [52], [53].

This behavioral aspect, i.e. adapting, is accepted as being more crucial for survival and growth than the documenting, i.e. planning, aspect. Nevertheless, decision theory reasons that the venture team's adapting capabilities [54][55] may also be fostered by planning activities, as they involve evaluating alternative actions and improving strategies.

While its sheer existence may be taken as evidence for the ventures team's capability to organize complex tasks efficiently [56], it may also represent a kind of informal contract that documents the identified opportunity and the intent to (how to) realize that opportunity by positioning a business into the value-network [35], [57]–[59]. The business plan is also seen as a circling artifact in the innovation system which moderates the business plan [10].

Academic research has tried to investigate the performance impact of the activity of writing a business plan in numerous studies [8], [13], [54], [55], [60], [61]. The empirical evidence on the impact of the activity of writing a business plan, however, is ambiguous in its results [8]. Other research has tried to identify the indicators different types of stakeholders use for evaluating the potential for performance, which can be concluded as being a heterogenic perspective on relevant indictors in the plan [11]. This puts into question whether business plans developed by technology-based ventures in an early-stage are of any analytical use, apart from the selective aspect of withholding support to ventures that lack a business plan.

The research gap addressed herein, is, instead of the impact of the activity of planning on the performance of venturing activities as often discussed in research, indicators in the content of written business plan which can be used to make conclusions on possible performance and survival in the early-stage of technology-based ventures. Empirically secured indicators, which meet valid, reliable, and objective standards of the performance and survival of early-stage technology ventures in business plans, are absent [11]-[12].

III. Hypothesis Development: Surviving Ventures Have Built a Growing & Maturing Value-Network

As outlined above, the business plan artifacts represent a snapshot model of a venturing activity [46] based on the mental model of the venture team at a given point in time. As the venturing activities evolve dynamically [14], the mental model will also frequently change. Thus, the business plan is distorted from reality by inaccuracy and uncertainty:

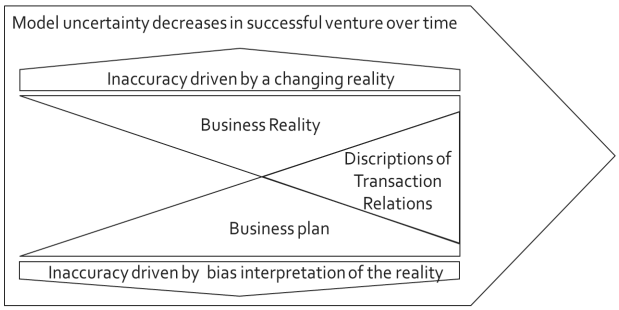

Fig. 1. Reality distortion in a business plan

The uncertainty is caused by a changing business reality [62], while the inaccuracy may be caused by the writer's bias, i.e. planning abilities [63], needs and expectations partners [64], interpretation, estimates, and the like. This inaccuracy may even be increased by context [65], e.g. an intermediary's preferences that may motivate a team to develop the plan as designed for the "customer" [6], [8]. Uncertainty may diminish over time however, i.e. along the maturing of the venture.

We conceptualize a technology-based venture as being embedded into a value-network of transactions with partners in various dimensions [15]. This transaction or value network of the venture is its business core and is created by the venture's cross-sections to selling, procurement, HR, and capital markets [35], [66]. Following that, the venture will mature as the number and dimensions of these network links, i.e. transaction relations, evolve and the quality of network partners increases. These transaction relations anchor the venture in reality.

Thus, descriptions on such transaction relations can be seen as a critical core to a business plan [47]. Establishing such relations is a crucial element for the survival of technology-based ventures [47].

H1: Technology-based ventures that exhibit a small number of described transaction relations in their business plan are unlikely to survive.

There are four types of transaction partners that characterize the value-network of ventures: customers, financial resources, human resources, and suppliers. In connecting with customers, available resources are put into application in exchange for money [47], [67]. This also applies similarly to factor markets, from which the venture acquires resources to transform them to a greater yield and value [68]. For successful value-creation, ventures have to connect to each of these transaction relation types:

H2: Surviving technology-based ventures evince in their business plans transaction relations in each dimension (customers, financial resources, human resources, suppliers).

Starting out from technology capabilities, a technology-based venture creates its value-network from scratch [35][47]. While doing that, their assumptions will be tested in interaction with transaction partners and eventually be improved, based on experiential knowledge gathered [8], [51]. This reduces uncertainty and continuously adapts the venture intentions to the needs of reality, which will be reflected in the business model documented by the business plan [69].

Regarding the financial resources dimension, initial relations will describe a venture team's private money, friends, and family. With maturation, these transaction relations should evolve to governmental grants, business angels, and institutional investors [70], [71]. In the human resources dimension, the venture evolves from a start-up team towards a functional organization with distributed responsibilities [72]–[75]. Descriptions of the founder(s) themselves [25] will change with maturation to descriptions of people with key skills to build the business [76]. Open innovation with suppliers will correlate with growth [77]. Thus, transaction relations to suppliers will form further dimensions [67] in which the strength of the ties increases along the maturation of the venture [78], [79]–[81]. Finally, on the customers' side, ventures will mature from initial assumptions on markets [52], [53] (e.g. based on secondary data), to qualitative market investigation and market tests with initial sales [82]–[84].

This adaption to reality results in the venture's transaction relations growing in number and strength to become mature network ties [47][64]. The strength of ties increases from weak, e.g. initial ideas, to mature, e.g. established business relations, which will typically go along with an increase in "quality" of transaction partners being linked to the venture. This "quality" refers to the degree to which a transaction partner is selective in building new ties.

H3: Technology-based ventures evince in their business plans transaction relations in four dimensions that can be characterized with regard to their maturity level.

IV. Research Design: Qualitative content Analysis

In order to test this hypothesis, we followed an exploratory, qualitative research approach with qualitative content analysis, which allows for the development of an in-depth understanding of transaction relations in the business plans of early-stage technology venture. [85] This type of analysis allowed us to categorize words and phrases that described different strengths of transaction relations into content-related categories with similar meaning [86]–[88].

The coding aimed at identifying "real life" venture transaction relations with transaction partners. Accordingly, descriptions on hypothetical considerations were not included in the analysis. Concerning identified descriptions, two different coding categories [89] were applied, which thus resulted in a two-dimensional representation of each venture's value-network as expressed in its business plan. The following represents the first category for distinguishing between the types of transaction partner: customers, financial resources, human resources, and suppliers. In a next step, we used these coded transaction relations for a deeper analysis with regard to its life-cycle phases, i.e. the second category.

For the initial stage, a sub-sample of forty business plans from the total sample of 800 standardized business plans of early-stage technology ventures were selected. The sample results were from longitudinal recordings between 1999 and 2014 in Baden-Württemberg. The recruitment of the sample followed a network-sampling technique, which is especially useful for the identification of hard-to-reach populations [90] [91]. The sub-sample is a convenient sample.

As can be expected, the failed ventures expressed none or only a small number of descriptions of transaction relations in comparison to survived ventures. Instead of developing a descriptive saturation, for which the sub-sample would have to be representative of the total sample, we aimed at achieving a theoretical saturation for the description of transaction relations with two groups of different outcomes (surviving, not-surviving). Theoretical saturation occurs when the results of qualitative content analysis occur rapidly enough in an individual strength so that it can be assumed that the theory fits adequately with each further analysis [92].

To achieve theoretical saturation in the various strength levels, four subgroups of business plans were selected: for the first group, twenty business plans of no-longer-existing / not-sold ventures were randomly sampled from the years 2006, 2007, and 2008; for the second group, ten business plans of survived ventures were sampled from the years 2006 and 2007. To this group, ten business plans were added which were considered by experts and generally accepted as "success stories" during the period in question (significant funds raised, high-growth).

Based on a self-evaluation, the venture teams categorized their business plan according to the life-cycle phases. In the second group (survived), one business plan was submitted in seed, ten in startup, and nine in the growth phase. In contrast, in the first group (non-survived), five business plans were developed by ventures in seed, twelve in startup, and two in the growth phase.

V. RESULTS: PROPOSED MEASUREMENT INSTRUMENT

H1 was tested on the basis of comparing the number of identified transaction relations in the first group (non-survivors) with the second group (survivors). In the latter, survivor group, the sample's business plans exhibited 206 descriptions of transaction relations in total, equaling an average of 10.3 transaction relations per business plan (median: 10; minimum: 7; maximum: 14; standard deviation: 2.01). In the former, non-survivor group, the sample's business plans exhibited 56 descriptions of transaction relations in total, equaling an average of 3.1 per business plan (median: 2; minimum: 0; maximum: 7; standard deviation: 1.96). Hence, H1 seems generally supported.

However, non-survivor group one had three outliers, each with six to seven relations (ID 21, 28, and 31). These outliers provided initial evidence that not only the number but also patterns of relations may be relevant, as seen in two cases where one dimension of transaction relations was totally missing (ID 21: customers; 28: suppliers) and the third, which had a particularly weak transaction relation to customers (ID 31). These outliers already seem to confirm, at least to some extent H2. This is further supported by the next-best ventures in non-survivor group one (ID 32, ID 38: each four relations), in which both also lack relations in one dimension (suppliers). In contrast, each business plan in the survivor group two exhibited transaction relations in each of the four dimensions. This confirms H2.

The identified transaction relations further suggest the relevance of patterns, as business plans in survivor group two exhibited particularly strong relations in the customer dimension with an average of four relations / business plan in that dimension (group one: ∅ 0,6). The other dimensions in group two exhibited an average of about two relations / business plan. In contrast, in non-survivor group one, the strongest dimension (on average) is financial resources (∅ 1,1), followed by the HR dimension (∅ 1).

In testing H1 and H2, it was found that a relatively high number of transaction relations identified in one dimension (e.g. customers) would typically result from the business plan outlining the evolution of the current state of the transaction relations over time. As such, in one case for example, the business plan outlined the preceding steps, i.e. previously established transaction relations in the customer dimension, which finally led to having 100 paying customers.

This results in a density of descriptions on transaction relations, at least in survivor group two, that allows for categorizing identified transaction relations according to the strength phases of the venture itself, i.e. seed, start-up, or early-growth. Based on the number of available descriptions, we were able to reliably dissemble the first two phases respectively into early and late. As a result, identified transaction relations could be characterized using an ordinal rating scale with five ranks, which enables the employment of a 5-point Likert-scale [12], [93]. Based on the following equation, we propose a measurement instrument for a venture's value-network maturity:

Value-network Maturity = (customer; financial resources; human resources; suppliers)

In the customer dimension, 93 transaction relations in total were identified (group one & group two). As indicated above, the vast majority of these were identified in survivor group two (87%). In that second group, out of the identified 81 transaction relations, 12 were categorized in seed (15%), 35 in startup (43%), and 34 in the growth phase (42%). In the non-survivor group one, out of the identified 12 transaction relations, seven were categorized in seed (58%), three in startup (25%), and two in the growth phase (17%). The following, TABLE I, illustrates examples of transaction relations identified in the customer dimension which are categorized according to the five ranks of the suggested ordinal maturity scale:

TABLE I.

Question: How mature is the transaction relation to customers?	
1	**Early Seed: Market hypothesis** (secondary analysis) "In Germany 65,000 regional doctors exist…. We expect that 10% are open for our product"
2	**Late Seed: Market investigation** (primary analysis) "Several potential customers already announced their interest in our system" (ID 28)
3	**Early Startup: Pre contract** (pre contracts and market tests) "After we had implemented field tests, the system has been used several times in a commercial application" (ID 2)
4	**Late Startup: Market entry** (Initial Sales) "We already sold licenses to several companies" (ID 3)
5	**Early Growth: Ready for take-off** (Growing Customer Base) "We were able to acquire already 100 customers for …" (ID 8)

In the financial resources dimension, 57 transaction relations in total were identified (group one & group two). Also here, the majority of these were identified in survivor group two (65%). In that group, out of the identified 37 transaction relations, 12 were categorized in seed (32%), 14 in startup (38%), and 11 in the growth phase (30%). In the non-survivor group one, out of the identified 20 transaction relations, 12 were categorized in seed (21%), seven in startup (35%), and one in the growth phase (5%). Here, it should be noted that funding the business from the generated cash flow was more frequently found than would be expected, at least on the basis of common entrepreneurial finance literature. The following, TABLE II, illustrates examples of transaction relations identified in the financial resources dimension being categorized:

TABLE II.

Question: How mature is the transaction relation to financial resources?	
1	**Early Seed: Wish for money** (Claim for investment) "We search for an investment of…"
2	**Late Seed: Private / awarded money** (non-professionals invest) "We used the price money from an award to cooperate with…" (ID 21) "The founders are supported by the grant program 'Young Innovators' for the first three years…" (ID 11)
3	**Early Startup: Business development** (initial seed investment) "An initial order financed development of the technology…" (ID 15) "The initial finance comes from an inexpensive loan…" (ID 28)
4	**Late Startup: Money for the market** (professional seed investment) "We received an initial investment of 500,000 Euro in equity" (ID 21)
5	**Early Growth: Ready for take-off** (professional growth capital) "We invested in total 7 Mio. Euro out of the cash-flow…" (ID 8) "We received a total amount of X Mio. Euro risk capital…" (ID 9)

In the human resources (HR) dimension, 63 transaction relations in total were identified (group one & group two). Again, the majority of these were identified in survivor group two (68%). In that group, out of the identified 43 transaction relations, 15 were categorized in seed (35%), 24 in startup (56%), and four in the growth phase (9%). In the non-survivor group one, out of the identified 20 transaction relations, seven were categorized in seed (21%), 13 in startup (65%), and none in the growth phase. Here, it should be noted that most of the ventures at least exhibited a management team. The following, TABLE III, illustrates examples of transaction relations identified in the financial resources dimension being categorized:

TABLE III.

	Question: How mature is the transaction relation with regard to human resources and organization?
1	**Early Seed: One man show** (single founder) "The idea was developed in the cores of my MBA studies"
2	**Late Seed: Early team** (multi founder) "The company is founded as a private corporation…" (ID 21)
3	**Early Startup: Functional team** (distinct functional responsibilities) "The core functions are managed by Markus Larsen as the CEO, Jörg Bauer as CTO, and Michael Mayer as CMO" (ID 20 und 21)
4	**Late Startup: Small operation** (early organization emerges) "Currently we have 8 employees" (ID 9)
5	**Early Growth: Business scale-up** (Scaling the business) "We have 25 employees" (ID 6)

In the supplier dimension, 49 transaction relations in total were identified (group one & group two). Almost all of these transactions were identified in survivor group two (92%). In that group, out of the identified 45 transaction relations, 19 were categorized in seed (42%), 16 in startup (36%), and ten in the growth phase (22%). In the non-survivor group one, out of the identified four transaction relations, three were categorized in seed (75%), one in startup (25%), and none in the growth phase.

Most frequently, transaction relations in the seed phase were related to a technology source in a research institute. It is further to be noted that while transaction relations in the other three dimensions (customers, finance, and human resources) were unambiguously identified, in the supplier dimensions, descriptions exhibited more ambiguity. This finding motivates a model refinement before applying the indicators to the full-scale sample. The following, TABLE IV, illustrates examples of transaction relations identified in the financial resources dimension being categorized:

TABLE IV.

	Question: How mature is the transaction relation to suppliers?
1	**Early Seed: Hypothetical Relations** (consideration of partnerships) "We need partners such as…" "In particular in long-term the cooperation with the network provides is crucial"
2	**Late Seed: Non-professional relation / initial contacts** (partnerships on non-professional level / exchange orientation) "We have access to more than 30 Ph.D. students in our institute" (ID 3) "We received an introduction to the following partners: …"
3	**Early Startup: Early professional partnerships** (partnerships in implantation in order to exchange something) "IBM asked us to register as a partner for…" (ID 9)
4	**Late Startup: Transaction partnership** (professional transactions on regualr basis) "The software is to certain extend developed by…" (ID 9)
5	**Early Growth: Validated partner relations** (growing, formalized partnerships) "We acquired in total 100 Partners" (ID 4)

VI. Discussion, Limitations and Conclusion

We conceptualize a technology-based venture as being embedded into a network of transactions with partners in various dimensions. Based on this, we have hypothesized, that these transaction relations would be reliably reflected on a venture's business plan – despite the fact that this business plan as a whole is distorted from reality for many reasons. Accordingly, we have derived a two-dimensional representation of a venturing activity that uses structured content analysis of descriptions of transaction relations in its business plan. This analysis was argued to enable the deriving of reliable indicators for the survival and growth of early-stage, technology-based ventures.

We empirically tested this concept in a pre-test on a sub-sample of 40 business plans: Three hypotheses were tested based on conducting the suggested structured content analysis on the sample. The findings so far seem to confirm all of the three hypotheses. However, for the third hypothesis, the suggested model exhibited some ambiguity when being applied in the supplier dimension. In this respect, we aim to improve the model by enacting respective refinements.

The test demonstrates that the suggested model may not only provide support in distinguishing likely-surviving from likely-non-surviving ventures. Moreover, the indicated impact of maturity patterns in the four dimensions of transaction relations suggests that focusing support on the critical part of such patterns (e.g. the lacking transaction relations in the customer dimension) may serve to address the efficiency challenge as faced by innovation intermediaries.

In addition to the quantitative patterns in the first dimension of the model (number of transaction relations in the four dimensions), the identified density of described transaction relations allowed for reliably characterizing identified transaction relations along a maturity model. This shows that not only the number, but also the strength of transaction relations may be derivable from the suggested content analysis of business plans. This strongly supports the suggested model of a measurement instrument for the maturity of the value-network as expressed in business plans.

Our initial findings thus support the argument that the maturity of a technology-based venture's value-network (as expressed by transaction relations) correlate with the venture's survival and growth. This model may provide some advantages when compared to alternatives, like evaluating the current status of the product, future market size, etc., as the suggested structured content analysis does not assume expertise in the domain (product, market), but in the process (content analysis, indicators). This can, for example, be well trained and thus more broadly made available for innovation intermediaries.

However, in its current extent, this research is still limited in several aspects. The selected sub-sample evinced only theoretical saturation, but is not yet representative. Further research is necessary to improve the understanding on the

herein weakly identified patterns in the maturity of transaction relations over their four dimensions. Such research should aim at distinguishing typical patterns, e.g. industry specific patterns. However, to the extent presented here, differences in industry sectors have not yet been taken into account. However, we expect different patterns in relation to maturation in e.g. biotechnology industry, ICT sector, and others.

Further, while generally confirming the hypotheses, the analysis nevertheless showed some outliers. which is even more relevant given the limited sample size. These outliers should be subject to further research as they might be the most interesting cases, i.e. those where effective support by innovation intermediaries may have the strongest impact (i.e. prevent the venture from failing otherwise). Thus, an initial test can be implemented to determine whether similar outliers in comparable occurrence can be identified in the total sample of the 800 business plans. This will be a next step in this research project.

Similarly, also the sample of 800 business plans should be extended, as this resulted from a network sampling approach. Thus, the selection probability for a venture is unknown, and only referred people with access to the surveyors (bwcon) can participate. Additionally, the properties of the network affect the sample [90].

However, the results indicate general applicability of the model. The reliability of the measurement instrument for identifying maturity patterns in transaction relations on the basis of descriptions in the business plan may be developed on that basis given an extended sample, which is available. This would enable the identification of the impacts of maturity patterns in a venture's value-network on the survival and growth of early-stage, technology-based ventures. Such findings may further motivate research to identify industry-specific patterns in different high-tech sectors.

However, already at this stage, the proposed model may support innovation intermediaries in analyzing the business plans of early-stage, technology-based ventures, identifying their strengths and weaknesses in transaction relations in order to derive actionable insights for prioritizing their support.

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VIII. LITERATURE

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