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Different patterns in the evolution of digital and non-digital ventures' business models

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ABSTRACT

The business model canvas (BMC) and the lean start-up manifesto (LSM) have been changing both the entrepreneurial education and, on the practical side, the mindset in setting up innovative ventures since the burst of the dot-com bubble. However, few empirical insights on the business model implementation patterns that distinguish between digital and non-digital innovative ventures exist. Connecting practical management tools to network theory as well as to the theory of organizational learning, this paper investigates evolution patterns of digital and non-digital business models out of the deal flow of an innovation intermediary. For this purpose, a multi-dimensional quantitative content analysis research design is applied to 242 ventures' business plans. The measured strength of transaction relations to customers, suppliers, people, and financiers has been combined with performance indicators of the sampled ventures. The results indicate that in order to succeed, digital ventures iterate their business on the market early and search for investment afterwards. Contrariwise, non-digital ventures already need financial investments in the early stages to set up a product ready to be tested on the market. In both groups we found strong evidence that specific evolutionary patterns relate to higher rates of success.

1. Introduction

Digitalization has been the driver of economic change, with ups and downs in all industries, since the end of the last century. The development of new options in information technology allowed newcomers to challenge existing value chains with innovative and often disruptive business models. In the days when the dot-com bubble burst, a serious backlash was directed at the digitalization of the economy, due to misdirected investments into unproven business models (Ayres and Williams, 2004; Drori et al., 2009; Min et al., 2008). As a consequence, it seems that the business model as a management tool suddenly went out of fashion, as judged by the publication statistics of Google Scholar and other, similar research (Al-Debei and Avison, 2010; Magretta, 2002).

Initiated once again by the publication of Osterwalder's Business Model Canvas (BMC) and Eric Ries' Lean Startup Manifesto (LSM) at the end of the first decade of the 21st century, a new way of thinking in the field of digital entrepreneurship diffused into practice (Chesbrough and Rosenbloom, 2002; Frederiksen and Brem, 2017; Osterwalder and Pigneur, 2011; Ries, 2011). In the combination of both approaches, Steve Blank recommended that the business model evolves based on assumption testing to become a better mechanism of resource combination. He recommends developing and testing hypotheses behind each building block of the BMC in an iterative process while implementing the business (Blank, 2013; Blank and Dorf, 2012).

All three authors tried to apply these mainly normative concepts for non-digital industries as well (Blank and Dorf, 2012; Fritscher and Pigneur, 2014). As the theoretical foundation of these practical management concepts, the scientific literature provides an explanation in the field of network theory as well as the theory of organizational learning (Al-Debei and Avison, 2010; Frederiksen and Brem, 2017; Fritscher and Pigneur, 2011; Guemes-Castorena and Toro, 2015; Harms, 2015; Hart, 2012; Kilkenny and Love, 2014). However, only little empirical evidence of distinctive patterns that are validating the assumptions behind business models over time in different sectors exists (Fritscher and Pigneur, 2011).

One reason might be the difficulties researchers experience in accessing real-life business model instances in the field. Empirical research on such evolutionary patterns of business models in the innovation system could allow research and practitioners to better understand the innovation process in business venturing. Sector-specific differentiation between digital and non-digital business models

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would allow focussing on the right implementation strategies. The objective of this paper is to compare patterns of business model evolution in digital and non-digital venture industries and to shed some empirical light on the usefulness of combining BMC and LSM methods.

The research is based on data that has been gathered from a multidimensional content-analysis research design applied to business plans, combined with cluster analysis. The business plans stem from the deal flow of one of the largest innovation intermediaries in the Southwest of Germany. This paper contributes to the business model literature by developing an understanding of different business model evolutionary patterns in digital and non-digital industries.

2. Theory and research question

2.1. Lean start-up and adaptive learning

LSM follows the idea of making implicit assumptions about the functionality of a venture explicit under empirical tests (Harms, 2015). The ideas expressed in LSM are not entirely new. Instead, LSM falls into the category of adaptive learning strategies. Adaptive learning strategies in the development of new venturing activities emerged under different names in management literature. With less attention to practice, Mcgrath and Macmillan, for instance, pioneered the concept of discovery-driven planning and Dykes and Dunham the idea of critical assumptions, published already by 1995, before the dot-com bubble (Mcgrath and Macmillan, 1995; Sykes and Dunham, 1995).

Following the essence of the LSM, the theory of organizational learning suggests that venture teams learn the necessities of their business based on a constant and self-regulated process (Fontes and Coombs, 1996; Tam and Gray, 2016). In fast and iterative learning processes, they follow the scientific method of learning their innovative business from and with their outside environment (Fontes and Coombs, 1996; Harms, 2015; Magretta, 2002). In this interactive inter-organizational learning process, the venture activity leads to a competitive knowledge advantage in their business model (Graham and Muyia Nafukho, 2007).

2.2. Connected evolution of the business models

Such tactical knowledge is expressed in the understanding of whom to connect with or what to avoid when operating the business (Chrisman and McMullan, 2004). Considering the concept of the BMC grounded in the so-called ego-centric – or rather venture-centric – network theory, entrepreneurs connect their business with customers on the output side and suppliers, people, and financiers on the input side (Carnovale and Yeniyurt, 2015; Elfring and Hulsink, 2007; Kilkenny and Love, 2014). The assumptions in the business model are verified by trustworthy people in the network (Song et al., 2017).

The theory of the ego-centric 'value network' looks at the cross-section between the internal and external environment of the venture (Anderson et al., 1990; Carnovale and Yeniyurt, 2015). Namely, it neglects factors of the resource-based view (RBV) and market-based view (MBV) on strategy such as patents or the respective sector, but builds the cross-section in-between (Borgatti and Foster, 2003; Carnovale and Yeniyurt, 2015; Giones et al., 2015). From this perspective, network theory attempts to explain business innovation, i.e. creating value with a higher-yield, from the external relations the venture builds over time (Anderson et al., 1990; Carnovale and Yeniyurt, 2015).

When discussing the evolution of the BMC, the development of the relationships has to be investigated from a longitudinal perspective. The theory of the venture's value network emergence suggests that the development of relationships shift from more people-oriented to formal business relations (Hite and Hesterly, 2001; Oksanen et al., 2010; Ostgaard and Birley, 1996; Sullivan and Ford, 2014; Witt et al., 2008). The relations surrounding the business become increasingly stronger when a real market opportunity is addressed over time (Hamm et al., 2002; Hite and Hesterly, 2001; Sullivan and Ford, 2014). The assumptions about the business interrelations to reality are proven. During this process, the venture's business model evolves to a higher validity of what we define as the 'venture-centric value network' (Konig et al., 2015).

2.3. Digital versus non-digital ventures

The fundamental ideas on LSM and BMC were created from a business innovation context in a digital venture industry (Blank, 2013; Osterwalder and Pigneur, 2011; Ries, 2011). In entrepreneurial literature, there is a growing body of literature separating digital ventures or software ventures from the larger field of new high-tech firms. Digital ventures are specific, as they are built on software and data with the potential for high and fast scalability (Bajwa et al., 2017; Giones et al., 2015; Nguyen-Duc et al., 2016).

Initial empirical research from Nguyen-Duc A et al. suggests that digital ventures often iterate their business model. The idea is to test potential customers' interest right in the beginning, and to ensure building the necessary product-market-fit. The study further describes that the members of the venture often include software developers who can finance their business out of the cash-flow in the beginning (Nguyen-Duc et al., 2016). However, their qualitative research only looks at a small group of surviving ventures (Bajwa et al., 2017; Nguyen-Duc et al., 2016).

Another study, which investigates the strategic focus of innovative ventures, finds that the group of digital ventures consider the first mover advantage as the most important competitive advantage (Graham et al., 2009). In contrast, innovative non-digital ventures try to set up a business that is often based on extensive research. In their self-evaluation of the competitive advantage, IP secrecy and special competencies seem to have a higher relative importance than the first mover advantage. Logically projected onto a business model level, this orientation requires high investment sums into an intangible asset before moving onto the market from a resource-based view (Graham et al., 2009; Samuelson, 2010). Hence, we suppose to identify these different patterns of evolution in the value network of early-stage ventures.

We have been investigating the process of business model evolution in a multi-level research design following the concept of the venture-centric (or 'ego-centric') value network that increases in strength over time. To detect distinct patterns in the evolution of different ventures' business models, we investigate business plans. In this paper, specific aspects of the business models of digital and non-digital ventures are compared:

> *Do specific evolution patterns in the business models of digital and non-digital ventures exist, and do these provide insights on their performance?*

For this purpose, we analysed the strength of transaction relations described in business plans. The artefact business plan describes the business model of a venturing activity at a certain point in time and projects its development onto a timeline. It thus represents a mental snapshot model of the venturing activity, a snapshot of an ongoing planning process that frequently changes in the dynamic environment of the innovation system (Doganova and Eyquem-Renault, 2009; George and Bock, 2011). In the text of the business plan, the venture's status is described – among other factors – by transaction relations with stakeholders such as customers, suppliers, employees, and investors (Ballin, 2011; Konig et al., 2015).

The artefact has been most frequently produced in high-tech ventures in the past. If a venture searches for support and investments in its surrounding innovation system, the business plan is a precondition for getting access to scarce resources of the innovation system (Doganova and Eyquem-Renault, 2009; Honig and Karlsson, 2004; Kirsch et al., 2009). In the selection process of innovation intermediaries (incubators, funds, consultants etc.), textual descriptions of the business

model, such as in the business plan, thus represent the entry ticket (Kirsch et al., 2009).

However, due to a lack of empirical evidence and differing perspectives of innovation intermediaries on indicators for the strengths and weaknesses of venturing activities, the business plan is not the only basis for support decisions (Doganova and Eyquem-Renault, 2009; Karlsson and Honig, 2009; Kirsch et al., 2009; Mason and Stark, 2004; Simon, 2012). For our research, we have access to the data base of Baden-Württemberg Connected e.V. (bwcon). The business initiative has been announcing the yearly business plan competition 'CyberOne' since 1999.

To capture a set of relevant business model evolution patterns of digital and non-digital ventures, we aimed at identifying different performance groups. Hence, we decided not to investigate ventures' business models with multiple measurements and a longitudinal research approach. Instead, we look at a large and heterogeneous deal flow of ventures in the early-stage of the business life-cycle. The identification of relevant patterns in the business models required a deal flow that is at least to a certain extent representative of early stage business venturing and includes a sufficiently large number of ventures. Moreover, secondary data on failure, survival, and growth must allow relating these patterns to performance.

3. Method

3.1. Research design development

We followed a rigorous approach in the development of a quantitative content analysis research design using human coders (Bailey et al., 2000; Kemal Avkiran, 1994; Krippendorff, 2004; Mikhaylov et al., 2012; Murphy and Ciszewska-carr, 2005). The basis was an iterative process of using both inductive and deductive research for the first step, the design of a content analysis research instrument (König et al., n.d.). In the first deductive step, we developed a solid theoretical grounding by investigating the life cycle literature in the context of the four transaction categories of the venture-centric value network. These are customers, financiers, suppliers, and people. Based on this life cycle-related literature research for each of the transaction categories, we conceptualised transaction relations as an anchor specifying the cross-section between the business model described in the artefact business plan and the business implementation status in reality (Konig et al., 2015).

In the first inductive step, we applied qualitative content analysis of business plans to analyse text passages that describe the venture-centric value network. In a comparative study with a convenient sample of 20 successful and 20 failed ventures, we developed an initial empirical grounding. The group of successful ventures was selected based on the success stories of bwcon and the failed ventures randomly from the total sample of the deal flow. We detected transaction relations such as "*We already have a pilot project with…*" for the customer category or "*We have received a business angel investment of 100.000 Euro…*" for the finance category.

We matched the findings with what the literature discusses in the context of the emergence of the venture-centric value network in the four transaction categories. The results were used to create a multi-dimensional research instrument for classifying the strength of the described value network on a 5-point Likert scale. Based on the transaction relations, these represent the stages early-seed, late-seed, early-startup, late-startup, early-growth, and thus, the status of the evolution of the presented business model (Konig et al., 2015).

We proceeded with the design development following a rigorous purification and data collection on a quantitative level (Bailey et al., 2000; Kemal Avkiran, 1994). In two iterative steps, we developed a sophisticated research data-collecting process. In the first testing loop, we tried to identify all interpretative flaws with applying the research design by a quantity of different human coders in a direct application of the instrument. Based on the result, we improved not only the research instrument but also the overall research design (König et al., 2016).

This entailed developing an advanced three-step process for human coding. First, transaction relations are identified in business plans. Next, they are evaluated according to their strength using the research instrument in a peer-reviewing procedure. Finally, they are judged on a business plan level, i.e. determining the strongest transaction relation found per category. This process is documented in a three-level research database:

(1) the first level comprises all business plans split into single sentences

(2) the second level encompasses all transaction relations that were identified in these sentences, including the codes defining their strength from applying the measurement instrument

(3) the third level represents an aggregation of the coding results for each business plan into the highest value per category, plus further variables such as the venture's sector (digital or non-digital), performance after five years, patents, and official registration.

This system allowed for improvement to the research instrument and adaptation of coding in the beginning. Based on initial quality control of the content analysis, research design improvements, and stepwise coding quality checks, we expected the quality of the coding defined by the inter-coder reliability to be above 67% in the overall sample (König et al., n.d.).

Through an additional quality analysis, we further tested the extent of agreement between transaction relations described in business plans and reality. For this purpose, we interviewed entrepreneurs directly after the submission of their business plans regarding the status of real transaction relations of their venture. In all categories except the supplier dimension, the agreement between both measures was again above 67% (König et al., 2017).

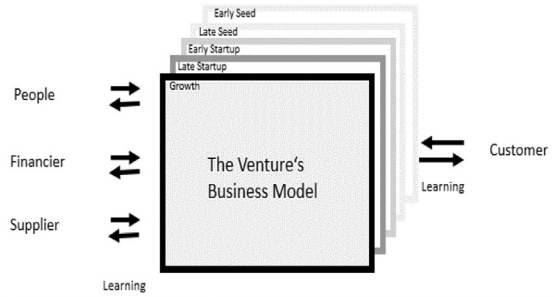
We adapted the research instrument in the supplier category to only capture the search for relations that are of strategic relevance for the value chain, and not commodity relations (König et al., 2017). Fig. 1 shows the overall research instrument. Based on the results of both inter-coder reliability as well as the instrument validity expressed by reflecting reality, we assume sufficiently high quality to use the data generated by the research design for further quantitative analysis.

3.2. Sample

The overall research is based on a sample of 837 business plans that had been collected between 2000 and 2016 at the official business plan competition for technology ventures in the German regional state of Baden-Württemberg. Since the start of the award, the collection of business plans in this deal flow followed a network sampling approach. This sampling approach tries to acquire elements based on the recommendation of a domain-specific network in hard-to-reach target populations. It applies the idea that peers within hard-to-reach target groups know other peers (Biernacki and Waldorf, 1981; Johnston and Sabin, 2010).

We suppose that network sampling is the acquisition approach used by every innovation intermediary in a certain innovation system. Based on our evaluation of a subsample in comparison to a study by the Centre for European Economic Research (ZEW) (Egeln et al., 2012), we assume representativeness for technology-based ventures in the State of Baden-Württemberg for the years between 2006 and 2012. We see agreement between the regional hotspots for funding high-tech ventures in the business plan sample with the ZEW study.

In contrast to the ZEW sample, which mainly looks at officially registered ventures, we are investigating a dataset of business model snapshots of ventures in the early-stage of the business life cycle. Accordingly, the sample is heterogeneous in the way that the various companies submitted business plans for the award at different maturity stages, i.e., including business plan submissions before and after the official registration. This lets us assume a large diversity of transaction



	Suppliers	People	Financiers	Customers
Early Seed	**Hypothetical relation** ***Example:*** "We need partners such as..."	**One man show (single founder)** ***Example:*** "The idea has been developed within the context of my MBA studies"	**Wish for money (claim for investment)** ***Example:*** "We need an investment of 100.000 Euro in order to..."	**Early Seed: Market hypothesis (top-down)** ***Example:*** "We expect that 10% of the 65,000 German regional doctors are open for our product which helps them to..."
Late Seed	**Non-professional relation** ***Example:*** "We received an introduction to ...; We are in contact with potential suppliers"	**Early team (multi founder)** ***Example:*** "The company has officially been founded as a private corporation..."	**Non-professional investments (awards, private money)** ***Example:*** "We used the price money from an ..."	**Market investigation (primary analysis)** ***Example:*** "Several potential customers already expressed their interest in buying our system..."
Early Startup	**Early professional partnership** ***Example:*** "IBM asked us to register as a partner...; we did research with the university of..."	**Functional team** ***Example:*** "The core functions are managed by Markus Larsen as the CEO, Jörg Bauer as CTO, .."	**Initial external seed investment** ***Example:*** "Markus Moor invested as business angel..."	**Pre-contracts and market tests** ***Example:*** "After we had implemented field tests, the system has been used several times in a commercial application."
Late Startup	**Transaction partnership** ***Example:*** "Since last year, our supplier delivers components..."	**Small operation** ***Example:*** "Currently, we have 8 employees"	**Initial professional investment** ***Example:*** "We received an initial investment of 500,000 Euro in equity"	**Market entry (initial sales)** ***Example:*** "We already sold licenses to several companies."
Growth	**Validated partner relations** ***Example:*** "In total, we acquired 100 partners in the past year"	**Early growth: Business scale-up** ***Example:*** "We have 25 people working for our startup"	**Professional growth capital** ***Example:*** "In total, we invested more than 7 Mio. Euro in our..."	**Ready for take-off (growing customer base)** ***Example:*** "We were able to acquire 100 paying customers for our product."

Fig. 1. Multidimensional research instrument.

relations.

For this paper we focused on a sample of business plans that were collected between 2006 and 2012, amounting to a total of 311 venture business plans, to assure comparability in our performance definition. This was necessary as secondary data were needed to compare the performance of ventures in the same period. We used data from an external data service provider as the basis for the evaluation. Therefore, we tested the data quality of different providers with a subsample. We decided to use the data from bisnode, one of the largest business data providers in Germany. However, the data were only available for five years after the relevant measurement point.

Due to the still-limited data quality for the ventures in our sample, we followed a pre-specified and pre-tested verification process for the data. Next, to the bisnode data, at least three persons independently checked the activity on the website of the venture, publication of news, as well as the available data from the official trade register. The few remaining differing results were discussed in groups and a final decision was made regarding the performance outcomes. Based on this information after five years of business plan submission, we decided to classify the ventures into the groups of failed, survived, and successful.

The success evaluation was difficult in that success itself is a very subjective construct in the context of a venturing activity (Kolasińska-Morawska, 2014). Hence, we followed a purely economic definition of success. First, we grouped ventures that showed growth into the success category. In literature, there are no generally used definitions for the growth of ventures in the early stage. However, the growth definitions are always based on aspects such as increases in turnover and staff within a specific time perspective (Coad et al., 2014; Moreno and Casillas, 2007; Parker et al., 2010).

Respectively, we defined that a growth venture must still be documented in official registers five years after business plan submission. Additionally, it must have reached a turnover above 300,000 euros as a bottom-line and must have tripled the turnover when initially between 100,000 and 500,000 euros or doubled when initially above 500,000 euros. The numbers mentioned in the business plan were used as reference turnovers.

In the case that reliable turnover information was missing, we used the growth in employees as an additional indicator. Again, three employees were the bottom-line. Between 3 and 15 employees, the number had to be tripled, and above 15 the number had to be doubled to be classified into the growth category. Moreover, ventures that have been identified as dead but were successfully sold to other companies, have also been grouped into this success group.

To answer the research question in this paper, we further excluded company spin-off projects from the sample. This allowed us to eliminate interferences in the coded transaction relations that can be related to a venturing situation supported within a company. These may arise due to business plans from a corporate organization not only explaining the transaction relations of the business model, but also of the core business. Moreover, the relation between the proposed business model and the company is difficult to delimit.

These steps reduced the sample to 242 ventures for our analyses. Assessing the sample regarding the performance outcomes failed, survival and success, we find that the sample contains 48.8% failed and 51.2% survived. From the latter, exactly half of them have been classified as successful ventures, which equals 25.6% of the total sample. Further 9 of the failed ventures were recorded as successful exits and so add to the group of the successful ventures.

To obtain insights concerning the research question, we added the sample information on the MBV and the RBV as additional indicators. Based on the MBV, we created the variable differentiating digital and non-digital ventures. Digital ventures were defined as ventures attempting to implement an intangible software tool at the core of their business model. Non-digital ventures were defined as ventures working on establishing a (tangible) hardware- or biotechnology-based business model. Although this variable may be considered as having an inside view on the venture, the two sectors differ in outside conditions such as legal and technological aspects. These require a very individual

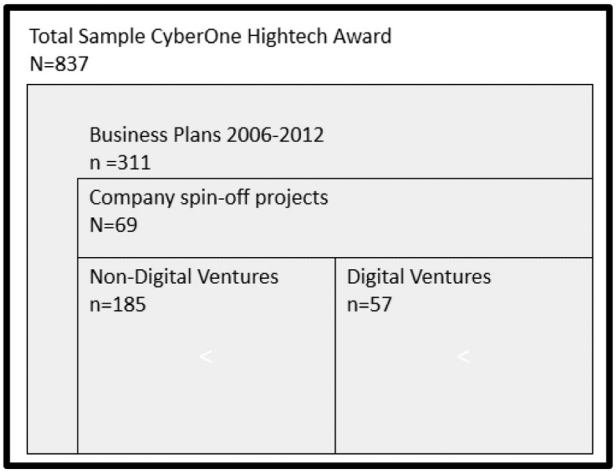


Fig. 2. Sample.

implementation of the business model. Out of the 242 ventures in the sample (see Fig. 2), 76.44% (185 business plans) were classified as digital and 24.55% (57 business plans) as non-digital ventures.

As reflected in the RBV, we collected information on each venture's patenting status from the business plan text. We decided in favour of this variable as it seems to be the major differentiating factor between digital and non-digital ventures according to the above-described literature. We thereby differentiated the patenting activities into (1) no attempt to patent, (2) option to patent, (3) applied for patent, (4) holds a patent, (5) holds a patent and applied for at least one further patent. For our analysis we developed a binary variable distinguishing between not (yet) holding a patent (1–3) and holding at least one patent (4–5). The data collection again followed a systematic content analysis process that assured high quality.

Finally, we also investigated the sampled ventures' post-finance activities based on desk research for every survived and successful company. We additionally gathered investment information from an expert, one of the most active investors in the innovation system of Baden-Württemberg in the relevant time period. Based on this data, we created a variable indicating whether the ventures received a venture capital investment within 5 years after submitting the business plan to the CyberOne award, thereby increasing the transaction relation strength in the financier category.

The variable post-finance only includes companies that, according to the text analysis of the business plan, had not yet received risk capital when applying to the award. Technically, ventures already coded with a 4 or 5 in the financier category are not included in this new post-financing variable. Due to potentially imperfect data on financing activities, the variable reflects which ventures for sure obtained risk capital financing in the years after the business plan award. However, it may overlook some venture capital financing activities.

3.3. Cluster analysis

For the exploration of our sample, we ran a range of cluster analyses based on the strength of transaction relations described in the ventures' business plans. Cluster analysis represents a collection of different methodologies that, in our case, support the grouping of the data structures to obtain homogenous groups of transaction relation patterns (Backhaus et al., 2011). Following this segmentation task, we grouped digital and non-digital ventures using the four transaction relation category ratings as clustering variables.

The chosen method is hierarchical clustering. Since the aim was to obtain homogenous clusters, the “Average Linkage Within Groups” served as a distance measure. This clustering approach combines the ventures according to their transaction relation strength by minimizing the average distance between the individual cases in the group (Colman, 2008). The sorting of cases into groups takes place through the arithmetic averages. It allows to overcome the disadvantages of the complete linkage clustering mechanism, in which outlier cases can prevent close clusters from merging. It also avoids potential downsides of the single linkage process, in which chain-like, rather heterogeneous clusters may emerge because the most similar cases are merged step-by-step (Yim and Ramdeen, 2015).

The statistically optimal number of clusters is defined as the last clustering step before two highly dissimilar clusters are merged, based on the dendrogram. In our attempt to gain a deeper understanding of the evolutionary patterns, we looked not only at the statistically optimal cluster solution but also investigated weaker cluster solutions. These could show relevant patterns in the context of ventures that survive and succeed. Therefore, in the results section, two tables are displayed for both digital and non-digital ventures. First the statistically optimal cluster solution, then the deeper investigation.

In addition to each cluster's average strength in the transaction relation categories, additional information on the respective rates of survival, success, patenting and financing activities are included in the result tables to provide a comprehensive overview on the cluster characteristics. The white columns in the result tables show the average of the four clustering variables. Subsequently, the defined performance categories for the clusters, as well as post-financing and patenting activities, are displayed in grey columns to understand the pattern implications of transaction relations.

4. Results

4.1. Digital ventures

When looking at the digital ventures, the statistically optimal number of clusters turns out to be two, according to the dendrogram. Table 1 shows the results of the two-cluster solution by presenting the average transaction relation strength in terms of people, financiers, suppliers, and customers, plus the mean survival and success rate of the ventures in each of the clusters. The average transaction relation strength refers to the maturity of the ties that the ventures have built towards the market in the respective category. The values can range from 1 to 5, where for example 1 in the financier category means that a venture seeks external funding whereas 5 means that several institutional investors have put their money into the venture. Hence, the higher the average value in the financier category in a cluster, the stronger the ties that have been built towards financiers by the ventures that belong to the cluster.

Reading Tables 1 to 4, Ø symbolizes the mean value, N represents the number of cases within one cluster and SD is the abbreviation for the standard deviation of values within the clusters. Survival and Success means can range from 0 (0% of ventures in a cluster) to 1 (100% of ventures in a cluster).

Looking at Table 1, cluster 1 mainly includes ventures with a low strength in transaction relations in all four categories. The business

Table 1
Digital ventures (2-cluster solution).

Clusters		People	Financier	Supplier	Customers	Survival	Success
1.	Ø	2.33	1.85	1.97	2.09	0.42	0.19
	N	162	162	162	162	162	162
	SD	0.810	0.652	1.111	1.030	0.495	0.390
2.	Ø	3.91	2.70	3.13	4.57	0.78	0.65
	N	23	23	23	23	23	23
	SD	0.793	1.020	0.757	0.507	0.422	0.487
Total	ø	2.52	1.96	2.11	2.39	0.46	0.24
	N	185	185	185	185	185	185
	SD	0.962	0.758	1.139	1.277	0.500	0.430

Table 2
Digital ventures (5-cluster solution).

Clusters		People	Financier	Supplier	Customers	Survival	Success	Post-finance total	Patent total	Post-finance success	Patent success
1.1	Ø	2.62	1.95	1.28	3.10	0.51	0.23	0.03	0.03	0.11	0.00
	N	39	39	39	39	39	39	39	39	9	9
	SD	0.782	0.605	0.793	0.641	0.506	0.427	0.160	0.160	0.333	0.000
1.2	Ø	2.18	1.64	1.66	1.14	0.27	0.10	0.04	0.01	0.43	0.00
	N	73	73	73	73	73	73	73	73	7	7
	SD	0.788	0.586	1.070	0.384	0.449	0.296	0.200	0.117	0.535	0.000
1.3	Ø	2.32	2.08	2.96	2.68	0.56	0.28	0.08	0.10	0.29	0.14
	N	50	50	50	50	50	50	50	50	14	14
	SD	0.819	0.695	0.605	0.653	0.501	0.454	0.274	0.303	0.469	0.363
2.1	Ø	3.72	2.22	3.11	4.50	0.78	0.67	0.33	0.06	0.50	0.08
	N	18	18	18	18	18	18	18	18	12	12
	SD	0.752	0.428	0.758	0.514	0.428	0.485	0.485	0.236	0.522	0.289
2.2	Ø	4.60	4.40	3.20	4.80	0.80	0.60	0.00	0.40	0.00	0.67
	N	5	5	5	5	5	5	5	5	3	3
	SD	0.548	0.548	0.837	0.447	0.447	0.548	0.000	0.548	0.000	0.577
Total	Ø	2.52	1.96	2.11	2.39	0.46	0.24	0.08	0.05	0.31	0.11
	N	185	185	185	185	185	185	185	185	45	45
	SD	0.962	0.758	1.139	1.277	0.500	0.430	0.265	0.227	0.468	0.318

Table 3
Non-digital ventures (2-cluster solution).

2 clusters		People	Financier	Supplier	Customers	Survival	Success
3	Ø	2.28	1.79	2.47	2.44	0.58	0.33
	N	43	43	43	43	43	43
	SD	0.826	0.466	1.032	1.315	0.499	0.474
4	Ø	3.57	3.71	2.93	4.21	0.93	0.86
	N	14	14	14	14	14	14
	SD	0.852	0.726	0.917	0.802	0.267	0.363
Total	Ø	2.60	2.26	2.58	2.88	0.67	0.46
	N	57	57	57	57	57	57
	SD	0.997	0.992	1.017	1.428	0.476	0.503

plans in this cluster were submitted in an early stage compared to the competition. In this group, the rates of survival and success are relatively low with only 42% and 19%. The business models in these business plans were mainly in an early ideation phase without many outside contacts.

We observe that cluster 2 scores particularly high in both the Customer and People categories. The 23 ventures in this rather small but high-performing cluster have an average survival chance of 78% and a growth rate of 65%.

Comparing the average survival rates of the two clusters with a simple independent *t*-test, the *p*-value of 0.001 shows that the difference is highly significant from a statistical point of view. The same result is obtained for the success variable ($p = 0.000$). The *t*-tests and the clustering results provide evidence for the network theory based assumption that stronger transaction relations lead to more survival and success.

Investigating the clusters in more depth, we decided to also explore smaller clusters to find more diverse patterns. In particular, we intended to see whether similarly performing clusters could be found that show different transaction relation patterns. We therefore investigated the 5-cluster solution depicted in Table 2. Here we also added the created variables Post-Finance and Patent Total, referring to all ventures in the analysis, as well as Post-Finance Success and Patent Success, only considering the successful firms. These additional data insights serve as indicators for success patterns.

The two clusters that split from the former cluster 2 are of specific interest. First, in cluster 2.1 we see ventures that, when applying for the award, used an approach of customer validation on the market, due to the strong customer relations of 4.5 on average. They had not financed their business with an investment. Companies in this group have a high rate of survival and success. Looking at the number of post-financing activities of the ventures in group 2.1, we found that at least 33% received risk capital financing in the time after the business plan contest. Looking at the subgroup of 12 successful ventures in this cluster, 50% of them received a risk capital investment in the follow-up of the award. With only 8% (one company) holding a patent, patenting activities are relatively low.

Compared to cluster 2.1, customer interaction is higher in cluster 2.2. The companies in this small group had already received capital from an investor, resulting in a high maturity in the financing category. Here, two of the five companies also hold a patent. Due to the configuration of our variable that excludes already financed ventures, in all five ventures in cluster 2.2, the average of post-financing activities is recorded as zero.

Table 4
Non-digital ventures (3-cluster solution).

Clusters		People	Financier	Supplier	Customers	Survival	Success	Post-finance total	Patent total	Post-finance success	Patent success
3.1	Ø	2.14	1.81	2.38	1.29	0.38	0.10	0.05	0.43	0.50	0.50
	N	21	21	21	21	21	21	21	21	2	2
	SD	0.727	0.512	0.973	0.561	0.498	0.301	0.218	0.507	0.707	0.707
3.2	Ø	2.41	1.77	2.55	3.55	0.77	0.55	0.36	0.55	0.67	0.75
	N	22	22	22	22	22	22	22	22	12	12
	SD	0.908	0.429	1.101	0.739	0.429	0.510	0.492	0.510	0.492	0.452
4.	Ø	3.57	3.71	2.93	4.21	0.93	0.86	0.14	0.50	0.17	0.58
	N	14	14	14	14	14	14	14	14	12	12
	SD	0.852	0.726	0.917	0.802	0.267	0.363	0.363	0.519	0.389	0.515
Total	Ø	2.60	2.26	2.58	2.88	0.67	0.42	0.19	0.49	0.42	0.65
	N	57	57	57	57	57	57	57	57	26	26
	SD	0.997	0.992	1.017	1.428	0.476	0.503	0.398	0.504	0.504	0.485

4.2. Non-digital ventures

Investigating the group of non-digital ventures, the optimal number of clusters turns out to again be two. Table 3 shows that in cluster 3, the average transaction relation category score is lower than 3. The proportion of surviving ventures is 58%, and thus clearly lower than in cluster 4 with 93%.

Similarly, the success rate of 86% in cluster 4 is considerably higher than in the first cluster of non-digital ventures with 33%. In this second cluster, we can observe comparably high scores in each of the four transaction relation categories. Only the supplier category stays below a mean value of three.

In contrast to the results for digital ventures, this 2-cluster solution already shows stronger financing activities in the second cluster (4). With an average financier transaction relation strength of 3.71, it can be assumed that a considerable number of ventures have received venture capital in this group. This difference between cluster 2 (digital venture results) and cluster 4 (non-digital venture results) does not appear in the customer, supplier, and people category that has similar averages.

t-Tests again provide evidence for the network theory based assumption that stronger transaction relations lead to higher survival and success rates. Comparing the respective proportions between the two clusters, the *p*-value of 0.0016 for survival and the p-value of 0.001 for success prove highly significant differences in performance.

Investigating the next best cluster solution (3-cluster solution) again yields evidence for different patterns. Again we added the same additional indictors as in Table 2. Compared to the digital firms, cash-flow finance may not work as well as for non-digital firms. Support for this assumption can be found in the cluster analysis results depicted in Table 4.

Cluster 3.2 and cluster 4 seem to differ considerably in their average financier category values: much stronger financing activities are evident in cluster 4, although cluster 3.2 is nearly as mature in terms of customer transaction relations. In this cluster 3.2, at least 36% of the ventures without risk capital investment at the date of the business plan submission received a risk capital investment in the follow-up. This accounts for 67% of the successful ventures after five years. The patenting activities are also quite high, with more than 40% of ventures holding at least one patent in each of the clusters.

Summarizing the results in a comparative look at digital and non-digital ventures, financing seems to be connected to survival and success. Non-digital startups exhibit stronger financing activities in the market entry stage (reflected in a customer relation strength of 4), while digital ventures more frequently reach this stage without having strong financier relations. Patents seem to play a more important role for non-digital ventures.

5. Discussion

5.1. Implications for academia

The results support the idea that the concept of the venture-centric value network, describing the cross-sections of the business model, connects to the fundamental theory of the evolving ego-centric value network in the business life cycles. Evidence is provided by both cluster solutions in Tables 1 and 3 that the earlier the venture's business model development stage, the higher the possibility of not becoming successful and of business failure. The findings show that the life cycle model behind our research instrument is not necessarily linear with respect to the four dimensions, thus showing different patterns.

The data yields clear evidence for different evolutionary patterns of business models, in particular when comparing digital and non-digital ventures. Specifically, it seems easier for digital ventures to draft a business concept than for non-digital ventures, which should also affect business plan proposal submissions to competitions. For non-digital ventures, the survival rate turns out to be 67%, which is 21% higher than in the sub-sample of digital ventures. This difference is also reflected in the lower rate of official business registrations among digital ventures.

The differences in the patterns become further obvious in the case of clusters containing ventures that show higher survival and success rates. We notice in the field of digital ventures that it is essential to create proof of the business offers for the customer right from the start. In the beginning, a balanced implementation of the value network is not critical for these digital ventures.

The results show that, in the case of surviving or growing digital ventures, the management team is usually capable of building, testing, and supplying a digital product or a service to the market that immediately creates revenue. Hence, financial investment into the venture is not necessarily the precondition for their market growth. This finding also confirms the results of the Berkeley Patent Study regarding prioritizing the first mover advantage, as well as the argumentation of Nguyen-Duc A et al. for software development capabilities in digital ventures (Graham et al., 2009; Nguyen-Duc et al., 2016).

For the group of non-digital ventures, the research results let us derive contrary suggestions. Here, a balanced value network provides evidence for better survival chances of the ventures. One interpretation for this circumstance might be that innovative non-digital ventures mainly come from hardware and asset-oriented industries. In these industries, an initial investment in assets for the value creation system is necessary. The results are also supported by the described Berkeley Patent Study, in which entrepreneurs in digital and non-digital domains prioritize their strategies differently (Graham et al., 2009). Non-digital ventures tend towards initial patenting and thus building on a more tangible strategic benefit. They are not reflecting the concept too intensely with the market as they build the value network more in parallel.

> *Reflected in the initial research question, we find that specific patterns in the value network evolution between digital and non-digital ventures do indeed exist, and that these patterns provide insights into venture success.*

The results further support the argumentation made by Brinckmann et al. that planning before execution should be made with caution (Brinckmann et al., 2010). Also Strehle's finding that strategic planning in a very early stage does not necessarily have a positive impact on success is reinforced (Strehle, 2006). Our results in particular show that in the case of digital ventures submitting a business plan that does not reflect sufficient learning from the customer market in the business model leads to ventures less likely to become successful. It seems that speaking to the customer and implementing the business on the market makes more sense, as the validity of the business model is thereby improved.

However, the findings for digital ventures to some extent contradict the argumentation of Shane and Delmar stating that ventures in general should write a proper plan before undertaking marketing activities (Shane and Delmar, 2004). At least if the aim of the award application is to pitch the business model described in the business plan in front of investors, the strategy of very early-stage ventures trying to fundraise investment for an idea seems to be rejected by the innovation system. This evidence may also support what the innovation system learned from the burst of the dot-com bubble: do not invest in untested business models. However, this could be different for non-digital ventures. It also does not fundamentally contradict the arguments of Shane and Dalmar, as our results do not imply that successful ventures did not properly plan their business before the submission.

When looking at the results of patenting activities, our findings support the ideas particularly prevalent in the RBV on strategy. They suggest that the entrepreneurs of successful non-digital ventures, engage in significant patenting activities. The same is true for the context of post-financing activities of ventures in their early stage. Both variables are seen as influencing success not only in our results, but also in

the academic discussion (Giones et al., 2015).

5.2. Implications for practitioners

The main implications for practitioners in innovation systems are threefold. First, the results of this research suggest that combining BMC and LSM approaches is generally useful. However, the implementation should follow different strategies depending on whether the context is a digital or a non-digital venture scenario. Depending on the technology, the entrepreneurs have to follow a different sequence of action to become successful. Therefore, intermediaries in the innovation system must offer different strategic support to entrepreneurs to make sure they are able to follow the steps to success with the right focus.

Secondly, innovation intermediaries can further use the concept of the measurement instrument to cluster their intake and to decide which venture to support and which not. It also gives objective evidence on the survivability of different high-tech ventures. This is the first step to an objective risk management, also for intermediaries such as early-stage investors. The developed measurement instrument but also the concrete results of this paper could allow for a more effective resource allocation.

Thirdly, applying the systematics of the research instrument could allow practitioners to follow the development of venturing activities with an easy-to-use indicator for evaluating progress in entrepreneurial learning. However, this indicator should be combined with other typical technology ventures evaluation criteria such at patenting, management team, sector, etc.

5.3. Limitations

Looking at the limitations of the research, it is important to point out that the instrument was developed based on data from an innovation system in Germany with a specific regional structure. It should be assumed, however, that each innovation system has its own structures and procedures. At least in the semantics for describing different investors, the research instrument has to be adapted to the innovation system in which it is to be applied.

Moreover, despite the assumed representativeness for the innovation system in the State of Baden-Württemberg, we cannot assure this. We can only assure that the data are a set of one innovation intermediary in a region. This may have excluded certain target venture groups which, for example, simply do not write business plans.

Further limitations exist with regard to the data quality. The entire data sample is based on secondary data. Moreover, it is difficult to accurately gather comparable data from ventures. Nevertheless, setting up a research project based on such a sample is always an explorative task and needs to be considered as such.

5.4. Further entrepreneurship research

Further research should first of all try to evaluate the research design in another innovation system. An initial test could show if the instrument produces similar results in another environment and, in addition, provides indicators for the need to adapt it to the economic fabric of the respective region.

Next, in an application of the instrument to other regions, further variables should be introduced to the model. These indicators should help by adding new patterns that involve indicators from the resources-based view of strategy for the patterns of transaction relations of early-stage ventures. One such indicator could be based on patent information supported as a competitive advantage for non-digital ventures.

This would further support building a model for predicting survival and success of ventures. Thus, the developed indicators should be investigated based on the use of predictive methodologies. One promising methodology could be rough set theory, which allows for the use of the entire information system to make conclusions on the success patterns using decision trees (Pawlak, 1998; Rissino and Lambert-torres, 2009).

6. Conclusion

The results give evidence that digital and non-digital ventures follow different patterns in maturing the business model through the early stages of the business life cycle. The results argue that different strategies and support schemes in digital and non-digital ventures are relevant from a longitudinal perspective. For the digital venture, this means in particular that the support has to focus initially on developing transactions with their customers before searching for investments. In contrast, non-digital ventures require investments beforehand to build capital-intensive assets for value creation.

Thus, systematically using both BMC and LSA, while considering relevant exchange partners and taking a longitudinal perspective that follows digital or non-digital patterns could allow practitioners to create sustainable entrepreneurial success. Using business plans to research these patterns further allows the confirmation of existing work and acquisition of new knowledge on the entrepreneurial process based on real artefacts.

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