Integrating Ecosystem Intelligence with the Hybrid Intelligence Accelerator

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Abstract

Setting up Internet of Things (IoT) business models is a challenging tasks which leads to dramatic numbers of failures. To support both corporates and startups, business accelerators gain increasing popularity. However, most of such efforts have several restrictions such as limited capabilities, networks or expertise. To overcome these deficiencies we propose the Hybrid Intelligence Accelerator as a novel service system to support the design process of IoT business models through connecting multiple actors via an online platform and combining the idiosyncratic benefits of collective and artificial intelligence. In the context of a design science research approach we developed an initial prototype version of the Hybrid Intelligence Accelerator and provide insights in the procedures as well as tentative design principles.

Introduction

Many internet start-ups such as Uber, Snapchat, Spotify, and Facebook are gaining major successes and quickly disrupt whole industries. Yet, many digital ventures fail. One reason for this is that entrepreneurial actors in the context of early stage start-ups face levels of extreme uncertainty when developing their opportunity (Alvarez et al. 2013). Uncertainty has two sides that let decision makers struggle. On the one side, entrepreneurs must deal with uncertainty regarding the prospect of a possible business idea, especially when neither the technological feasibility (supply side) nor the market (demand side) yet exist (Alvarez and Barney 2007). On the other hand, potential investors, particularly angel investors, informal investors that devote their private equity in new ventures, face the challenge to decide if the start up at hand is worth financing or not. Angel investors often make such decisions before neither the feasibility of a new product nor the existence of a market for products or services is proven (Maxwell et al. 2011). For both sides, failing to deal with this uncertainty might lead to disastrous decisions.

As the success of new ventures is not only crucial for individual actors such a business angels or entrepreneurs themselves, but also crucial for economic development (Bradley and Klein 2016). Therefore, especially early stage start-ups need a supportive environment for their development and growth. Entrepreneurship policy developed a solution for this query. Incubators and more recently accelerators emerged as institutions to facilitate entrepreneurial ventures by offering support services, facilitating economic development, innovativeness, and the emergence of novel technology-based ventures (Bergek, & Norrman, 2008). Such institutions offer entrepreneurial talents links to knowledge-based assets or technological capital to accelerate the development of new ventures and on the other hand preselect and evaluate start-ups for angel investors to signal value to them. Accelerators and incubators are often publicly funded and affiliated to universities and research institutes or take shares of the supported companies. Historically, business incubators were developing through different stages of maturity and continuously extend their service value propositions. Therefore, they provide various support services such as access to physical resources (e.g., office space), start-up mentoring and coaching, matching services through access to networks (e.g., employees, customers, or suppliers), or to financial resources (e.g., venture capital) and certifying the value of a new venture (Bruneel et al., 2012).

One of the most relevant services provided by business incubators and accelerators is knwoeldge intensive mentoring. In this vein, mentors (i.e. experienced consultants, experts, or successful entrepreneurs) attempt to help the early stage start-up team to gain problem-solution fit by conducting one-to-one support initiatives such as workshops and offer entrepreneurs methods to continuously develop their idea into a novel venture (Cohen and Hochberg 2014). However, due to limited capacities and locally bounded resources or limited social capital startup support institutions frequently struggle in providing effective support services. Highly specialized incubators or accelerators thus fail to offer each startup an adequate mentor or investor. Moreover, the certification and valuation of new ventures to subsequent angel investors might be biased through the opportunistic self-interest of such support institutions that frequently have an equity stake in these startups. Thereby, IT provides novel and innovative ways to overcome such limitations.

By applying a service system perspective, the aim of this research is to develop a new service system for supporting early stage entrepreneurial efforts and to develop a socio technological system that connects multiple mentors, investors and entrepreneur through an online platform and provide services such as validation, feedback, valuation matching by combining the complementary strengths of collective and artificial intelligence. To reach our aim, we follow a design science approach to develop an artefact that solves a real-world problem (Hevner et al. 2004). To combine both relevance and rigor we use inputs from the practical problem domain (relevance) with the existing body of knowledge (rigor) for our research project (Hevner 2007). We therefore use knowledge from previous research that proved to be valuable in various contexts of uncertain decision making, as well as practical insights, to develop principles for an IT artefact that instantiate a prototype version and evaluate it in focus group workshopss. To ensure the practical relevance as well as generalizability of the problems and a corresponding solution we analysed the service provision of accelerators and incubators and its limitations during a multiple case study approach and interviews with incubators (n=24), entrepreneurs (n=26), and mentors (n=10) that provide advice to get a deeper understanding of the practical problem. Based on previous theoretical work, we propose a Hybrid Intelligence Accelerator that combines the strength of both machine intelligence such as machine learning techniques to handle large amount of information as well as collective intelligence, which uses the intuition and creative potential of individuals while reducing systematic errors through statistical averaging. Our research then will provide a design theory that will serve as a blueprint for policy makers in entrepreneurship to develop similar solutions in the future (Gregor and Jones 2007).

Our intended contribution is threefold. First, our research will provide prescriptive knowledge that may serve as a blueprint to develop similar Hybrid Intelligence Accelerators in the future (Gregor and Jones 2007). So far, we propose preliminary prescriptive knowledge about form and function (i.e. design principles) as well as principles of implementation (i.e. our proposed implementation). This contribution is in contrast to previous contributions in the field of entrepreneurship that focus on explanatory or describtive knowledge.Second, we contribute to research on entrepreneurship support mechansism such as business incubators (e.g. Bruneel et al. 2012)and accelertaors (e.g. Cohen and Hochberg 2014) by offering a novel and innovative approach to overcome the limitations of current practice. Third, we propose a novel approach to support entrepreneurial decision making by combining machine and collective intelligence and thus contribute to recent research on combined applications in other domains (e.g. Nagar and Malone 2011; Brynjolfsson et al. 2016).

Related Work

Startup Support Services

As the success of new ventures is not only crucial for individual actors such a business angels or entrepreneurs themselves, but also crucial for economic development (Bradley and Klein 2016). Therefore, especially early stage start-ups need a supportive environment for their development and growth. entrepreneurship policy developed a solution for this query. The most common and popular approaches for this purpose are incubators and more recently accelerators (e.g. Cohen and Hochberg 2014; Pauwels et al. 2016).

Business incubators emerge as institutions that provide a protective environment for the development of new ventures and gain increasing popularity. Such incubators are often publicly funded and affiliated to universities and research institutes or take shares of the supported companies (Hackett and Dilts, 2004). Historically, business incubators were developing through different stages of maturity and continuously extend their service value propositions (Bruneel et al., 2012).

Business incubators offer their services just for the early stages of entrepreneurial effort. Thus, their service provision typically has a limited period of approximately three years (Rothaermel and Thursby, 2005). During this time, the start-ups should actively shape their organizational structure, processes, and routines and develop a final version of their value proposition to grow into established ventures that are ready to launch in the market and get equity financing.

To participate in a business incubator, entrepreneurs must apply for admission and are selected through a desirability and feasibility assessment of the incubator team. Consequently, business incubators are frequently highly specialized on distinctive industries (e.g., Fintech) or technologies (e.g., Blockchain). The service provision ranges from infrastructure such as co-working spaces, shared resources, business support, and access to networks. Being part of a business incubator accelerates the success rates of early stage start-ups (von Zedtwitz, 2003).

Infrastructure is the most basic service that is commonly provided by incubators. Such include clerical services, meeting rooms, conference rooms, co-working spaces, or car parking (Bergek and Norrman, 2008). Moreover, infrastructure services can also span more specialized resources, for instance makerspaces for 3D printing, laboratories, research equipment, or fabrics.

The second common service provided for start-ups is business support. In this vein, business incubators help entrepreneurs through coaching, training, developing their business models and learning. Coaches and mentors in the business incubator attempt to help the early stage start-up team to gain problem-solution fit by conducting one-to-one support initiatives such as workshops and offer entrepreneurs methods to continuously develop their idea into a novel venture. Moreover, business support is offered through marketing support, market research, basic business support etc.

Third, incubators function as a boundary spanner (e.g., Ferrary and Granovetter, 2009) to provide entrepreneurs with access to external actors that are relevant for start-up maturity. Incubators create a strong network around their efforts to connect entrepreneurs with potential customers (which is especially crucial in the B2B context), suppliers, technology partners, business angels, and institutional investors (Hansen et al.,2000). This is a valuable service for entrepreneurs in early stage start-ups, as these start-ups frequently struggle to get access to such networks.

The increasing importance of knowledge intensive support services and the vice versa decreasing costs of experimentation for early-stage tech start-ups led to the emergence of the second support policy instrument: accelerators (Isabelle 2013). Accelerators represent *"fixed-term, cohort-based program, including mentorship and educational components, that culminates in a public pitch event or demo-day"* (Cohen and Hochberg 2014: 4). Such programms can be defined as evolutions from the traditional incubator programm and have some idiosyncracies.

Accelerators can be for-profit or non-profit by taking some size of equity stake and providing pre-seed funding for startups. The focus is much more on knowledge intensive support services than on providing physical resources to develop startups to investor ready ventures (Cohen and Hochberg 2014) Therefore, accelerators rely on strong networks and are especially closely related to business angels rather than venture capitalists (Pauwels et al. 2016). Moreover, accelerator program provide only time limited support (average 3-6 months) and focus on the intensive interaction between entrepreneurial teams and mentors to intensify the learning and growth of a new ventures. Contrary to business incubators that concentrate on nurturing the development of startups in a safe environment apart from market forces over a longer period of time, accelerators speed up the learning process of entrepreneurs in a setting close to the market (Hochberg 2016).

Although slightly different in the design of offering value to early stage startups, the value proposition of current startup support instruments can be summarized along three main dimensions. First, connecting and matching entrepreneurs with a network of relevant mentors, financiers etc. Second, providing knowledge intensive support such as business idea validation, feedback, and mentoring. And third, certifying valuable ventures and signaling their value to subsequent investors (e.g. Cohen and Hochberg 2014; Pauwels et al. 2016).

Service Systems and Service System Engineering Perspective

One theoretical perspective to explain and structure such complex systems such as incubators or accelerators that consist of a huge network of mentors, investors etc. is the standpoint of service systems (Maglio et al. 2006). This concept is based on the service-dominant logic which gains increasing popularity among researchers in multiple fields as well as practicioneers and constitutes the exchange of service as foundation of value creation through collaboration and contextualization (Vargo and Lusch 2006). In this vein, service systems represent complex and interrelated socio-technological systems that allow the co-creation of value. Such service system consist of a configuration of both actors (e.g. mentors or investors) and resources (e.g. knowledge and skills, technology) that are bound together through a value proposition (e.g. supporting startups) to co-create mutual value for all involved parties (Böhmann et al. 2014). For the context of our research this means that startup support mechanisms such as accelerators or incubators involve actors like startups and mentors to exchange resources to co-create value. This becomes obvious as both parties have their individual interest in working together but are both aiming at accelerating the growth of a venture in search of future returns.

One challenge for both research and practice is to engineer such socio-technological constructs (Alter 2012). Service systems engineering thereby provides three major levels of designing systems that enable the co-creation of value among different stakeholders. First, the engineering of service architectures, which describes the value proposition of a service system into a set of actors, resources,and value co-creation activities. Second, the engineering of service system interactions that defines how and why actors interact to co-create value. And third, the design of resource mobilization focusing on how resources are accessed and exchanged within the service system (Böhmann et al. 2014).

We, thus, conceptualize entrepreneurship support mechanisms such as accelerators as service systems that defines a configuration of actors and resources guided by the four main value proposition outlined in the previous chapter. The aim of this research is consequently to design and engineer novel service systems for supporting the creation and growth of new ventures, which we will outline in the following sections.

Methodology

Explaining Design Science

Design is a commonly accepted form of research for instance in the field of information systems (Gregor and Jones 2007). Design science aims to construct innovative artefacts and solution to address managers and policy decision makers. Generalization and abstraction of the findings then allows to develop a design theory. This prescriptive theory of design and action contrasts with the commonly applied theory for analysis, explanation, prediction of behavioural science (Gregor 2006). Contrary to these types of theory, design theory attempts to provide statements that say how something should be done in practice and thus concrete prescriptive knowledge (Gregor and Jones 2007). Although, entrepreneurship research is a highly practical oriented domain and previous research calls for research on design (e.g. Dimov 2016), prescriptive theories in entrepreneurship research are scarce. We thus argue, that a design theory for novel systems to support entrepreneurs in the early stages might provide valuable insights that may guide entrepreneurship policy makers in the future.

Research Procedure

For resolving the above-mentioned limitations, we conduct a design science research (DSR) project (Hevner et al. 2004; Peffers et al. 2007; Gregor and Hevner 2013) to design a new and innovative artifact that helps to solve a real-world problem. To combine both relevance and rigor we use inputs from the practical problem domain (relevance) and the existing body of knowledge (rigor) for our research project (Hevner 2007). Abstract theoretical knowledge thus has a dual role. First, it addresses the suggestions for a potential solution. Second, the abstract learning from our design serves as prescriptive knowledge to develop a similar artefact in the future (Gregor and Jones 2007). To conduct our research, we followed the iterative DSR methodology following Vaishnavi and Kuechler (2015).

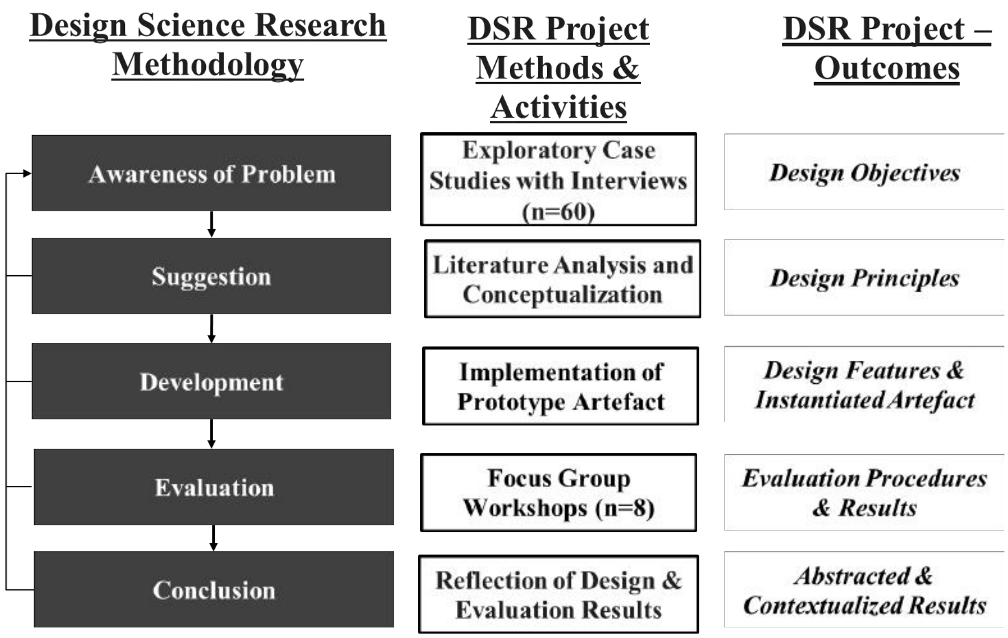

Figure 1. Research Process

Our research consists of an iterative design cycle with each phase applying different research methods. First, the research starts with the formulation of a problem that is perceived. To refine and validate the relevance of this problem we conducted an explorative study within the problem domain. For this reasons, we choose the case study approach that particularly allows to research into little explored topics with the purpose of theory building (e.g. Eisenhardt, 1989; Gillham, 2005; Dul and Hak, 2007). Contrary to other research strategies, the case study methodology is not intended to make predictions about statistical relationships and frequencies (Eisenhardt and Graebner, 2007; Yin, 2013). Instead, the conclusions drawn from case study results are "[…] generalizable to theoretical propositions and not to populations or universes […]" (Yin, 2013: 13). The main source of data collected was qualitative expert interviews with executives at business incubators as wella s accelerators (n=24), entrepreneurs (n=26), and mentors (n=10). The results achieved, provided advice for a deeper understanding of the practical problem. The results of the interviews were coded and analyzed by two of the researchers to identify common themes. We then analyzed literature to ground the identified problem in the perspective of service systems engineering and formulated objectives for a solution afterwards. In a second step, we analyzed previous research on entreprneurship support mechanism and decision support systems to identify a body of knowledge that provides suggestions for a potential solution resulting in a scientific grounded version of tentative design principles. The initial version of the tentative design principles was then instantiated into a prototype version of an IT artefact (i.e. a web service application) and demonstrated, evaluated, and refined in a total of eight expert workshops (Sonnenberg and vom Brocke 2012). These workshops were focused on the criteria based evaluation of the hybrid intelligence accelerator to prove the value and feasibility of the new concept in solving the problems and limitations of previous forms of incubators and accelerators.

Development of Solution

Awareness of the Problem

The design science research project is motivated by both a gap in previous research on systems that support business model validation services and practical problems of entrepreneurs and incubators. Therefore, we conducted exploratory interviews with executives incubators and accelerators, mentors as well as entrepreneurs to include a two-sided perspective on the problems (n=60). The interviews were guided by the central question of how service providers typically provide support services for entrepreneurs and the perceived limitations of these approaches. By analyzing the interviews, we gained a deeper understanding of the problem domain and discovered seven key problems:

- ***Problem 1:*** The market of early stage startups is highly intransparent and information assymetrie is enormous.
- ***Problem 2:*** Service providers do not use structured processes to conduct support services, which leads to the loss of implicit knowledge.
- ***Problem 3:*** The distribution of investments and accelerators is highly location depenend and focuses on hubs such as Silicon Valley, London or Berlin.
- ***Problem 4:*** The feedback of single is frequently perceived as subjective, industry bound, and thus misleading.
- ***Problem 5:*** Expertise is highly domain specific and networks are specialized for certain industries rather than having all required resources “in-house”.
- ***Problem 6:*** As accelerators are investors in startups that they are certifying, they might be incentivized to overvalue them for other angel investors.
- ***Problem 7:*** As costs of experimentation and time of scaling decrease, angel investors frequently prefer to make small investements in a larger portfolio of startups.

Suggestions for a Solution

Service Architecture

Existing research on effective solutions for the problems mentioned in the previous chapter are scarce. However, IS research provides an extensive body of research on online platforms (e.g. Rochet and Tirole 2003) and decision support systems that provide computational decisional advice to enable faster, better, and easier decision making in various contexts. Accelerators are defined as “computerized aids designed to enhance the outcomes of an individual's decision-making activities” (Singh 1998). Thus, they combine the capability of a decision maker with the support of computational provided decisional advice to enable faster, better, and easier decision making.

First, online platforms gained increasing importance in recent years to connect two sides of a market via web-based platforms (e.g. Amazon, Ebay). This approach allows time and location independent connection of service providers and users to exchange value (Hagiu 2009).

Second, two recently popular approaches for providing high quality guidance in decision support for uncertain settings are computational methods and the use of collective intelligence. Computational methods become particularly valuable due to progresses in machine learning and machine intelligence to identify, extract and process various forms of data from different sources to make predictions in the context of financing decisions, financial return, or bankruptcy of firms. Machine intelligence is thus particularly valuable as biases or limited capacity of human decision makers does not taint it. On the other hand, the use of collective intelligence leverages the “wisdom of crowds” to aggregate the evaluations of a large group for reducing the noise and bias of individual mentoring (Blohm et al. 2016) to inform decision makers and uses creative ideas from multiple sources to suggest potential solutions (Leimeister et al. 2009; Afuah and Tucci 2012). The value of crowds compared to individuals underlies two basic principles: error reduction and knowledge aggregation (Larrick et al. 2011). Error reduction is because although individual decision maker might be prone to biases and errors (such as individual entrepreneurs or mentors in our context), the principle of statistical aggregation minimizes such errors by combining multiple perspectives. Second, knowledge aggregation describes the diversity of knowledge that can be aggregated by combining multiple decision makers and which enables to capture a fuller understanding of a certain context (Soukhoroukova et al. 2012). Thus, collective intelligence can advise individual decision making by accessing more diverse information and reduce the threat of biased interpretation.

To design the Hybrid Intelligence Accelerator we thus decided to combine machine and collective intelligence for improving guidance quality due to three reasons. First, machines are better at information processing and provide consistent results, especially when data is dispersed and unstructured (Einhorn 1972). Second, human decision makers are particularly useful to interpret and evaluate innovative outcomes as they are superior in making judgments such as creativity, which is required for start-up business models. Human decision makers can use their intuition and gut feeling which is especially relevant for such decisions (Huang and Pearce 2015). Collective intelligence thus is applied to capitalize on the benefits of humans and simultaneously minimize the drawbacks of individual decision makers including bias or random errors. Third, aggregating judgement from different sources is always superior in providing advice for uncertain outcomes. Moreover, human decision makers such as entrepreneurs are more willing to take advice when human sources are included (Önkal et al. 2009).

Our proposed Hybrid Intelligence Accelerator, thus, includes several main actors that are connected through an online platform. The IT enabled connection of actors ensures time and location independent provision of services. First,our proposed service system consists of entrepreneurs and their startups that need support in accelerating growth. Second, it contains the mentor crowd, which includes several mentors, business angels, and consultants that have heterogenous expertise to provide mentoring for entrepreneurs. Third, the Hybrid Intelligence Accelerator requires a crowd of investors, which provide funding to the startups.

The value proposition of the Hybrid Intelligence Accelerator can be decomposed in four main service moduls (e.g. Tuunanen et al. 2012). First, it offers the matching of entrepreneurs with a network of relevant mentors, financiers etc. Second, it provides knowledge intensive support such as business idea validation, feedback that helps both investors and startups to make predictions about the potential success of a new venture. Third, it certifies valuable ventures and signaling their value to subsequent investors by providing a more objective and transparent valuation through the hybrid intelligence approach. Fourth, it enables startups to acquire financial ressources through mechanisms of crowdfunding.

Service System Interaction

At an abstract level, the workflow for the service interaction within the Hybrid Intelligence Accelerator consists of six resource flows (Figure 2). First, the entrepreneur provides detailed profile information on her startup to the mentor crowd. Second, the mentor crowd provides feedback and mentoring to feed an artificial intelligence. Third, the mentors receive performance on their feedback quality, which enables the mentors to learn in return. Fourth, the artificial intelligence provides the entrepreneur decision support in form of information on the success prediction, valuation and guidance. Fifth, information regarding success prediction and the valuation of a startup are visualized for a crowd of investors. And sixth, interested investors provide financial resources in terms of funding to the entrepreneur. Finally, the investors receive equity stakes conversely.

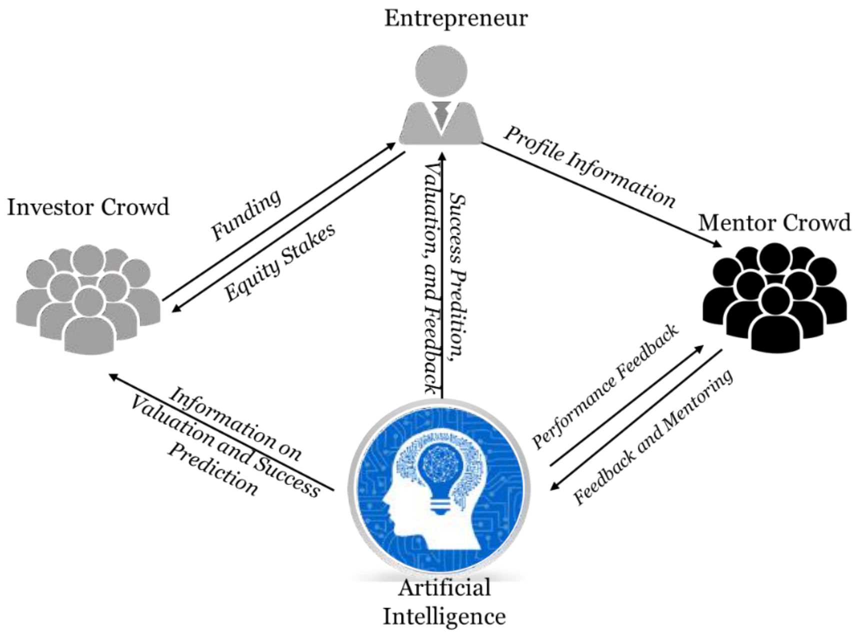

Figure 2. Service System Interaction

Resource Mobilization

The mobilization of ressources focuses on the concrete implementation of how resources are accessed and exchanged within the proposed service system and is visualized in Figure 2.

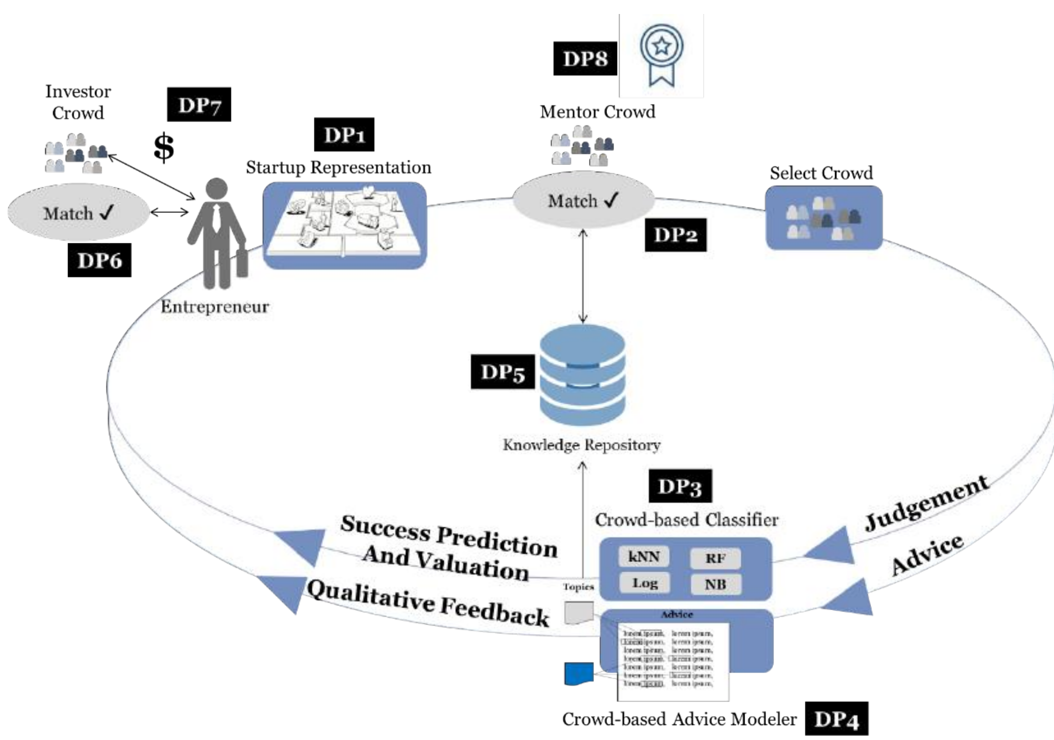

Figure 3. Visualization of Design Design Principles

Design Principle 1: *Provide the Hybrid Intelligence Accelerator with Profile Data of the Entrepreneur´s Business Model*

Entrepreneurs must transfer their current assumptions of their future venture to the crowd participants. We choose the concept of business models as proxy for a new venture as in the context of early-stage startups, business models become particularly relevant when entrepreneurs define their ideas more precisely in terms of how market needs might be served. In addition to that, it helps the entrepreneur to examine which kind of resources have to be deployed to create value and how that value might be distributed among the stakeholders (Demil et al. 2015). This representation needs to consist of all relevant information required to assess the quality of the current version of the business model. Therefore, we develop a representation format based on a taxonomy consisting of Osterwalder and Pigneur´s (2013) nine dimensions of business models (i.e. value proposition, customers, partners, activities, cost structure, revenue streams, resources, channels, and customer relations) and the relevant criteria of early stage startups (e.g. Maxwell et al. 2011) defining their success. Our representation format is standardized and dynamically adaptable for the entrepreneur to further refine it and iterate the process of getting advice.

Design Principle 2: *Provide the Hybrid Intelligence Accelerator with an Expert Matching Algorithm*

To receive valid decisional guidance from collective intelligence, the composition of the crowd is highly dependent on the ability of individuals (Keuschnigg and Ganser 2017). We, thus, use a "select crowd" approach to select mentors that have expertise in the specific domain of the business model (e.g. Mannes et al. 2014). Hence, we decided to integrate a matching algorithm to find and access suitable members of the mentor crowd. Due to our assumption that self-assessment of expertise is insufficient, we use a topic modeling approach with a proximity measure (Shi et al 2016) to match expertise of crowd members from prior projects stored in a repository. Topic modeling is a text mining technique that uses a Latent Dirichlet Allocation (LDA) (Blei et al. 2003) as unsupervised statistical learning method to discover abstract "topics" in text documents (in our case the description of previously evaluated business models). We then automatically match experts who with expertise in topics with high proximity (i.e. with high similarity of topic distribution) with the relevant business model. This approach learns through the accumulation of topics in a repository.

Design Principle 3: *Provide the Hybrid Intelligence Accelerator with a Crowd-based Classifier*

The business model representation is the processed as input for the selected crowd. The crowd then judges the quality of the business model´s current version along two dimensions: feasibility and desirability which represent the main indicators for entrepreneurial success (Fitzsimmons and Douglas 2011). W, therefore use a multi-item rating scale which provides the most accurate results in collective intelligence judgement (Blohm et al. 2016). The input of the crowd is then used to train a machine learning classifier (e.g. Tensorflow) to assess the probability of success with the version of the presented business model. The same approach is used to valuate the startup and thus provides a pre-money valuation for investors. This result is processed to the entrepreneur and provides informative guidance on the quality of the business model and thus the need for adaption.

Design Principle 4: *Provide the Hybrid Intelligence Accelerator with a Crowd-based Advice Modeler*

Finally, the crowd provides suggestive guidance on required adaption of the business model through textual advice. Such raw textual data contributed through collect intelligence requires the entrepreneur to obtain a huge quantity and complexity of information that needs to be processed (e.g. Nagar et al. 2016; Rhyn and Blohm 2017). To discover patterns and extract useful information from the textual advice in a fast and scalable approach, we develop a crowd-based advice modeler which structures the suggestions of the crowd to identify the most frequent mentioned topics. Therefore, we use the same modeling algorithm LDA as for matching (**DP 2**) (Blei et al. 2003). This unsupervised statistical approach does not require manually labeling each textual advice and extracts topics from the suggestions of the crowd through the probabilistic distribution of words in the content. We suggest that this approach is useful to enhance decision efficiency as the most frequently suggested topics represent the most relevant advice for adapting the business model.

***Design Principle 5:** Provide the Hybrid Intelligence Accelerator with a Knowledge Aggregation Repository*

Our proposed Hybrid Intelligence Accelerator needs to accumulate the knowledge created during use in a repository, to continuously improve the guidance quality through machine learning (Jordan and Mitchell 2015). This consists of two different pieces of knowledge: the information on a member of the crowd and the description of advised business models for the expert matching algorithm(**DP2**) as well as the information startup success, valuation and the judgment results as well as the feedback of the crowd to improve the crowd-based classifier (**DP 3**). The knowledge should be stored in a preprocessed format (e.g. LDA) to make it easy applicable for the machine. Consequently, the knowledge of mentors remains in the total service system and can be accessed on demand.

***Design Principle 6:** Provide the Hybrid Intelligence Accelerator with an Investor Matching Algorithm*

As one central aspect of accelerators in general is providing financial resources (Cohen and Hochberg 2014), we decided to implement an investor matching algorithm to increase a startups probability of funding. As defined in the service system interaction structure (Fig. 2), investors get insights on success probability, information on the startup in general, and a pre-money valuation result. We then again use a investment proximity measure (Shi et al 2016) to match startups with an investors funding preferences (e.g. investment size, deal structure, risk preferences) retrieved from prior projects stored in a repository.

***Design Principle 7:** Provide the Hybrid Intelligence Accelerator with a Crowdfunding Mechanism*

For providing financial support to early stage ventures, crowdfunding proved to be an adequate mechanism(e.g. Mollick 2014). Crowdfunding is thereby a very versatile tool that through the distributed collection of small sums among many funders can amount to relatively large investment sums granted to the entrepreneur. In addition to that, crowdfunding provides several other advantages such as flexibility (Gierczak et al. 2016). We, thus, choose a crowdfunding mechanism to enable a large amount of matched investors (**DP 6**) to provide small investments to collectively fund a new venture.

***Design Principle 8:** Provide the Hybrid Intelligence Accelerator with Activation Supporting Components*

One central aspect to make the Hybrid Intelligence Acclerator run< is providing incentives to its users for participating. In this vein, activation supporting components are crucial to make users contributing to service provision (e.g. Leimeister et al. 2009). While some economic motives such as investing for return, reducing information assymetrie or getting feedback are obvious, other activation supporting components for non-economic motives are required (Bretschneider and Leimeister 2017). For instance, mentors might have altruistic motives or aim at learning from the system, which can be achieved through performance feedback on their assemsent of a startup and the advisory provided (Fig. 2). Moreover, approaches such as gamification can be leveraged to activate users (e.g. Schöbel et al. 2016).

Development

To instantiate the design principles into an artefact we developed a webservice application on the cloud platform Microsoft Azure (www.azure.microsoft.com*)*. Figure 4 to 10 highlight exemplary insights on the prototype version of the Hybrid Intelligence Accelerator platform[1].

[1] Further technical details on the implementation can be assesed from the authors

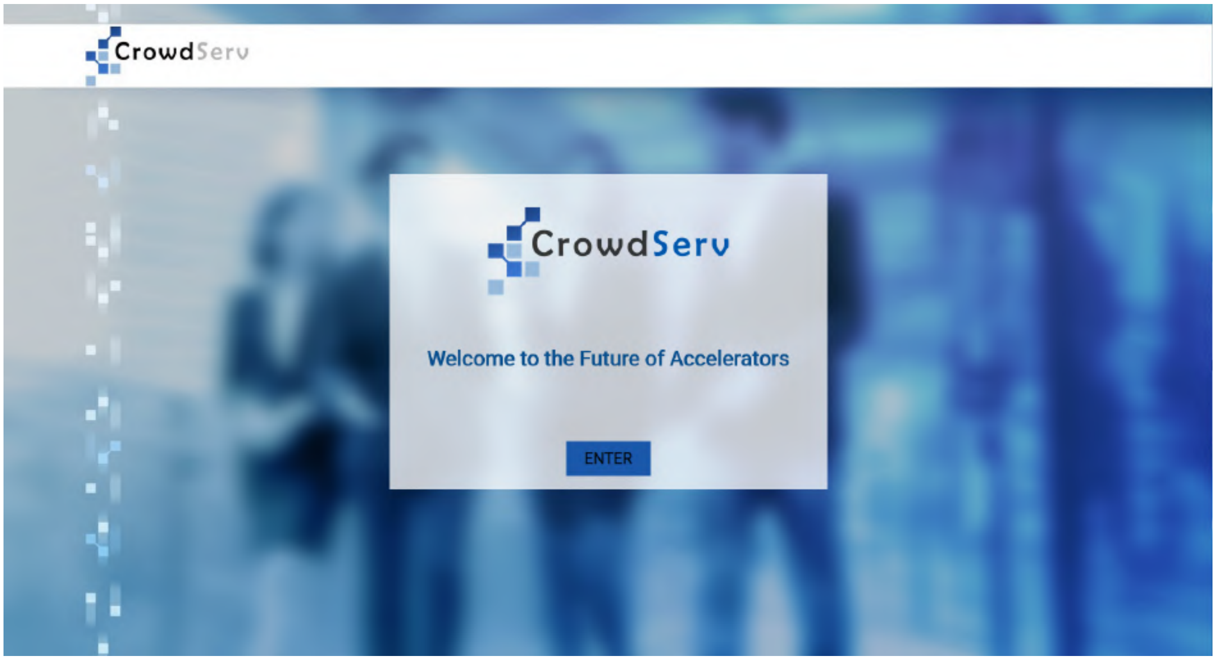

Figure 4. Start Page

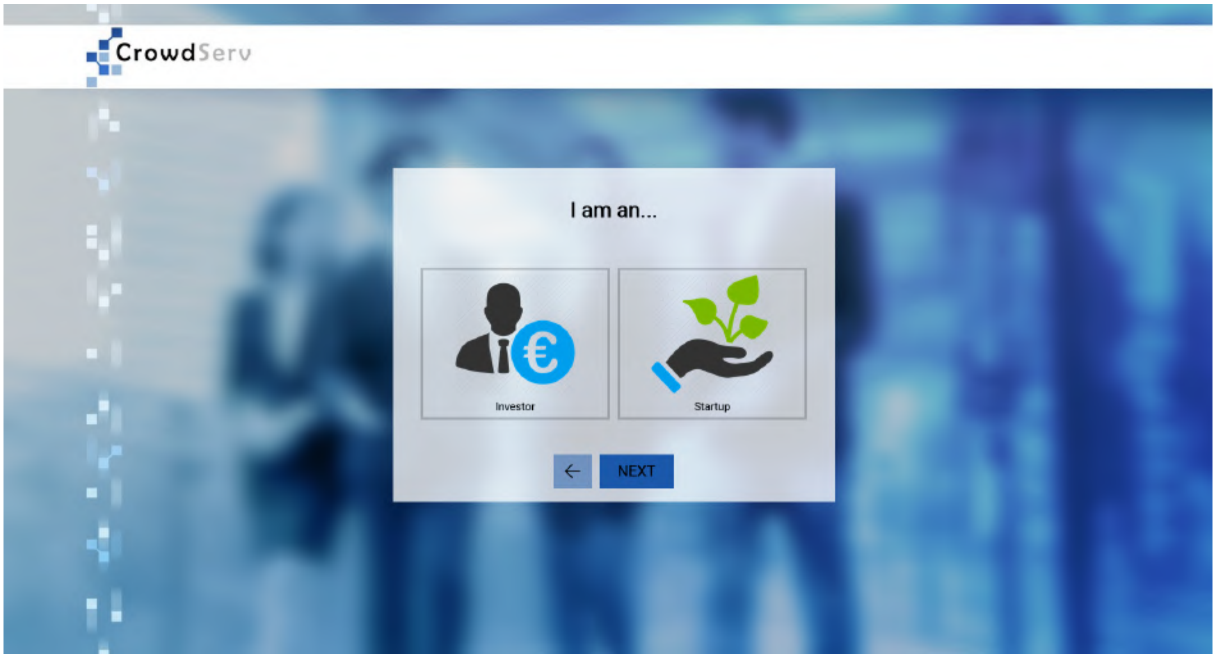

Figure 5. Login Page

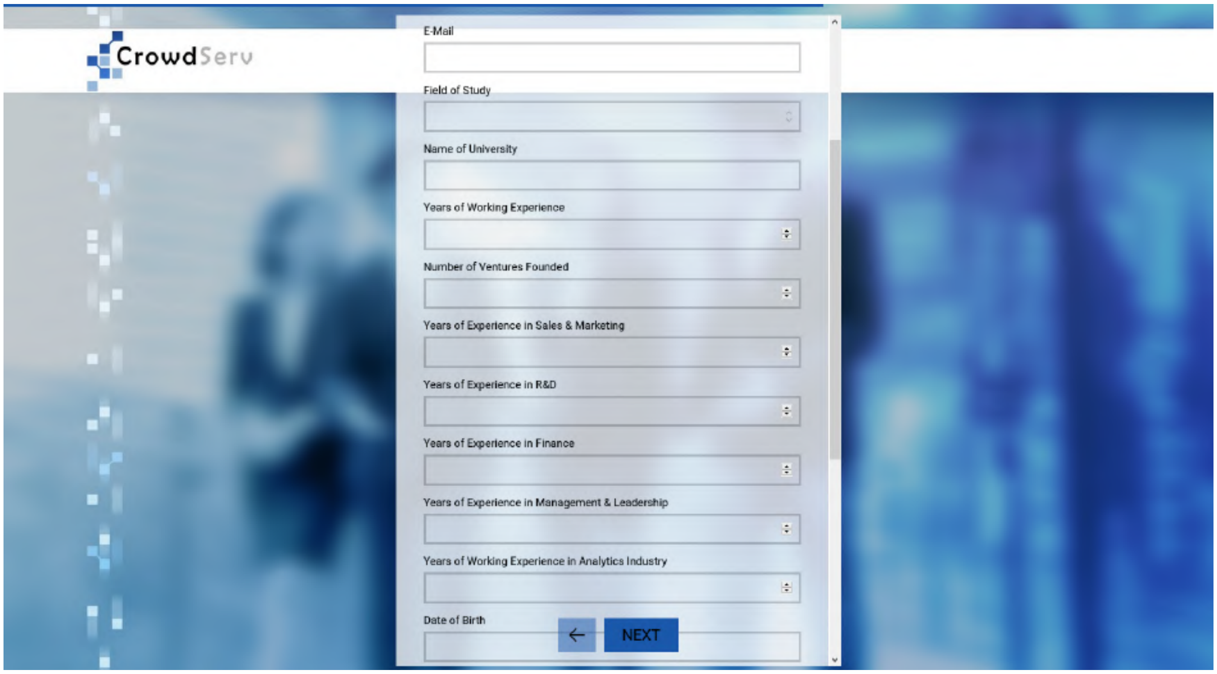

Figure 6. Profile Page

Figure 7. Profile Startup

Figure 8. Feedback Mechanisms

Figure 9. Prediction and Valuation

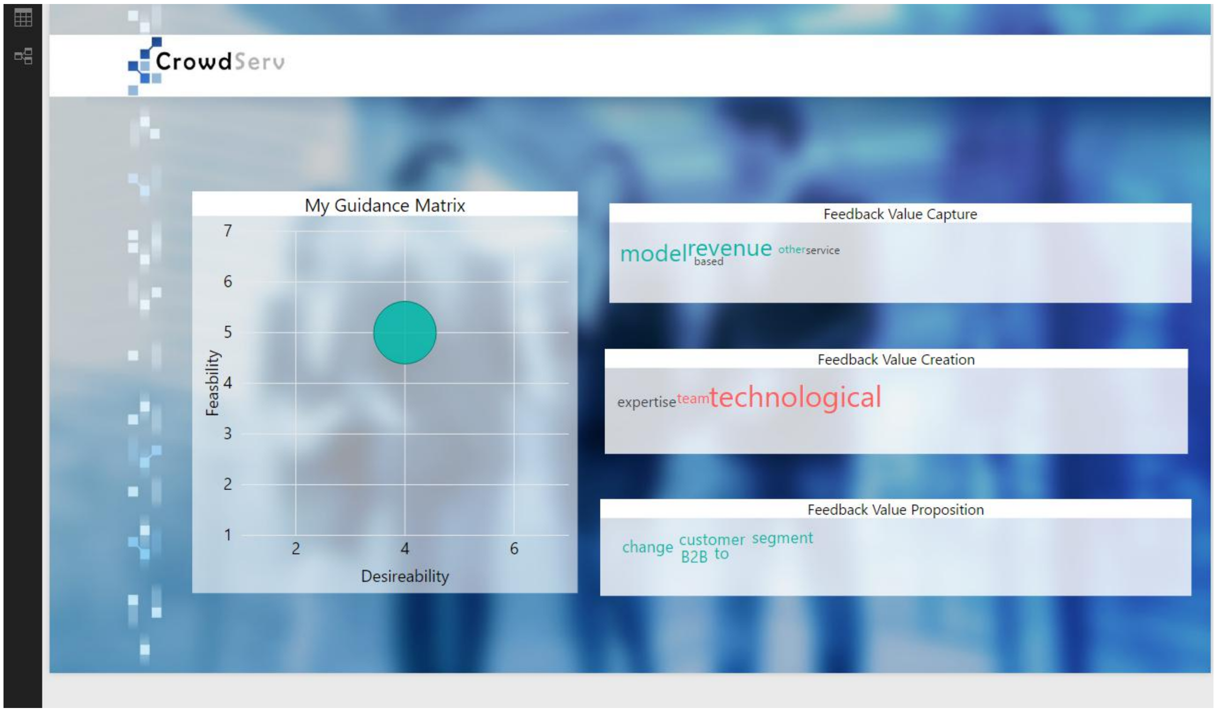

Figure 10. Guidance

Evaluation

The first evaluation of our Hybrid Intelligence Accelerator serves as lightweight and formative intervention to ensure that the IT artefact will be designed as an effective instrument for solving the underlying research problem (Sonneberg and vom Brocke 2012). In order to do so, we conducted an exploratory focus group (Hevner and Chatterjee 2010). Originated in the field of psychology, the focus group gained increasing popularity as a knowledge elicitation technique in the field of software engineering (Massey and Wallace 1991, Nielsen 1997). When conducting the focus group, we followed a process proposed by Hevner and Chatterjee (2010). Within this focus group our design principles were demonstrated, validated, and refined by entrepreneurs and mentors (n=4; 8 participants; average duration: 90 min), business angels (n=2; 5 participants; average duration: 75 minutes) as well as with developers to validate the technical feasibility of the design principles (n=2; 6 participants; average duration: 90 min).

Discussion and Conclusion

Setting up and growing an early stage startup is a highly challenging and uncertain task for entrepreneurs, mentors that support entrepreneurial efforts, and angel investors. While entrepreneuship support mechanisms such as business incubators or accelertaors that aim at increasing the probability of success of a new venture are gaining growing importance, they have several limitations which prevent them from reaching their goals. Within the paper we developed the idea of a novel form of support mechanism, which we call the Hybrid Intelligence Accelerator. This approach combines the strength of artificial intelligence as well as collective intelligence in a novel service system that connects mentors, entrepreneurs, and angel investors via an online platform to deliver support services such as matching, decision support, valuation, and financing.

Within the context of an DSR project we analyzed problems in the current practice of business incubators and accelerators. We then developed and refined principles for a Hybrid Intelligence Accelerator that combines the specific benefits of machine and collective intelligence structured through the lens of service systems. We then implemented our proposed solution into an IT artefact and preliminary evaluated our generalizable and abstract findings. As we proceed our project, we will testing our Hybrid Intelligence Accelerator in a real world setting to further improve it and evaluate the applicability.

Within this research, we intend to make three main contributions. First, our research will provide prescriptive knowledge that may serve as a blueprint to develop similar Hybrid Intelligence Accelerators in the future (Gregor and Jones 2007). So far, we propose preliminary prescriptive knowledge about form and function (i.e. design principles) as well as principles of implementation (i.e. our proposed implementation). This contribution is in contrast to previous contributions in the field of entrepreneurship that focus on explanatory or describtive knowledge. Second, we contribute to research on entrepreneurship support service systems such as business incubators (e.g. Bruneel et al. 2012) and accelertaors (e.g. Cohen and Hochberg 2014) by offering a novel and innovative approach to overcome the limitations of current practice. Third, we propose a novel approach to support entrepreneurial decision making by combining machine and collective intelligence and thus contribute to recent research on combined applications in other domains (e.g. Nagar and Malone 2011; Brynjolfsson et al. 2016; Kamar 2016).

Noticeably, our research is not withouth limitations. First, we focused on problem statements in the German speaking entrepreneurship support market. Future research might thus examine the problem relevance across country boundaries. Second, the derived design principles proposed within this paper are just one possible suggestion for solving the identified problems. Further design oriented research in the field of entrepreneurship should focus on finding alternative designs of service systems to accelerate the growth of new ventures. Third, our proposed design and prototype version represents a tentative solution for a problem. The active use in a real world context will thus show the usefulness of our artefact and lead to improved version.

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