Scenario-Based Design Theorizing:

The Case of a Digital Idea Screening Cockpit

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Abstract:
As ever more companies encourage employees to innovate, a surplus of ideas has become reality in many organizations – often exceeding the available resources to execute them. Building on insights from a literature review and a three-year collaboration with a banking software provider, this paper suggests a Digital Idea Screening Cockpit (DISC) to address this challenge. Following a design science research approach, we suggest a prescriptive design theory that provides practitioner-oriented guidance for implementing a DISC. Our study shows that, in order to facilitate the assessment, selection, and tracking of ideas for different stakeholders, such a system needs to play a dual role: It needs to structure decision criteria and at the same be flexible to allow for creative expression. Moreover, we make a case for scenario-based design theorizing by developing design knowledge via scenarios.

Keywords: Scenario-based design theorizing, scenario-based design, employee-driven innovation, Digital innovation, Idea screening, Idea evaluation, Idea selection, Idea tracking

1 Introduction

As fostering innovation has become fundamental and necessary for companies in today's digitally networked world (Chesbrough, 2003; Tidd and Bessant, 2011), employee-driven innovation emerges as increasingly important phenomenon (Robinson and Schroeder, 2014; Høyrup et al., 2012). Today's leading companies encourage employees to act entrepreneurial within the confines of the organization (Desouza, 2011).

With the advent of modern information technologies (IT), and the related ongoing digitalization of business processes in organizations, there is a growing interest in how IT can enable innovation practices (Yoo et al., 2012). IT can facilitate innovation in a way that gives rise to new forms of direct participation in which the employee takes the initiative to generate, develop, and implement ideas for innovative products (Høyrup et al., 2012; Kesting and Ulhøi, 2010). For instance, IT can support the emergence and harnessing of knowledge networks (Etemad and Lee, 2003) and strengthen networking capabilities (Ciriello and Richter, 2015). One fundamental problem in employee-driven innovation is a surplus of potentially valuable ideas that usually exceeds an organization's capacity to put them in practice (Lindič et al., 2011). A global study among 1.600 executives found that the process of selecting the right ideas, also termed idea screening, was among the top three obstacles when investing in innovation (Andrew et al., 2010). Idea screening is a complex, cognitively challenging task imbued with uncertainty. A recent study among 330 managers found that organizations are more effective in screening collected ideas when using IT (Schulze et al., 2012).

Alongside with the screening process itself, studies have shown that employee-driven innovation also means that the employees need support from experienced colleagues that challenge and enrich their ideas (Desouza, 2011; Fichter, 2009; Høyrup et al., 2012; Tortoriello et al., 2014). For such facilitators, it is important to maintain an overview over existing ideas and initiatives within the company. As such, employee-driven innovation crucially depends on appropriate screening (i.e. assessment, selection, and tracking) of ideas. Hence, the need for comprehensive, multi-attribute idea screening support throughout the whole innovation cycle has recently been brought forward (Gressgard et al., 2014; Riedl et al., 2010; Schulze et al., 2012), which requires a revisit of established approaches for screening ideas.

Classical approaches for realizing value from IT investments, such as IT portfolio management (Peppard and Ward, 2004) and benefits management (Peppard et al., 2007), are helpful for integrating new digital technologies into the corporate strategy in a way that envisaged benefits are achieved. However, screening large amounts of ideas from different sources in a short time requires a radical rethink of received strategic frameworks to manage IT projects (Yoo et al., 2010). To cite a prominent case, the British Petroleum (BP) company placed a public call for ideas to contain the infamous oil spill resulting from the Deepwater Horizon disaster in 2010. During this period BP received more than 35,000 ideas. However, lacking a way to quickly and accurately screen these ideas from diverse sources, frustration grew as BP seemed unable to select and implement solutions in time (Lindič et al., 2011).

More recently, innovation platforms gain momentum as a promising means to fund and realize ideas from a crowd of internet users (Mollick, 2014). However, it remains a challenge to integrate these approaches with innovation initiatives in a corporate context (Riedl et al., 2010; Schulze et al., 2012). For instance, a study among 313 participants of an innovation community found that popular simple idea screening mechanisms based on thumbs up/down or 5-star rating are invalid and outperformed by fine-granular, multi-attribute idea screening mechanisms (Riedl et al., 2010). In line with this, Lindič et al. (2011) argue that idea screening mechanisms purely based on numeric scores tend to be too restrictive to reflect the value of human intuition. However, practitioners tend to prefer simple scales based on benefit and risk, often neglecting more complex approaches (Schönwälder, 2013). Although recent studies acknowledge the potential of IT to better capture the complexity of idea screening, we know little about effective designs in practice (Schulze et al., 2012).

Hence, we identify a research gap on how to provide comprehensive and multi-attribute idea screening support. Our goal with this paper is to (1) elicit the requirements for IT that supports idea screening and (2) propose an artifact that fits the according work practices of various stakeholders involved in idea screening. For this reason, we raise and address the guiding research question (RQ):

RQ: *How can an IT artifact support different stakeholders in the assessment, selection, and tracking of employee-driven ideas*?

This paper makes three contributions to the design knowledge base.

The first contribution is project design knowledge (Drechsler and Hevner, 2018), which is specific to our design science research (DSR) project. We provide an in-depth description of critical situations for employees in the context of collaborating on and selecting employee-driven ideas from an in-depth field study inside a banking software firm. Based upon this rich illustration in form of problem scenarios, we suggest a creative solution approach in form of activity scenarios. This provides a holistic account of knowledge when it comes to designing

IT-supported idea screening for digital innovation. We implement a prototype and demonstrate its usefulness in an evaluation. Section 4 describes this project design knowledge in detail.

The second contribution is solution design knowledge, which is more abstract and informs the production of project design knowledge (Drechsler and Hevner, 2018), including the development of DISC artifacts in future DSR projects. A literature synthesis of idea screening criteria allows us to suggest a holistic framework for assessment, selection, and tracking of ideas. The idea screening criteria catalogue consists of *purpose, value proposition, risk of adopting, risk of rejecting, scope, type, stage, communication strategy, resources, and participant roles*. We then integrate the learnings from our DSR project and related literature into a prescriptive DISC design theory, which is structured along the generic design theory components as suggested by Gregor and Jones (2007). This may also inform further DSR studies as well as practitioners who wish to apply or extend our DISC design theory in other contexts. Section 5.1 describes this solution design knowledge in detail.

The third contribution is DSR methodology knowledge. We make a case for scenario-based design theorizing by tightly linking scenario-based design activities, such as the identification of problem and activity scenarios (as suggested by Rosson and Carroll, 2009), to generic DSR practices, such as problem identification and definition of solution objectives (as suggested by Peffers et al., 2007) and the formulation of design requirements, principles, and features (as suggested by Meth et al., 2015). This may also inform further DSR studies who wish to replicate our approach by using scenario-based design theorizing to develop project design knowledge and solution design knowledge. Section 5.2 describe this DSR methodology knowledge in detail.

The remainder of this paper is structured as follows: We start by synthesizing a multifaceted framework for idea screening from a structured literature review (Section 2). The research method section then offers detailed insights into our scenario-based design theorizing approach and illustrates how literature and insights from our empirical study informed the design of the DISC (Section 3). We then describe the design process and outcome (Section 4). We continue with discussing the lessons learned from our design and integrating them into a design theory (Section 5). The paper concludes with summarizing the key takeaways and pointing to further research (Section 6).

2 Theoretical Foundation

Following the literature synthesis framework by Vom Brocke et al. (2009), we conducted a structured literature review, in which we first defined the review scope and conceptualized the topic by searching leading journals using the keyword filters that the online databases EBSCO and IEEE Xplore, the ACM Digital Library, the AIS Electronic Library, and Google Scholar offer. Our search covered but was not restricted to the terms “idea selecting” OR “idea screening” OR “innovation screening” AND “ICT” or “digitalization” OR “digital” OR “innovation management” OR “intrapreneurship” OR “open innovation” OR “employee-driven” OR “practices” OR “roles” OR “assessment”. Conference proceedings complemented the list of articles. Forward and reverse searches provided us with additional relevant articles for our study. We then analyzed the articles by reading titles, abstracts, and introductions, leading to a synthesis of 73 sources into a comprehensive criteria catalogue consisting of

purpose, value proposition, risk of adopting, risk of rejecting, scope, type, stage, communication strategy, resources, and participant roles.

Our literature analysis yielded the following idea screening criteria: *Purpose, Value Proposition, Risk of Adopting, Risk of Rejecting, Scope, Type, Stage, Communication Strategy, Resources, and Participant Roles*. Figure 1 presents an overview of idea screening criteria in the form of a canvas, and the criteria are further explained below.

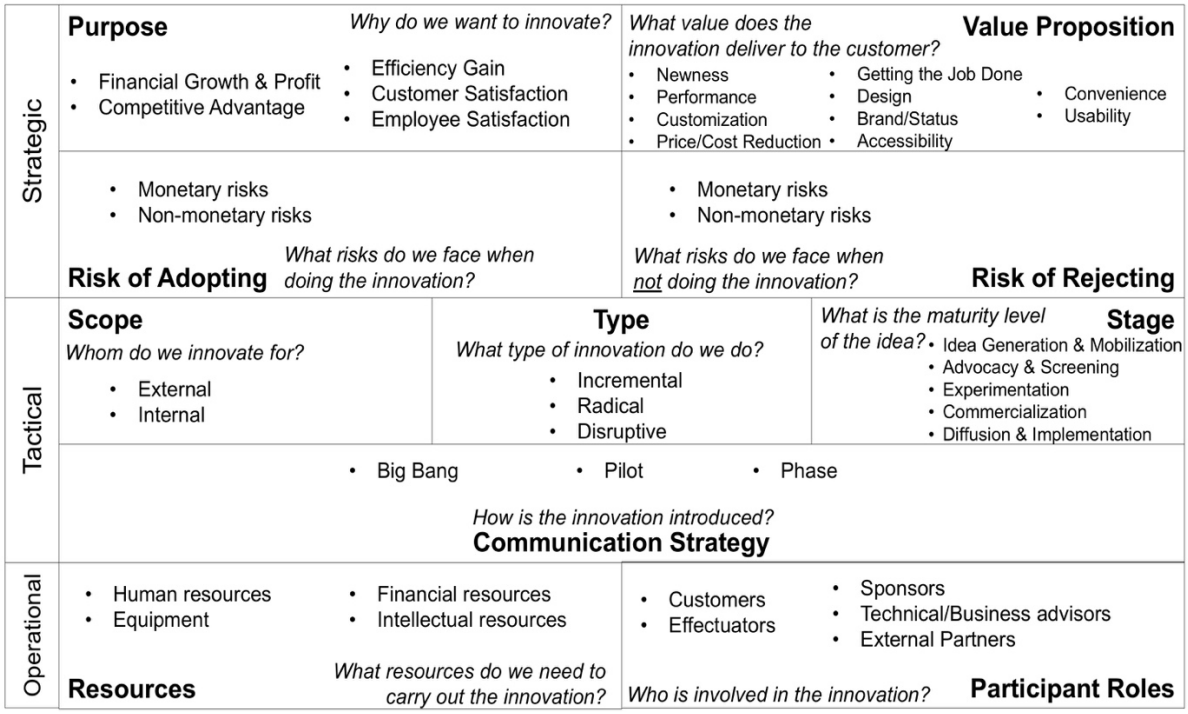

Figure 1: Overview of Criteria for IT-supported Idea Screening

1) Purpose (Christensen, 1997, Gama et al., 2007, Desouza, 2011, Tidd and Bessant, 2011)**:** Defining the purpose of an innovation helps to better understand the direction in which innovators are moving and the kind of benefits we can expect from moving into that direction. It facilitates the creation and recognition of links between the organizational strategy and the idea. Ultimately, any innovation should create a clear business benefit. The different reasons to innovate identified during our research can be encompassed by four different attributes: *Financial Growth & Profit, Competitive Advantage, Efficiency Gain* and *Customer or employee satisfaction*. Such innovations contribute to the creation of a compelling place to work and deal with sources of customer frustration.

2) Value Proposition (Osterwalder and Pigneur, 2010, Van Riel et al. 2011, Vantrappen & Metz 1996, Veugelers & Cassiman, 1999, Voelpel et al. 2006)**:** This criterion helps to identify the benefits that the innovation brings to the customer, and implicitly, the customer problems and needs that the innovation satisfies. This is important for the customer to determine whether to do business with the company. The attributes of this criterion are derived from the business model canvas by Osterwalder and Pigneur (2010): *Newness, Performance, Customization, Getting the job done, Design, Brand/Status, Price, Cost Reduction, Risk reduction, Accessibility,* and *Convenience/Usability*.

3) Risks of Adopting (Khazanchi et al., 2007, Rogers, 2010)**:** This criterion refers to how the changes produced by the adoption of an innovation could negatively influence the

organization and its environment. This is relevant for screening ideas because it helps to explore the scenarios that could result from adopting the innovation. *Monetary risks* are financial risks of adopting the innovation. *Non-monetary risks* cannot be measured in financial figures.

4) Risks of Rejecting (Christensen & Raynor, 2003, Rogers, 2010): This criterion refers to how the rejection of an innovation could affect the organization and its environment. This is relevant for screening ideas because it helps to explore the scenarios that could result from not innovating.

5) Scope (Chesbrough 2003, Fichter, 2009, Neyer et al., 2009): This criterion refers to the target group of the innovation endeavors, which can either be internal or external. This criterion can provide awareness about the balance of the innovation efforts made by the organization internally and externally. *External* innovations would encompass all products, processes, and services developed for customers outside the organization; while *internal* innovations comprise the innovations developed to be used within the organization.

6) Type (Christensen & Raynor, 2003, Ettlie et al., 1984, Stringer, 2000, Trauffler, 2005, Walker, 2008)**:** Considering the type of innovation is important because different types of innovation require different managerial approaches. Literature differentiates between *Incremental innovation, Radical innovation* and *Disruptive innovation.* It is important to note that here, the type of innovation, reflects the inner view of the organization (i.e. is the innovation incremental, radical, or disruptive for the organization), not the market view.

7) Stage (Desouza, 2011, Desouza et al., 2009, Gregersen et al., 2011, Lindič et al., 2011)**:** Awareness about the maturity level of the ideas is important because it helps to identify what has already been done, what tasks are currently important, and what are the next steps. Identifying the stages of the innovation process is necessary for proper idea screening. A five stage innovation process described by Desouza (2011) serves as a base for this criterion: 1.*Idea Generation & Mobilization* stage, 2. *Advocating & Screening* stage, 3. *Experimentation, 4. Commercialization, 5. Diffusion and Implementation*

8) Communication Strategy (Eason, 2005, Fichman, 2004, Kemerer, 1992): This criterion covers the way the idea is implemented in the target organization. Not all ideas are introduced to the world in the same manner, and the way organizations introduce a new idea may have a significant impact on its subsequent success. This success depends on different factors such as resistance caused by attachment to extant tools, learning curves, or perceived low value provided to individual adopters in the beginning that only increases with the size of the adoption network. Awareness of this Criterion can help to determine if and how an idea should be implemented at a given moment. We identified the following strategies: *Big Bang*, *Pilot* and *Phase*.

9) Resources (Christensen & Raynor, 2003, Christensen, 1997): This criterion is important for screening ideas because feasibility analyses prior to taking ideas forward are crucial. Not considering technical, financial, market, and human resource aspects before starting to realize an idea could result in project failure or serious losses. A good understanding of the innovation capabilities of the organization is crucial to determine which ideas it can realize and which ones it simply cannot afford. The attributes of this criterion are extracted from (Christensen, 1997): *Human resources*, *Equipment*, *Financial,* and *Intellectual*.

10) Participant Roles (Chakrabarti & Hauschildt, 1989; Hering & Philipps, 2005, Meyer, 2000, Roberts & Fusfeld, 1988, Sarasvathy, 2001, Tidd and Bessant, 2011)**:** Several studies focus on the identification and categorization of different roles relevant for innovation and

define different roles. We suggest the following differentiation: *Customers, Effectuators, Technical advisors, Business advisors*, *External partners*, *Sponsors*.

3 Research Method

We position our study within the design science research (DSR) paradigm (March and Smith, 1995; Peffers et al., 2007), as our goal is to extend human and organizational capabilities by creating a new artefact (Gregor and Hevner, 2013; Hevner et al., 2004) and extract prescriptive knowledge from that experience (van Aken, 2004; Walls et al., 1992). Our DSR strategy was to solve a company's specific problem, embedded in the context of a larger research project, by building a concrete IT artifact and package that into a general solution concept to address a class of problems (Iivari, 2015).

3.1 Research Relationship with the Company

In line with the above-summarized literature, we engaged in a research relationship with a company that wanted to better support employee-driven innovation. We use a pseudonym, as the company wishes to remain anonymous.

Case Presentation: Banking and IT Solutions (BITS)

BITS was founded in the early 1990ies by a group of software engineers in Switzerland. The company rapidly grew to an international market leader in banking software. Until 2008's financial crisis increased the pressure to innovate and diversify its solution portfolio, the strategic focus of BITS was the development, distribution, and operation of its proprietary core banking system. The executive board became increasingly concerned that the product lifecycle of that system might have peaked, and initiated substantial investments in establishing an internal innovation management framework. In the following years BITS has been investing large parts of their earnings on innovation to develop various new products and services in the areas of mobile banking, outsourcing, financial services, and consulting. As part of a new strategy, the company leaders wanted to reap the innovative potential of their own employees. This required them to identify and support their most creative and entrepreneurial employees.

In their effort to establish an intrapreneurial culture, BITS started town-hall meetings where the top management met and inspired the employees. They organized exhibitions where employees could present early concepts and prototypes of innovation and they implemented a phase-based innovation process. However, those approaches had limited success. Successful innovation at BITS rather depended on engaging in appropriate innovation practices (Ciriello et al., 2017). The awareness of those practices offered novel opportunities to support them, e.g. offering tools that made informal innovation activities transparent to them and to gently transition them into the official development process.

Throughout the research project, we maintained an open mind to what the company's real problem is, how to address it, and what to learn from addressing it (Iivari, 2015). We engaged in an intensive long-term collaboration (Carlsson et al., 2011) with BITS, where employees from different departments and from all hierarchical levels informed our design activities. We started with an in-depth qualitative field study (cf. section 3.2) to map out people's perceptions of the problem from multiple sides and layers of the organization. The core design team then consisted of the authors on the academic side, with us having a

background in information systems, and three managers at the BITS side, with them holding a PhD in either marketing, economics, or innovation management. In addition, students were involved in development activities as part of their project or thesis work. We firmly believe that this interdisciplinarity of the research team sparked creativity and led us to develop a useful solution for a concrete practical problem (Iivari, 2015), as BITS was eager to implement and use our designed artifact right away.

3.2 Data Collection and Data Analysis

Data collection and analysis proceeded in iterative-incremental cycles as part of an in-depth qualitative field study (Walsham, 2006). In all, we conducted and analyzed 62 interviews that helped us to understand the phenomenon and identify key use cases and requirements, 4 workshops with test users for the development and evaluation of the DISC, as well as 196 days of participant observations spent onsite the case company. In the first data collection phase (02/2013 – 10/2013), the study focused on the way employees communicate ideas. One author spent between 2-4 days a week onsite at the BITS headquarter and had access to an in-house workstation and intranet platforms. From there, the author conducted 32 semi-structured interviews to get an in-depth understanding of the focal phenomenon from a participant's perspective (Miles and Huberman, 1994). Questions addressed the participants' innovation practices when collaboratively developing ideas, whereat participants were required to use authentic examples of their own experience. In doing so, we could document in detail the information requirements of various stakeholders throughout the innovation process.

In the second data collection phase (01/2014 – 12/2014), the study focused on how BITS employees collaborate across geographically distributed locations. One author continued to spend 1-2 days a week onsite at the BITS headquarter, and additionally spent a week in a row onsite at a remote subsidiary of BITS, during which he interviewed additional 30 experts. Questions addressed the way employees organize and share information about their innovative ideas. We thoroughly analyzed online networking platforms regarding their actual and potential usage for innovation and elaborated a set of key use cases.

In the third data collection phase (01/2015 – 12/2015), we developed an IT artefact as proof-of-concept and deployed it in BITS' intranet. We conducted several evaluation workshops with BITS to evaluate the artefact's usefulness and to obtain in-depth feedback on the prototype.

We carried out the data analysis collaboratively relying mostly on interview transcripts, collected documentary material, and field reports. We met in weekly focus groups (Krueger, 2009) to maintain a critical distance with the case company (Wickson et al., 2006). The interviews were recorded, transcribed, and processed using MAXQDA, where we developed a codebook to facilitate joint analysis and increase confidence in the findings (DeCuir-Gunby et al., 2011), through which we identified problem scenarios and activity scenarios.

3.3 Scenario-based Design Theorizing

We extract a prescriptive design theory (Gregor and Jones, 2007) from our concrete design artifact through inductive processes of reflection and abstraction (Gregor et al., 2013; Weick, 1995). As design theorizing usually operates in an instance domain and an abstract domain, reflection helps to identify essential conditions that are applicable to a broader class

of problems, and abstraction helps to derive generic features from observed instances of the solution (Lee et al., 2011). The primary sources of inspiration were the DISC system, as a specific solution to a problem encountered in practice, and the process of developing the system (Iivari, 2015). Building on Gregor et al.'s (2013) framework for design theorizing, we reflected on the *purpose and scope* by focusing back on the source of novelty of the design idea for the DISC. We reflected on *principles of function* by analyzing the way the DISC operates to initiate the trajectory of a change. Finally, we reflected on *principles of form* by focusing on the DISC's essential material properties that facilitate the performance of some action in a specific use context (Markus and Silver 2008, Gregor and Hovorka 2011).

We adopted a scenario-based design approach (Rosson and Carroll, 2002), to create rich descriptions of the problem and solution. Scenarios allow to convey important characteristics of users, typical tasks they engage in, tools they use, and their organizational context. This approach allowed us to describe and discuss the envisaged artifact at an early stage in the development process and to involve potential users in the creation of narratives of their performed activities, thus ensuring alignment with actual work practices. In addition, we regard the scenarios as interim artifacts in our theorizing process (cf. Weick, 1995), as they contain rich contextual details, which makes them suitable devices for transferring contextualized and implicit knowledge (Swap et al., 2001). Here, we employ Rosson and Carroll's (2009, p.1) definition of scenario:

> "Scenarios are stories. They consist of a setting, or situation state, one or more actors with personal motivations, knowledge, and capabilities, and various tools and objects that the actors encounter and manipulate. The scenario describes a sequence of actions and events that lead to an outcome. These actions and events are related in a usage context that includes the goals, plans, and reactions of the people taking part in the episode."

Our design process is guided by the DSR framework by Peffers et al. (2007) and section 4 is therefore structured along the therein recommended generic DSR activities. We also found inspiration in Meth et al.'s (2015) distinction between design requirements, design principles, and design features. We developed *problem scenarios* as basis for the problem identification, from which we derive generic design requirements (Section 4.1), and *activity scenarios* as basis for the solution objective, from which we derive generic design principles (Section 4.2). We framed each scenario in a specific way that allows it to be evaluated, but also to remain broad enough to be easily adapted (Rosson and Carroll, 2009). This served as foundation for designing and developing an artifact, namely a working prototype (Section 4.3), which we demonstrated and evaluated in several workshops with BITS (Section 4.4). From this, we derive specific design features, which we describe in section 5, along with suggesting a prescriptive design theory for DISCs.

4 Designing a Digital Idea Screening Cockpit

This section describes in detail the design process and its outcome. From a comprehensive field study and analysis of stakeholders, we develop five problem scenarios as a way to identify the research problem. Following the scenario-based design method (Rosson and Carroll, 2002), the scenarios are stylized cases of observed recurring problems at the case company. We used problem scenarios to describe prototypical human actors engaged in meaningful activities, highlighting features of the current practice that have

important problematic consequences for the actors (Rosson and Carroll, 2009). Next, we define the solution objectives of the envisaged artifact via five corresponding activity scenarios associated with idea screening in digital innovation. Building on problem scenarios, activity scenarios allow to envision how current activities might be enhanced or transformed by technologies (Rosson and Carroll, 2009). We then describe the design and development of a working prototype for the DISC. Moreover, we show via the demonstration and evaluation of a prototype how a DISC can be implemented and used in a firm.

4.1 Problem Identification

In this section, we illustrate in detail the problem understanding we obtained from the data set described above and illustrate the information requirements for the various stakeholders of the innovation process in form of problem scenarios.

Problem Scenario 1: An employee wants to realize an idea

Malcolm, a 25-year-old recent university graduate and junior software engineer at BITS, recently had an idea for a mobile banking application for smart watches. He quickly sketches a few screens and discusses them with colleagues during a coffee break. Malcolm's colleagues are excited about the idea, but he is still unsure about its feasibility, since BITS does not have any experience with smart watch applications yet. Also, Malcolm does not have a well-established network in the company yet, so he asks his line manager for advice. The line manager is currently quite busy and tells Malcolm to ask Dennis, an experienced business analyst, who has promoted a lot of ideas in the past. A bit doubtful, Malcolm reveals the idea to Dennis, who generally likes it, but emphasizes the importance of elaborating a business plan, to see how the company can make money with the idea. Malcolm has never created a business plan but is motivated to invest two weeks of his spare time and a lot of help from his peers to write one. Afterwards, Dennis sends the business plan to Corinne, an innovation manager at BITS. Corinne knows by chance that another team already develops a prototype for such an application, which is very similar to Malcolm's idea. Malcolm is very frustrated to have spent that much effort in vain.

The first problem scenario illustrates the need of employees for orientation, transparency, and feedback along the innovation process. From this, we derive the first design requirement:

DR1: *Raise awareness and transparency of ideas in the organization.*

Rationale DR1.1: Lacking overview of the innovation process can lead to disoriented employees. Although many companies employ a formal innovation process, employees often do not fully understand the decision structures behind the innovation process of the company and lack an overview over existing ideas. As a result, they need to invest substantial time in building a social coalition for their idea, which is difficult because different stakeholders have different information requirements, and they often lack the social capital to persuade advocates and sponsors. These stakeholders have different knowledge, perspectives and backgrounds and it can be difficult to satisfy the different information requirements of each of them. A software engineer touches on this topic: „There are the techies that say: Cool, that's exactly what we need. On the other hand, there are the sponsors, who make the funding decisions and ask: But how does this benefit the business?" (Interview 15, translated).

Rationale DR1.2: Intransparent decision criteria can discourage employees. Employees need guidance and orientation to ensure completeness and consistency of decision-relevant

criteria, and to ensure that all relevant stakeholders are involved. Often employees do not know who is responsible for the funding decisions and communication is often intransparent. Lacking transparency can lead to rumors and gossip about how ideas were chosen. One of the participants points out the issue of transparency, when talking about a closed innovation project: “Even if the innovation board provides you the budget, that still does not mean that you will get the necessary human resources. For developers the process is not really transparent.” (Interview 13, translated).

Rationale DR1.3: Late feedback or absence thereof can stifle motivation. Employees often get no feedback for their ideas, which means that they will get dissatisfied and sometimes stop contributing. One of the participants mentions: “I had an idea, which I wanted to share from the perspective of the goals of the idea and not immediately in terms of business value. [...] I wanted to find out whether we see potential for such an idea at BITS. And there I had the feeling that the innovation board did not feel responsible.” (Workshop 2, participant 2, translated).

Problem Scenario 2: The innovation manager pre-selects ideas

Corinne, a 38-year-old now innovation manager at BITS, sends out emails to all the BITS employees to collect their ideas. Those who think they have a valuable idea can fill out the template that is attached and send it back within the next 30 days. In this template they have to name and describe their idea and explain why the customer would be willing to pay for it. After the submission period ended, Corinne is surprised that an overwhelming number of 243 ideas have been submitted, so she starts immediately to browse through them. Firstly, she throws out the ideas that seem obviously incomplete or not serious to her. Next, she filters out ideas that are too vague and do not really seem thought through. She often has to get back to the employees and ask them to refine their ideas. After a long and exhausting assessment, she ends up with 15 ideas that she thinks have the biggest potential and should be presented in front of the innovation board. Despite all the effort, Corinne is still unsure if she may have discarded a valuable idea.

The second problem scenario illustrates the cognitive challenges associated with screening an abundance of ideas. From this, we derive the second design requirement:

DR2: *Reduce cognitive effort to select ideas.*

Rationale DR2.1: There is often an abundance of ideas in an organization, which can make collecting ideas complex, inefficient, and overwhelming. Thus, efficient screening is critical for the success of the innovation process. However, it is often difficult to compare ideas with different maturity levels and it is hard to assess their potential value, therefore idea screening is a time consuming and cognitively demanding tasks. The large number of ideas that are generated and the big problems that show up in the assessment process are pointed out in an interview: „In a company like BITS, where maybe 35‘000 ideas are generated each day, it is extremely important to say at a certain point: Put them all into an idea pool, but we will develop these five ideas further. Then the cost and benefit are in a reasonable balance. But we do not evaluate the ideas properly. Everything is pursued in some way and in the end, in a mysterious manner, some ideas are developed and others not.” (Interview 8, translated).

Problem Scenario 3: The innovation board evaluates ideas

Corinne organizes a meeting with the innovation board, a committee of experienced employees, in order to decide which ideas should receive funding. She also invites the employees to present their business plans. Some presentations are very technical, and the innovation board has a hard time fully understanding the

idea and assessing the benefits and risks. This makes the assessment very demanding. Some of the ideas are presented with the help of an elaborated prototype. In these cases, the ideas are more comprehensible, but rejecting these ideas is even harder for Corinne, because she knows that already a lot of work was invested in the idea. Many of the presented ideas look promising to her, but she knows that they can fund only few of them because most of them do not fit into the strategy of the company. Moreover, the resources they can allocate are limited, because this year's strategy is to focus on implementing customer requirements. They must rely on intuition to evaluate the ideas, as fully assessing all ideas in these different representations would be too demanding and time consuming.

The third problem scenario illustrates the need of innovation managers for clearly defined decision criteria. This often stands in contrast with the need of innovators for expressing ideas freely. From this, we derive the third design requirement:

DR3: *Enable semi-structured assessment of ideas based on multiple attributes.*

Rationale DR3.1: Assessing ideas is a time consuming and cognitively demanding task. Lack of clearly defined decision criteria makes it hard to evaluate ideas and to compare them with each other, making it very complex to assess the potential value of an individual idea. Companies are often held captive by customer requirements which consumes innovation resources, because most funding decisions are based on financial aspects. One drawback of screening models purely based on numeric scores is that they tend to be too rigid and neglect human reflection and experience.

Problem Scenario 4: Innovation manager wants to track the status of an idea

Corinne has her monthly status meeting with Michaela, the CEO of BITS. Michaela just came back from an IS conference and was intrigued by a talk about cryptocurrencies. She is convinced that cryptocurrencies will soon become a disruptive innovation in the banking industry, so she asks Corinne whether there already exist any related ideas in BITS. Corinne must acknowledge that she does not know for sure. She has overheard a conversation about cryptocurrencies at lunch a while ago, but she only recently taken over this position after the former innovation manager left the company. There is no idea repository and Corinne must now ask all responsible employees for the status of all innovation projects she inherited. The employees themselves are not satisfied with having to start explaining their ideas anew and often give Corinne snippy responses. Both Michaela and Corinne are frustrated that even the innovation management does not seem to know about all ideas within the company.

The third problem scenario illustrates the need of innovation managers for staying up-to-date regarding a single idea's current status and next steps while also having an overview of the organization's entire innovation process. From this, we derive the fourth design requirement:

DR4: *Enable collective and individual tracking of ideas.*

Rationale DR4.1: Lacking overview of innovation process makes it difficult to track the status of existing ideas: Without a comprehensive overview of ideas that are currently developed inside an organization, it is very difficult to track the status of a single idea. This may lead to redundancies or unexploited potential for synergies when employees are working on similar ideas without knowing of one another.

Problem Scenario 5: An innovation team searches for a subject matter expert

Mary, a lead developer working at BITS, wants to realize a new financial consultancy feature together with a customer, who agreed on co-financing large parts of the development. The Innovation Board decides to provide the remaining financial and the necessary human resources to develop a prototype. The know-how of the small team around Mary is sufficient for the development, until they are confronted with some tricky questions concerning financial regulations. It is very challenging for them to find an expert in that particular field who would be able to answer their questions. Mary therefore decides to spend half a day collecting the questions, describing the project and writing some emails to colleagues. After two months her mail coincidentally gets forwarded to Emma, an experienced business analyst working at BITS who gained expertise in that field from her last job. Emma asks Mary if she would still be interested in an expert, but in the meantime the customer has already dissolved the funding contract. In the meeting, they find answers to the questions and Mary and her team would now finally be able to advance their prototype, provided that they find a new customer, who is willing to finance the development.

The fifth problem scenario illustrates the need of innovation teams for accessing expert knowledge outside the core team's expertise. From this, we derive the fifth design requirement:

DR5: *Enable externalization of knowledge and facilitate access to subject matter expertise.*

Rationale DR5.1: Lacking access to tacit knowledge can stifle an innovation process. Technical or business knowledge for the development of an idea is often missing. Apart from managers that act as process facilitators and door openers, employees often need advice from subject matter experts in order to be able to advance their ideas. Often employees need to actively search for these experts, which can be very time consuming as pointed out in the following quote: “You cannot find this information easily. You have to trial and error, or you find someone that you might have contacted before and you try to see if the person knows and he can try to make a reference, to refer you to someone that he or she knows” (Interview 43).

4.2 Solution Objective

Our subsequent analysis of the solution objective is based on the development of corresponding activity scenarios. As we elaborate later on the evaluation section, we used these activity scenarios to demonstrate potential interactions of stakeholders with the Digital Idea Screening Cockpit. The sequence of the scenarios and the actors remain the same as in the previously presented problem scenarios in order to propose solutions for the identified problematic situations at BITS.

Activity Scenario 1: An employee wants to realize an idea.

Malcolm, a junior software engineer working at BITS, has had the idea to use smartwatches to facilitate the mobile banking login for the firm’s banking system. The next day, he discusses his ideas with colleagues and receives encouraging feedback from them. Motivated by the interaction, Malcolm thinks that this is a good chance to submit his first idea to the DISC, a new innovation tool that was introduced recently. When creating an Idea Space, the system automatically displays similar Idea Spaces on the page. Malcolm finds no similar idea on the DISC and decides to create a new Idea Space. To do this, he has to define a title, fill out a short description of the idea, assign related keywords and specify further fields that are marked as mandatory at this stage of the project. The DISC provides existing model Idea Spaces with sample descriptions, business plans and other sample artefacts, which Malcolm studies eagerly. Pete, a colleague from Malcolm’s team, wants to support the development of the idea and Malcolm adds him to the project team on the Idea Space. Two days later Malcolm’s idea has already received multiple positive ratings and comments from co-workers. The comments provide some advice on technical details and encourage them to

advance the idea. One of the followers recommended the Idea Space to Dennis, who studies the Idea Space and gives advice on how to improve the description of the business case, which they have created. A week later the two decide that their idea is now ready, and they request to proceed to the next stage. The request is granted the next day together with feedback on how to improve the idea presentation and questions they need to answer in this stage. Malcolm is at the same time looking for additional support from Idea Advocates and contacts different managers. Dennis, who had put the idea on his watch-list, agrees to back him and gets registered as supporter of the idea, which is visible for everyone and sends a positive signal, because Dennis is a respected Idea Advocate. A week later, Malcolm and Pete decide that the idea is ready to proceed to the next phase, despite some critical remarks that they have not yet been able to solve. They request funding for the idea and get a negative response by Corinne three days later, which instructs them to provide more details about the idea together with a short justification. The feedback directly from an Innovation Board member makes them clear that they have still some work to do. Thus, Malcolm continues to devote himself to his idea and comes up with a new approach on how to improve it. Pete contacts a smartphone application Expert, who advises them on how to improve the usability of the feature. After some further adjustments on the description and the prototype, they make a new funding request. This time they convince Corinne and get an invitation to present their idea.

The first activity scenario illustrates how a DISC can raise employees' awareness and transparency of the innovation process in an organization. From this, we derive the first design principle:

DP1: *Provide semi-structured, multi-attribute idea spaces.*

Rationale DP1.1: Visually displayed semi-structured Idea Spaces offer guidance and orientation in generating and selecting ideas. The DISC should offer a possibility to publish ideas in a way that they are visible for the whole organization. Employees can create these so-called Idea Spaces, which consist of a description of the idea, uploaded artefacts and semi-structured data according to the screening criteria that underlie the DISC (cf. Section 2.2). Others can comment ideas and share them. Additionally, idea owners can also request feedback from innovation managers. On specified decision gates, these innovation managers decide if an idea is ready to enter the next stage, if more information is required or if it should be closed or archived, because it does not fit into the strategy. In short, semi-structured, multi-attribute Idea Spaces offer guidance and orientation to employees and allows managers to foster ideas and communicate with employees in a transparent way.

Activity Scenario 2: The innovation manager pre-selects ideas.

Corinne, a member of the Innovation Board, sends out messages to all the employees of BITS to collect their ideas that could provide BITS a competitive advantage, and invites them to create Idea Spaces on the DISC or to advance their existing ones. She explains that if Idea Space owners make a funding request in the next 30 days they might get selected and have the chance to present their ideas in front of the Innovation Board. Corinne further points out what kind of ideas the board is particularly interested in. After the deadline, the board starts to evaluate the 58 Idea Spaces that were created by innovators, are in the demanded stage, and have requested funding. The innovation managers have made sure that not all ideas reached this stage, but only the ones that are mature enough and well-elaborated. Corinne and her colleagues start with the assessment and decide to first filter out the incremental ideas and the ones that have an internal scope. Further, they compare different ideas with the help of the DISC and by studying the description and the key words. Based on the rating of the ideas, the comments, the registered Idea Advocates and the impression of the project artefacts and documentation, they choose 15 ideas that they see as the most promising. The Innovation Board further provides a short feedback and explanation to all the Idea Spaces owners. Some of the ideas are closed and archived, others remain open.

The second activity scenario illustrates how a DISC can reduce cognitive effort to select ideas. From this, we derive the second design principle:

DP2: *Provide a structured workflow for processing idea spaces.*

Rationale DP2.1: A structured workflow for processing Idea Spaces facilitates assessment and selection of promising ideas. The DISC offers different stages for ideas and makes sure that the ideas are well-elaborated before their owners have the possibility to request funding. Employees receive feedback from Sponsors already in the early phase of the development of their ideas, which prevents them from investing a lot of time into ideas that will never be realized. Sponsors can browse through the ideas as well as filter and compare them, based on the defined values for the ten underlying dimensions. Thus, by offering a structured workflow for processing the semi-structured set of ideas, the DISC facilitates the assessment and the selection of the most promising ideas.

Activity Scenario 3: The innovation board evaluates ideas.

Corinne organizes a meeting with the Innovation Board, a committee with experienced employees and innovation managers, in order to decide which ideas should receive funding. She also uses the DISC to invite the idea generators to present the business plans and ideas, which made it through the first assessment round. The Innovation Board studies the information on the Idea Spaces the day before the presentation in order to be well-prepared and understand the goals of the different ideas. The presentations are then primarily a chance for the idea creators to promote their ideas and clarify ambiguities and open questions. After the presentation, the board sends feedback to all the presenters via the DISC. Depending on the decision of the Innovation Board the innovation managers change the state of the Idea Space and enter the provided funding in the specific field of the Idea Space.

The third activity scenario illustrates how a DISC can enable semi-structured assessment of ideas based on multiple attributes. We can relate the first design principle to this (DP1: provide semi-structured, multi-attribute idea spaces).

Rationale DP1.2: Semi-structured Idea Spaces facilitate idea assessment by providing decision-relevant criteria and transparently documenting decisions. The DISC allows employees to request feedback and study other Idea Spaces before they present their own idea and compete for funding with the others. Potential sponsors can get an overview of the ideas that will be presented. The DISC requires employees to provide holistic information of their ideas and facilitates the assessment and comparison of ideas by Sponsors which later results in the funding decision. This funding decision can then also be communicated using the DISC, which makes it comprehensible for third parties, such as facilitators, collaborators, subject matter experts, or sponsors.

Activity Scenario 4: Innovation manager wants to track the status of an idea.

Michaela, the CEO of BITS, starts the executive board meeting by announcing that a competitor will soon launch a new module for their system and that she thinks that this module will make the BITS system significantly less competitive. Today's main topic of the executive board meeting is therefore how to improve the competitiveness of the company with the focus on the innovation process. Corinne, the innovation manager, sends out a short innovation report prior to the meeting. She exported the report directly from the DISC and distributed it to all members of the executive board. The report offers an aggregated view over the ideas of the organization and shows the amount of ideas in the different stages of the innovation process. Corinne has decided to present an overview of only the ideas that might give a competitive advantage. To put this illustration into context, Corinne has further attached a similar illustration of another organization's

innovation process. The board firstly discusses the differences between the two illustrations. Afterwards, they collect measures how to improve what they identified as weaknesses in the process. Further, the innovation report lists all the projects that were funded in the last quarter, their current state and an overview of the deployed resources. At the end of the report, there is a list with the employees who were the most active users of the DISC. The board decides to reward the top three of this month. After the meeting, Corinne wants to have an update on the ideas that BITS funded in the last funding session. These ideas were added to a watch-list and the DISC now displays their current stage. Two ideas that are no longer pursued are archived. To learn more about the ideas the Innovation Board members can review the latest artefacts. In the cases, where the ideas are not fully up-to-date, or Corinne needs more detailed information she contacts the person who is listed as idea owner of the Idea Space.

The fourth activity scenario illustrates how a DISC can enable individual and collective tracking of ideas. From this, we derive the third design principle:

DP3: *Provide a repository of Idea Spaces to facilitate individual and collective tracking.*

Rationale DP3.1: A repository of Idea Spaces facilitates status tracking and aggregated overviews of innovation activity within the firm. The DISC allows tracking ideas over different stages. It also offers an aggregated view over the ideas or a filtered subset of them, which enables a macro analysis of the innovation process for managers and facilitates the comparison of innovativeness of an organization to other organizations. Further, the most innovative employees can be identified, contacted, and rewarded based on the activity on the DISC.

Activity Scenario 5: A developer team searches for a subject matter expert

Mary, a lead developer working at BITS, wants to realize a new financial consultancy feature in cooperation with a customer. This customer is listed on the Idea Space. The know-how of the small team around Mary is sufficient for the development until they are confronted with some tricky questions concerning international regulations. The DISC has an interface to a tool, where they can ask their questions and that helps them to search an expert in this field. With the help of the tool, Mary finds three experts. She decides to contact Emma, an experienced business analyst working at BITS, because she found out with the help of to the DISC that Emma has already consulted two related ideas. Emma knows that Mary can add her as business consultant to the project and that she might get rewarded for her support, if the idea is realized successfully. This is an additional incentive for her to help Mary. In a meeting they discuss the different questions and find answers to them.

The fifth activity scenario illustrates how a DISIC can enable externalization of knowledge and facilitate access to subject matter expertise. From this, we derive the fourth design principle:

DP4: *Enable subject-based search and discussion.*

Rationale DP4.1: Adding contact information of contributors to idea spaces facilitates searching for relevant subject matter experts with tacit knowledge. The DISC integrates the search for subject matter experts and makes the support of them more transparent by openly registering them. Based on this information, experts can be searched for and other innovators, who have similar questions or problems, can contact them. Furthermore, the DISC allows registering customers and other external partners of an innovation project.

4.3 Design and Development of the Digital Idea Screening Cockpit

We motivated the need for a DISC by illustrating the problem along with its significance and envisaging how a solution could look like via activity scenarios. From this, we derived design requirements and corresponding design principles. Figure 2 maps the design requirements and design principles to corresponding design features and the following section describes in detail how we designed and developed the design features in our study.

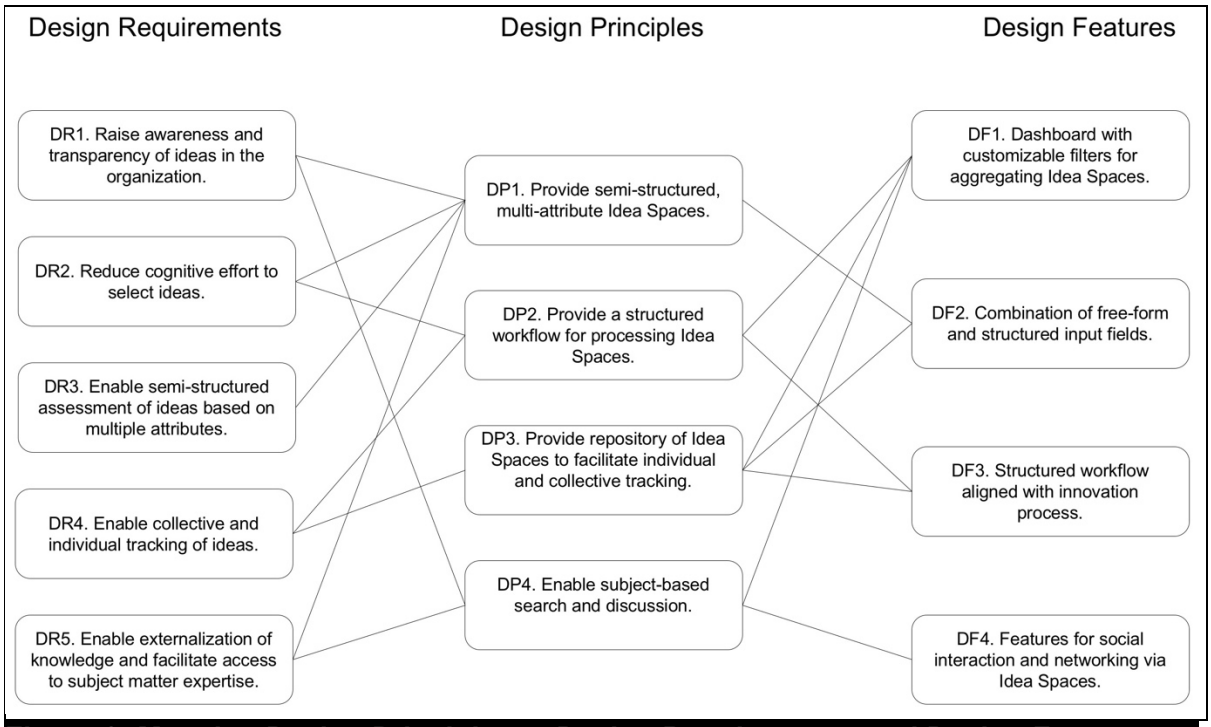

Figure 2: Mapping Design Principles to Design Requirements and Design Features

DF1: *Dashboard with customizable filters for aggregating Idea Spaces.*

Following our above-described analysis, we learned that the DISC should provide guidance through the innovation process by supporting the assessment, selection, and tracking of ideas. Through a central idea repository, employees should be able to assess ideas by submitting them in a semi-structured manner, focus on relevant criteria, find relevant experts, and obtain community feedback. Through this idea repository, employees should also be able to select relevant ideas from a large pool and, thereby, get an overview and orientation of the existing innovation process. Entries in the idea repository should enable the employee to track the status of his/her idea.

From a manager's point of view, the DISC should allow managers to assess, select, and track ideas to make informed decisions of innovation projects within the organization. Through an aggregated overview of the innovation process, managers should be able to detect weaknesses and strengths by assessing ideas in different stages and make micro and macro level analyses of ideas. Through a semi-structured set of criteria, managers should be able to compare ideas against each other and select the most promising ones for further funding. Again, entries in the idea repository should enable managers to track the status of ideas.

Thus, the DISC should enable ideas to be published in Idea Spaces that are visible for other members of the organization. Others should be able to search and filter Idea Spaces through a customizable dashboard. Adding Idea Spaces to a personal watch list enables followers, contributors, and sponsors to stay up to date on the development of an idea.

DF2: *Combination of free-form input fields and structured input fields.*

The DISC should provide enough structure to adequately illustrate decision-relevant information for managers at the right level of detail and abstraction. At the same time, it should provide employees with enough flexibility to allow for sufficient openness and ambiguity that matches creative ideas. This is a wicked problem: If the DISC was too rigid, it would prevent complex ideas to emerge and only serve few managers for decision support, but employees would not feed the system with the necessary data. However, if the DISC was too loose, the process would become arbitrarily complex, ideas could not be compared with each other, and managers would not take the system seriously. The DISC Idea Spaces should therefore combine free-form input fields (e.g. free text, attachment upload, video player) with structured input fields (e.g. morphological analysis corresponding to idea screening criteria in figure 1) to enable balancing between structure and flexibility.

As we learned from our study, the DISC should be seamlessly integrated into the everyday work environment to increase the likelihood of being used. Thus, we developed the DISC as web application that functions as a plug-in for the BITS intranet, which means that employees could already use and test the system from an early stage on. Figure 3 shows the dashboard, from where the Idea Spaces can be accessed via different categories (Idea Spaces on a personal watch-list, Idea Spaces that were created most recently, Idea Spaces that received the best voting and the user's own Idea Spaces).

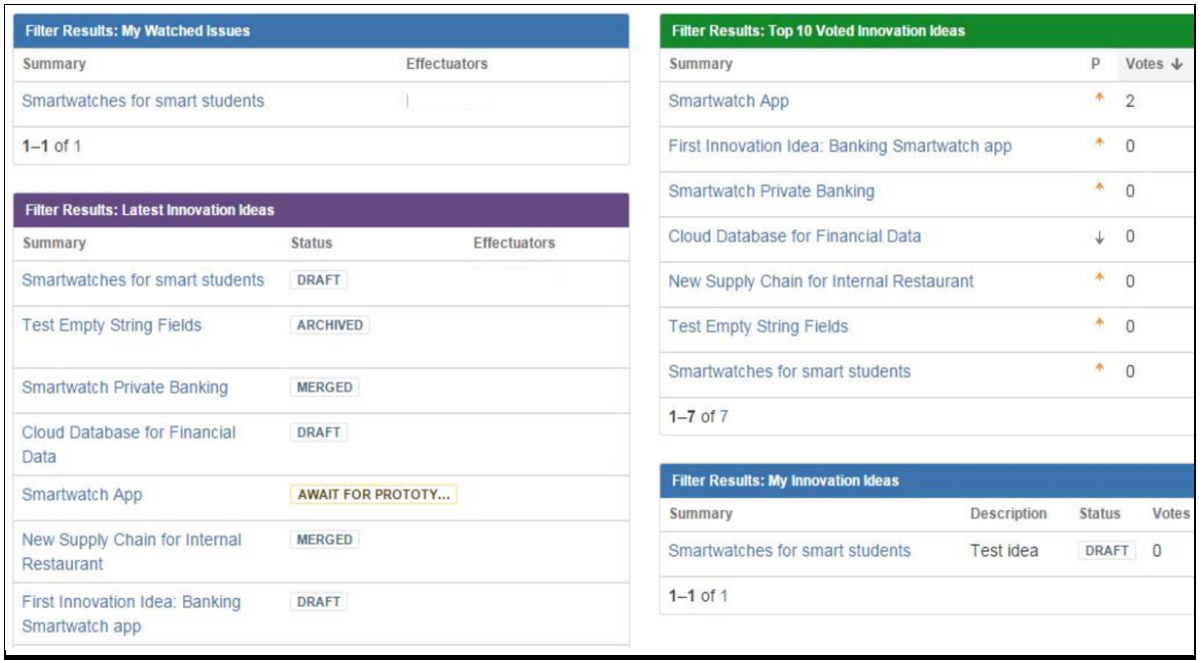

Figure 3: The Dashboard of the DISC

Further, figure 4 shows the screen, where Idea Spaces can be created and edited. The various dimensions that need to be defined can be accessed via the different tabs on this screen (for instance "Purpose" or "Participant Roles"). The employee can choose among

pre-defined values or free text according to the defined idea screening criteria. In addition, it is possible to upload multimedia attachments (e.g. image or video).

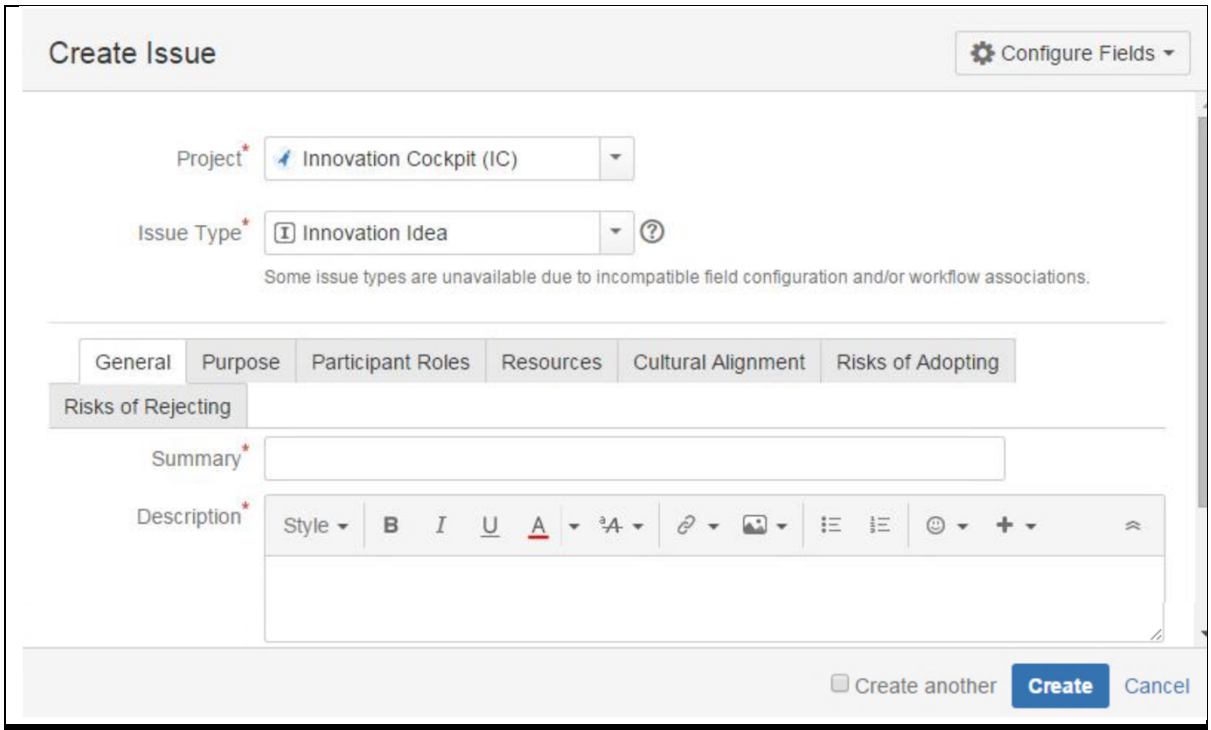

Figure 4: The Idea Space creation interface

DF3: *Structured workflow aligned with innovation process.*

In line with the identified need to provide a structured workflow, we aligned the DISC workflow with the innovation process that was in place at BITS. Hence, the criteria in brackets (e.g. “[Stage]") are derived from the idea screening criteria catalogue in figure 1. Whenever a new idea emerges, the idea owner can add a new idea with a title, a short description, and keywords. At this stage, the idea automatically has the *[Stage]* value “idea generation and mobilization” and the other criteria are optional fields. The idea owner can choose whether the idea is private to some users or publicly displayed and the system suggests some experts for the *[Participant Roles]* criterion based on entered keywords. Users can then comment and rate the idea. If the idea owner wants to further pursue the idea, he sends a request for promotion to the “advocacy and screening” *[Stage].* Here, the criteria *[Purpose, Value Proposition, Scope, and Type]* become mandatory fields that guide the assessment, along with the [*Risk of Adopting and Risk of Rejecting*], whereat the idea assessor can either fill in the values themselves or request further information from the idea owner. An idea assessor, who is typically an innovation manager, then assesses the idea in an innovation board meeting. After this activity, the idea assessor decide on whether to accept or reject the idea at this stage of the process. If the idea is accepted, the idea reaches the "initial fundraising" *[Stage]* and the idea owner can further refine the idea and elaborate especially in the *[Resources* and *Participant Roles]* criteria, which are now mandatory at this stage of the process. Here, the Digital Idea Screening Cockpit guides the idea owner with clearly formulating the necessary criteria for a business plan. If the idea receives initial funding from the executive board or an external source, the idea owner can send another request to the idea assessor for promoting the idea to the “experimentation

and prototyping" *[Stage]*. In this case, the idea assessor makes another assessment of the idea based on the criteria *[Participant Roles, Resources, Risk of Adopting, and Risk of Rejecting]* and decides in an executive board meeting on whether and how many resources to allocate for "experimentation and prototyping". The idea owner can now publish information regarding the idea on the idea page, provide updates on outcomes of the experimentation, and discuss issues with facilitators. This also allows idea assessor to track progress and generates useful documentation for marketing & sales personnel when the idea proceeds to the "implementation" *[Stage]* and a marketing plan needs to be developed. Marketing and sales personnel then provides a [Communication Strategy] including a roll-out plan to prepare the idea for the "diffusion" *[Stage].* Modifications are historicized to facilitate backtracking of an idea's development. Thereby, the DISC allows to create innovation reports, which provide an aggregated perspective over the whole innovation process. The DISC may also be used to identify the most innovative employees - the ones that are most active on the DISC. Through this iterative workflow, the IT Artefact limits the complexity of the DISC. At all stages, an Idea Space can be either archived (if not further pursued), merged (if substantially overlaps with another idea), or closed (if competed). Figure 5 provides an overview of the workflow.

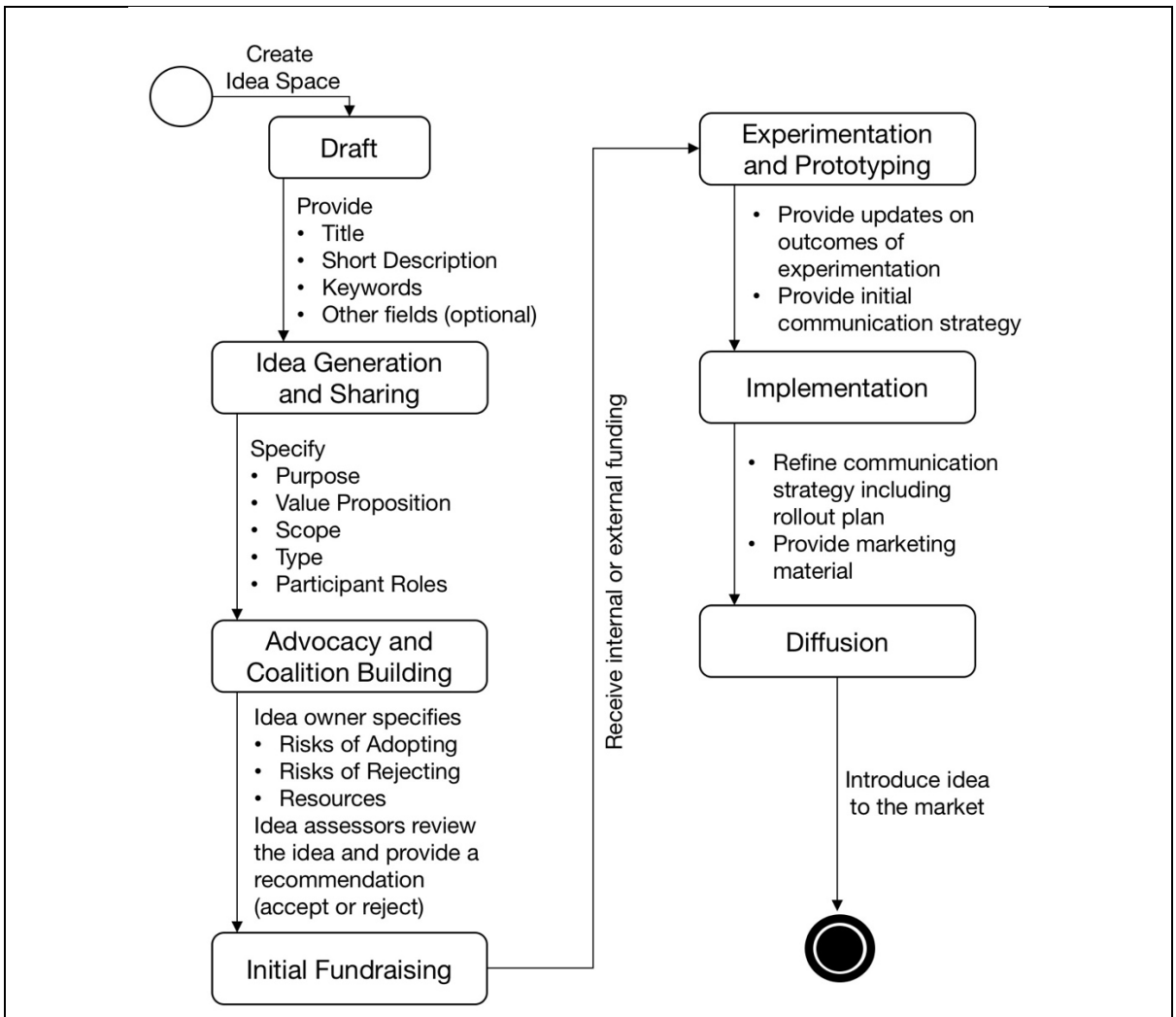

Figure 5: Structured Workflow in DISC

DF4: *Features for social interaction and networking via Idea Spaces.*

As we learned from our study, a DISC should enable subject-based search and discussion in order to enable externalization of knowledge, facilitate access to subject matter expertise, and raise awareness and transparency of ideas in the organization. Thus, it should be possible to read, rate, comment, and share Idea Spaces for everyone having access to the DISC. Idea owners should have the possibility to update Idea Spaces throughout their lifecycle and to request feedback from others. Managers should be able to list themselves as supporters of an Idea Space and explain their rationale for supporting or funding an idea. Moreover, the DISC should enable the search for subject matter experts by allowing to search people based on skills they list on their profile or subjects they have discussed on the DISC. Experts who contribute to the development of an Idea Space should be acknowledged as contributors on the Idea Space.

4.5 Demonstration and Evaluation

We conducted four half-day workshops with 1-3 BITS employees to evaluate the artefact's usefulness and to obtain in-depth feedback on the prototype. We started with discussing the activity scenarios and an early prototype extensively in the research team and obtained feedback from key informants from BITS who viewed the addressed problem from various perspectives. From these sessions, we obtained helpful feedback about different goals of managers and employees and were also able to develop and evaluate a working prototype.

For the first evaluation workshop, we sent out the problem scenarios along with a spreadsheet containing a list of 36 potential features to the participants up front. We then read and discussed the scenarios and feature list together and let the participants assign priorities (low, medium, high) to the proposed features. This resulted in a prioritized and agreed list of features the DISC should have (high: 9, medium: 11, low: 14, rejected: 2).

As preparation for the second evaluation workshop, we synthesized the activity scenarios (Section 4.2) in a video presentation that we used to visualize the key issues and design claims to the participants. The participants responded positively to the video, but also pointed out that the issue of transparency should be particularly emphasized. One participant pointed out that lacking transparency can lead to gossip and thus, it should be clear "*who was responsible for this and who made the decisions"* (Workshop 2, participant 1).

In the third evaluation workshop, we demonstrated an early working prototype of DISC. This was useful to see how participants would react to the system and sparked fruitful discussions. The test users commented positively on the functionality to select from large amounts of ideas, compare them against each other, and make an aggregated macro level analysis of all ideas in the different innovation process phases. Since the initial flat representation of the DISC was perceived as complex, we grouped the criteria into categories.

Additionally, we used a printed version of the DISC prototype to categorize existing ideas that were in progress at BITS at that time. This enabled participants to make suggestions directly to the prototype via post-it notes (cf. figure 6).

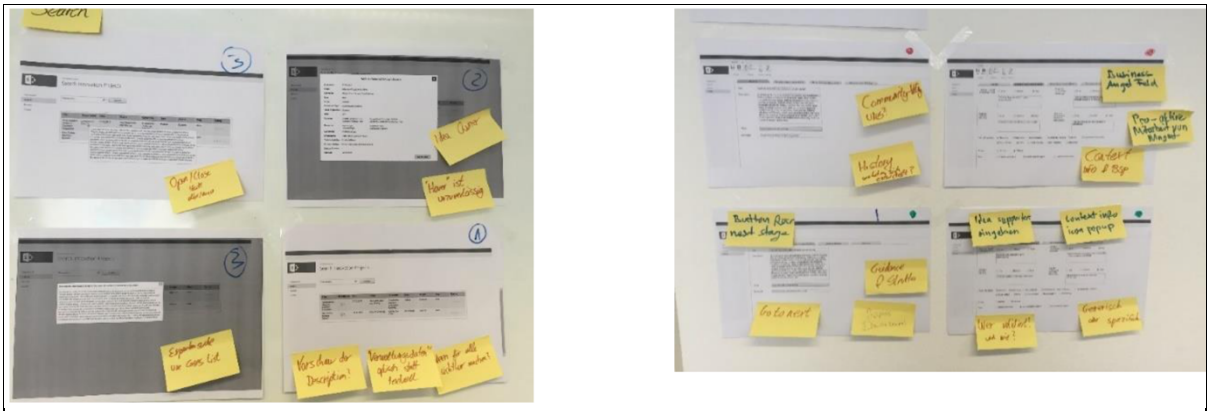

Figure 6: Post-it notes on prints of mockups during evaluation workshop

We also prepared a list of implementation options (1: development from scratch, 2: development of a plug-in for already used software, or 3: customization of a newly purchased software) with according advantages and disadvantages. Considering that a plug-in for an already used software would enable the most productive and integrated use of the DISC while enabling to reuse software components, we reached a consensus on option 2: *"I think you need to have a holistic perspective on the whole project and be aware of everything that will be coming from there. We cannot have the DISC and different tools for all the different things in addition. We need an integrated view!" (Workshop 3, participant 1, translated).*

In the fourth workshop, we walked the participants through the revised prototype and could validate that they perceived the DISC to be useful and usable to improve the described problems, confirming that the idea screening criteria were valid and complete. In this workshop, it came evident that the DISC needs to find the right balance between structure and flexibility to allow different stakeholders express their different views in the system. While some participants requested to break down the proposed assessment criteria into additional sub-criteria, others responded that the structure should be simplified by grouping criteria together. For us, one of the most important outcomes of our evaluation was that, based upon our findings, the senior management of BITS decided to implement the DISC and appropriate processes as part of their company-wide innovation management. By the time we terminated the design process and our research relationship, BITS had collected several dozens of ideas in the platform. It should be noted, however, that our evaluation focused on the scenarios and the prototype. An evaluation of the system-in-use was not possible due to budgetary constraints, turnover of the design team, and confidentiality issues.

5 Discussion

In this section, we integrate our learnings from the above-described concrete design process into a more abstract design theory of digital idea screening cockpits. We then also summarize the methodological contribution of the paper by making a case for scenario-based design theorizing.

5.1 Design Theory of Digital Idea Screening Cockpits

Building on Gregor and Jones' (2007) framework for describing design theories, table 1 provides an overview of the DISC design theory, and the following sections describe its components in further detail.

Table 1. DISC Design Theory		
#	**Design Theory Element**	**Description**
1	**Purpose and Scope**	Prescriptive knowledge for developing DISCs, a class of IT artifacts that supports the assessment, selection, and tracking of ideas.
2	**Constructs**	Idea screening criteria (cf. figure 1) Assessment, selection, and tracking of ideas Semi-structured, multi-attribute idea spaces
3	**Principles of Form and Function**	We derive five design requirements (DR1-5) and four design principles (DP1-4) to support the idea screening process and suggest corresponding design features (DF1-4).
4	**Artifact Mutability**	The ideas collected via the DISC and the underlying idea screening catalogue depend on the organizational context, which will likely evolve as ever more ideas are processed.
5	**Testable Propositions**	We formulate heuristic hypotheses to test the effects of different configurations of design principles on idea screening.
6	**Justificatory Knowledge**	We elicit the design requirements and corresponding design principles from our field study at a company and from existing prescriptive knowledge from the idea screening literature.
7	**Principles of Implementation**	We provide three guidelines for implementing the DISC in an organization: 1) How to communicate the benefits of idea screening, 2) How to implement performance metrics for idea screening, 3) How to tailor the DISC to the specific needs of the organization.
8	**Expository Instantiation**	We present the working prototype that has been implemented at our case company as instantiation of the DISC design theory.

1) The *purpose and scope* of a design theory refer to a set of goals that specify the type of artifact to which the theory applies (Gregor and Jones, 2007). The here proposed design theory provides descriptive knowledge for developing digital idea screening frameworks, a class of IT artifacts, that support the assessment, selection and tracking of ideas. One key design lesson learnt is that a DISC needs to be a servant of two masters. On one hand, it needs to provide decision support by illustrating the relevant information for deciders in the right level of abstraction. In that regard, the DISC needs to be a precise and accurate model of an idea that provides unambiguous decision-relevant information. But at the same time, the DISC needs to provide a sufficient level of ambiguity and openness to serve as boundary object across intersecting social worlds (Star and Griesemer, 1989). We contribute to extant literature by illustrating the dual role of idea screening, putting it into the work context of employee-driven innovation, and providing prescriptive knowledge for developing an IT artifact to support these practices.

2) *Constructs* represent the most basic units of a design theory (Gregor and Jones, 2007). Organizing ideas for easy assessment, selection, and tracking requires a taxonomy that classifies ideas by decision-relevant criteria (Desouza, 2011). This paper contributes a synthesis of ten idea screening criteria grounded in related literature and validated by empirical data from a field study which allows us to suggest a holistic framework for assessment, selection, and tracking of ideas. This criteria catalogue, as outlined in section 2 provides the basic constructs of the DISC design theory. Moreover, the semi-structured, multi-attribute idea spaces provide essential design features (cf. figure 2) and are thus also a construct of the DISC design theory.

3) *Principles of form* represent enabling conditions of an artifact's characteristics provided to a user group in its context of use, and *principles of function* represent deliberate acts that facilitate the achievement of an artifact's goals (Gregor and Jones, 2007). This paper provides a rich description of critical situations in the context of idea screening in form of problem scenarios and provides creative suggestions how to support these situations with IT in the form of activity scenarios. From these problem scenarios and activity scenarios, we derive five design requirements (section 4.1) and four design principles (section 4.2), respectively. We then mapped these design requirements and design principles to specific design features to be incorporated into the concrete DISC artifact (figure 2). Specifically, the DISC design theory suggests organizations that want to screen ideas to raise awareness and transparency of ideas in the organization (DR1), reduce cognitive effort to select ideas (DR2), enable semi-structured assessment of ideas based on multiple attributes (DR3), enable collective and individual tracking of ideas (DR4), and enable externalization of knowledge and facilitate access to subject matter expertise (DR5). A DISC can help to achieve this by providing semi-structured, multi-attribute idea spaces (DP1), provide a structured workflow for processing idea spaces (DP2), provide a repository of idea spaces to facilitate individual and collective idea tracking (DP3), and enable subject-based search and discussion (DP4). For this purpose, it helps to provide a dashboard with customizable filters for aggregating ideas paces (DF1), combine free-form with structured input fields (DF2), align the structured workflow with the organization's innovation process (DF3), and facilitate social interaction and networking via idea spaces (DF4).

4) *Artifact mutability* refers to the constantly evolving nature of flexible and adaptable IT artifacts (Gregor and Jones, 2007). The ideas collected via the DISC and the underlying idea screening catalogue depend on the organizational context, which will likely evolve as ever more ideas are processed. As such, organizations that use a DISC may likely customize the here proposed idea screening catalogue, as well as the DISC's look and feel as suggested in the here proposed design features, to their specific needs. Also, employees and managers will likely gain more experience and trust in the system as they use it more, which will further improve idea screening. As the DISC is a flexible IT artifact that can adapt to various work practices, it is likely that organizations will adapt the DISC to the various settings in which they use it, and vice versa adapt the settings to their use of the DISC.

5) *Testable propositions* represent hypotheses about the artifact to be built that allow to test whether the artifact, if following certain principles, will work (better) in some way (Gregor and Jones, 2007). We propose and test heuristic design propositions by instantiating the above-described design requirements, principles, and features with a concrete IT artifact that has been implemented at a case company, demonstrating that it is possible and useful to develop a DISC in the here-described way. However, at this time in the process, it is unfortunately only possible to report on the prototype instantiation and a full evaluation of the proposed design should be subject of future work.

6) *Justificatory knowledge* provides explanations to understand how the designed artifact will behave and why it may behave in a certain way (Gregor and Jones, 2007). We developed the DISC design theory by building both on practitioner's knowledge, which we achieved by collaborating with a company, and scientific literature on idea screening, which we summarize in section 2.

7) *Principles of implementation* represent the means by which the design is brought into being (Gregor and Jones, 2007). With this paper, we provide a blueprint for developing a DISC. We recommend organizations to consider the following guidelines for implementing a DISC system:

- *Tailor the DISC to the specific needs of the organization.* While the DISC design theory builds on extant theories on idea screening, and is thus likely to be useful to other organizations than the one we provided its instantiation for, other organizations may require different configurations of the instantiation. The criteria catalogue (figure 1) and workflow (figure 5) are typical components of the DISC that may require tailoring to the specific needs of an organization. We propose to involve selected managers and employees actively in the development of the DISC by informing them about the problems, intended solution, and the functionality from a perspective that focuses on idea screening. People who have previously been active in the innovation process of the firm usually have a lot of knowledge and experience to contribute to the design process.
- *Communicate the benefits of idea screening.* A DISC is a servant of two masters in need to fulfil the dual role of supporting entrepreneurial and managerial practices simultaneously. These different stakeholder groups have different and sometimes conflicting interests in idea screening. Thus, it is important to clearly communicate the benefits of the DISC for all stakeholder groups. While the specific formulation of benefits depends on the context of each individual organization, it was helpful in our case to use the above-described scenarios to define the problem and the benefits of the solution. We therefore recommend organizations to use our scenarios as a basis for their benefits definition, and to communicate the benefits continuously to managers and employees via workshops, presentations, video tutorials, manuals, and coaching. As the implementation of any IT system should be carefully planned, organizations may find further useful guidance in the benefits and change management literature.
- *Implement performance metrics for idea screening.* Implementing performance metrics is a helpful way to ensure that the benefits of the DISC are met. These metrics can further increase transparency of ongoing innovation activities and should thus be easily accessible for employees and managers. We recommend establishing the following performance metrics: Average time required for screening and processing an idea, number of ideas being experimented on, cost and revenues of ideas, number of implemented and diffused ideas, quality of ideas, most competent employees and reviewers, and satisfaction with the system when screening ideas.

8) An *expository instantiation* helps to identify potential problems in a design theory and to demonstrate that the design is feasible and worth considering (Gregor and Jones, 2007). As our DSR strategy was to synthesize our experience from developing a solution for a concrete problem in an organization into a general solution concept to address a class of problems (Iivari, 2015), the here presented artifact represents an expository instantiation of the DISC design theory.

5.2 Making a Case for Scenario-Based Design Theorizing

Besides contributing a DISC design theory, this paper also contributes to the ongoing discourse on design science research (DSR) methodology by making a case for scenario-based design theorizing. Figure 7 provides an overview of the scenario-based design theorizing approach underlying this study, as described in detail throughout the paper. A short summary follows below.

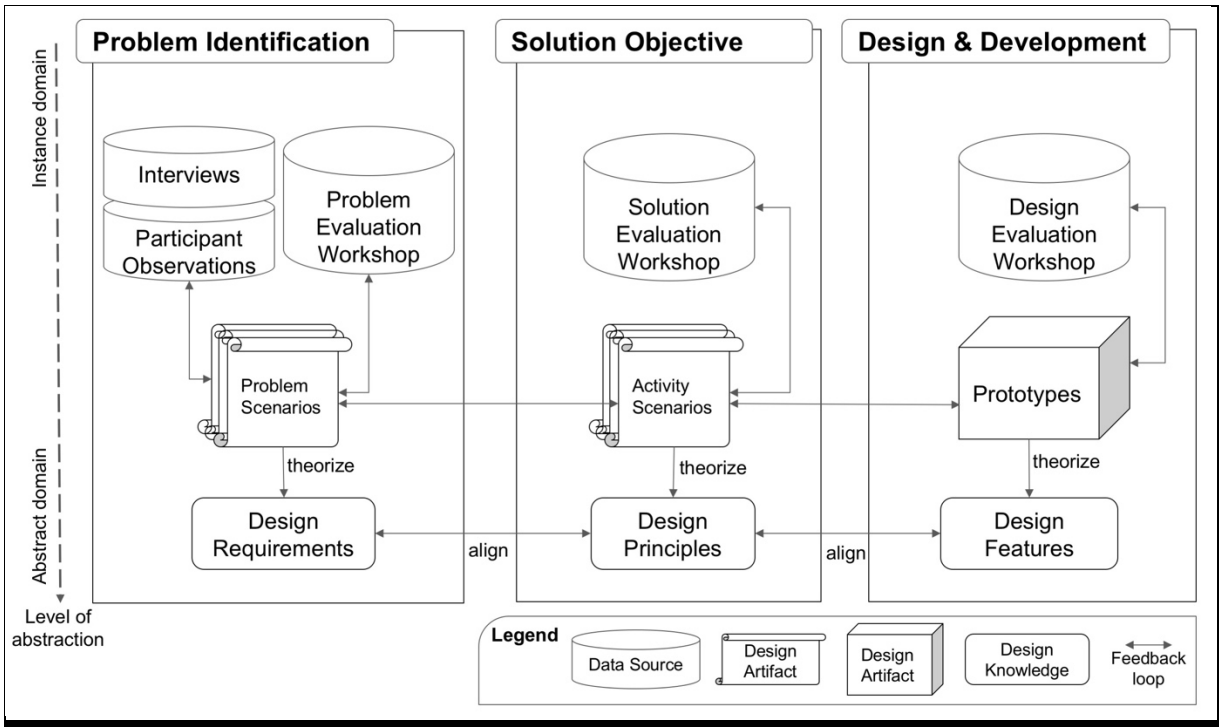

Figure 7: Our Approach - Scenario-Based Design Theorizing

We tightly link scenario-based design activities, such as the identification of problem and activity scenarios (as suggested by Rosson and Carroll, 2009), to generic DSR practices, such as problem identification and definition of solution objectives (as suggested by Peffers et al., 2007) and the formulation of design requirements, principles, and features (as suggested by Meth et al., 2015). The scenarios presented in section 4 greatly helped us to provide concise, rich, and contextualized descriptions of innovation practices. We used problem scenarios to understand current innovation practices (Richter et al., 2018). And we used activity scenarios to define the solution objective of the desired artifact that transforms these into digitally empowered innovation practices (Richter et al., 2018). As such, scenario-based design theorizing aligns well with the generic DSR activities as described in Peffers et al. (2007). Moreover, as scenarios are a very useful device for conveying implicit and contextualized knowledge (Rosson and Carroll, 2009), they can be regarded as interim artifacts in the theorizing process (cf. Weick, 1995). So, the scenarios fulfilled two tasks:
1) They acted as communication tool between researchers and practitioners to validate and refine the problem statement and solution objective in various design cycles.
2) They acted as carriers of important design knowledge, from which we could derive design requirements and design principles.
Because they allow readers to relate to the everyday work practices of people involved in the phenomenon, scenarios are an inherently appealing, convincing, and memorable way to transform concrete design experiences into abstract design theory. We hope that our study inspires and guides further research on scenario-based design theorizing.

6 Conclusions and Outlook

With the increased connectedness of innovation activities within and across organizations, employee-driven innovation gains importance (Desouza, 2011). However, the potential of information systems to support employee-driven innovation practices is not yet fully understood. The present study contributes to this discourse by demonstrating how the implementation of a DISC can support the screening of employee-driven ideas.

As employee-driven innovation becomes more widespread, appropriate screening of large amounts of ideas becomes more crucial for firms. Organizations tend to generate more ideas than they can actually implement, and these ideas compete against each other for resources (Andrew et al., 2010; Desouza, 2011). Against this backdrop, idea screening should not only be seen as a single phase of the innovation process, but rather as something that should be considered throughout the whole process. This paper reports on our experience from designing and implementing a DISC within one organization. We suggest that the here proposed DISC provides an appropriate structure to facilitate assessment, selection, and tracking of ideas while also providing appropriate flexibility to capture complex ideas.

Companies may implement this DISC and customize the specified criteria and attributes according to their specific needs. While our test of the DISC shows great potential to enable employee-driven innovation in practice, it would be interesting to test whether the here proposed design is useful in other kinds of organizations, too.

This study needs to be seen in the light of its limitations. We designed the DISC in cooperation with the software company BITS and developed the artifact to address the identified problems. While our design theory provides explicit prescriptions on how to adjust a DISC system to the specific needs of an organization, it requires further research with different kinds of organizations to enhance generalizability. Moreover, our design evaluation is limited to a prototype implementation, and a full evaluation of the design should be subject of further research.

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