# Communicating Ideas Purposefully - Toward a Design Theory of Innovation Artifacts

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# COMMUNICATING IDEAS PURPOSEFULLY: TOWARD A DESIGN THEORY OF INNOVATION ARTIFACTS

*Complete Research*

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## Abstract

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*Keywords: Design Theory, Innovation Artifacts, Innovation Management, Boundary Objects, Intrapreneurship, Open Innovation, Causal Analysis.*

## 1 Introduction

A company's strategic position in a competitive market depends crucially on its innovative capacity (Tidd and Bessant 2011). Therefore, fostering innovation is an essential task, particularly in the dynamic software industry (Fitzgerald et al. 2008). The continuous acceleration of innovation rates forces ever more established companies to fundamentally rethink their understanding of innovation (cf. Chesbrough 2003, Christensen 1997, Desouza 2011).

In this context, a larger share of existing studies focuses mainly on establishing processes and organizational structures that facilitate innovations. According to the open innovation paradigm, companies should purposefully use both inflows and outflows of knowledge to accelerate internal innovation and expand the market for external innovation (Chesbrough et al. 2005). Similarly, the intrapreneurship paradigm describes a shift from traditionally centralized, R&D oriented organizational structures to network-based work structures (Desouza 2011). This view regards current

trends such as democratization of innovation, empowerment of front line employees and a new employee generation of digital natives as the main drivers of this fundamental change (Desouza 2011, von Hippel 2005, Palfrey and Gasser 2008, Schawbel 2013). Ever more companies recognize this potential and support their employees in realizing ideas by establishing innovative organizational conditions. Popular examples include 20 percent innovation time for employees, as well as hackathons, idea contests, and informal programs where employees pitch ideas directly to executives (Schawbel 2013).

Against this backdrop, we argue that the innovative capacity of a company depends crucially on how it supports employees in realizing ideas, and particularly on the way they communicate ideas through objects. At first, an idea exists only as an abstract conception, an image in the mind of a person (Partridge 1991, pp. 303-304). That image is likely to evolve as the person sees the physical image that answers to the idea of it. In today's corporate environment, innovation is an iterative task involving social interaction with numerous stakeholders (Neyer and Maicher 2013). The well-established notion of boundary objects provides a suitable theoretical lens to understand these complex interactions and to develop and maintain coherence across intersecting social worlds (Star and Griesemer 1989). All kinds of physical or digital objects like diagrams, visual representations, or prototypes have been examined as boundary objects (e.g. Carlile 2002, Koskinen 2005, Nicolini et al. 2012). These approaches are regarded as useful to create a better understanding of the way objects influence innovation (Carlile 2002, Neyer and Maicher 2013). However, explicit guidance on how to design and use such artifacts is scarce. Without a thorough examination of interdependencies between objects, idea communication, and innovation processes, this objective seems hardly feasible. Our research aims to bridge this gap by unifying the perspectives of innovation management and boundary objects in one comprehensive approach. In this vein we introduce the term "innovation artifact" and define it is as an underspecified representation of an envisaged solution that is used to communicate an emerging idea across intersecting social worlds in a corporate environment. In contrast to boundary objects, innovation artifacts facilitate creating a tangible preview of a possible future product or service.

We conducted an exploratory field study in a major Swiss banking software provider – an industry highly depending on continuous innovation. By interviewing 32 experienced innovators, collecting the artifacts they create and use for communicating ideas, and analyzing these *innovation artifacts* systematically, we focus our discussion on these research questions:

1. What role do innovation artifacts play in communicating ideas in a corporate environment?
2. How can innovation artifacts be designed to communicate ideas purposefully?

Applying causal analysis (Gregor et al. 2013), we examine our collected innovation artifacts with respect to their purpose, scope, form and function to extract general knowledge from them. The outcome of this research is a nascent design theory in the sense of Gregor and Jones (2007) that provides structured guidance for practitioners on how to design and use innovation artifacts. We argue that this design theory will contribute to improving the innovative capacity of a company by guiding its employees how to design artifacts to communicate ideas purposefully. Moreover, the proposed design theory helps to understand the role of innovation artifacts when employees communicate ideas in a corporate environment.

The remainder of this paper is structured as follows. Section 2 summarizes previous work in our field and motivates the need for developing a design theory of innovation artifacts. Section 3 describes our research methodology. Section 4 comprises an exemplary analysis of our collected data. In section 5, we reflect on these findings and delineate the quintessence of our nascent design theory. Section 6 summarizes the main aspects of this paper and draws an agenda for future research.

# 2 Related Work

## 2.1 Innovation management

Management-oriented literature that focuses on fostering innovative organizational structures and conditions has become increasingly popular (cf. Kim and Mauborgne 2005, Tidd and Bessant 2011, Tschirky et al. 2010). Among the most prominent representatives of this category are the concepts of open innovation (e.g. Chesbrough 2003, Chesbrough et al. 2005, Stoetzel and Wiener 2013) and intrapreneurship (e.g. Desouza 2011, Hisrich 1986, Antoncic and Hisrich 2001, Nielsen et al. 1985). According to the open innovation paradigm, companies should open up the innovation funnel to both peripheral inside innovators (i.e. innovators inside an organization but outside the R&D department) and external collaborators (Chesbrough et al. 2005, Neyer et al. 2009). While this leads to increased connectedness and specialization, it also leads to shrinking innovation cycles and increased competition. Consequently, ever more companies shift from traditionally centralized, R&D-oriented organizational structures to decentralized, network-based work structures (Desouza 2011). As opposed to the centralized paradigm, where isolated groups of experienced professionals develop ideas with a 3-5 years horizon, innovation is increasingly driven by so-called intrapreneurs. These are employees that share the drive and zeal of entrepreneurs, but rely on resources provided by their organization. They do so because they want to focus on developing ideas, but need the organization's support when it comes to providing human, technological or financial resources, and established networks of partners or customers (Desouza 2011).

Some also refer to this phenomenon as internal open innovation, as opposed to external open innovation with collaborators outside the organization (Stoetzel and Wiener 2013, Neyer et al. 2009). Ever more companies focus on strengthening internal innovation and empowering employees, hoping to benefit in two regards: Firstly, they seek to enhance the company's innovative capacity. Secondly, offering an innovative working environment could attract further highly skilled employees. Prominent examples of products that result from intrapreneurial efforts are Google's AdSense, News, and Mail, Facebook's like-button, and post-it notes at 3M (Schawbel 2013). Fostering internal innovation, however, places a stronger focus on understanding how employees exchange ideas across functional, technical, and organizational boundaries (cf. Leonardi 2011). Previous research has built on the notion of boundary objects to examine these complex interactions (e.g. Carlile 2002, Carlile 2004, Nicolini et al. 2012), as we outline in the next section.

## 2.2 Boundary objects

In the software industry, advancing ideas requires interaction with numerous distinct stakeholders, ranging from customers and external partners over business analysts, software architects and software engineers up to marketing and sales personnel, project managers and executives (Neyer et al. 2009). Any one of these stakeholders has a different perspective on potentially valuable ideas. Hence, to advance an idea, it is decisive to maintain its integrity in different contexts (Desouza 2011), because people tend to make sense of new things according to their existing mental model. For example, when Thomas Edison introduced the newly invented light bulb, he deliberately imitated features of existing gas lighting, so that people who had been using that technology for about 50 years could make sense of the innovation (Hargadon and Douglas 2001). In other words, demonstrating a novel idea via familiar living examples facilitated mental model matching among observers, thereby creating a common understanding about something that hasn't been there yet (cf. Smith and Shaffer 2000). Some refer to this phenomenon as interobjectivity (Latour 1996, Neyer and Maicher 2013, Nicolini et al. 2012), as opposed to intersubjectivity, which describes the practice of reaching a consensus through professional disputes and qualified subjective evaluations (Tschirky et al. 2010).

A considerable amount of research has examined constellations of interobjectivity in innovation under the well-established notion of boundary objects, which are defined by their ability to develop and maintain coherence across intersecting social worlds (Star and Griesemer 1989). In the context of innovation, boundary objects are perceived as objects that facilitate preserving an idea's integrity as it travels across technical, functional and organizational boundaries (Carlile 2004, Neyer and Maicher 2013, Rehm and Goehl 2013). For example, Carlile (2002) vividly illustrates boundary objects in new product development with the case of a manufacturing engineer struggling to persuade a design engineering board of an idea. After several unsuccessful attempts, he finally came up with a drawing that reflected the mental models of the design engineers. Only then were they willing to collaborate and advance the idea. In other words, although the arguments did not change at all, he enabled the audience to mentally dock on by establishing a shared syntax, i.e. creating a boundary object. Previous research has examined various classes of boundary objects as enabler of interaction in innovation (Carlile 2004, Neyer and Maicher 2013). These range from tangible artifacts such as PowerPoint slides, standardized forms, sketches, drawings, IT artifacts and prototypes (Carlile 2002, Nicolini et al. 2012, Schoeneborn 2013), over more abstract objects like metaphors (Koskinen 2005), discussions and research projects (Kimble et al. 2010), up to portfolios of objects, which are referred to as composite boundary object (Rehm and Goehl 2013).

Neyer and Maicher (2013), however, argue that the notion of boundary objects in itself does not suffice to capture the multi-faceted nature of work performed by objects in innovation. Building on the novel analytical framework proposed by Nicolini et al. (2012), they study the role of objects in innovation following a pluralist approach that embraces *boundary objects, epistemic objects, activity objects,* and *material infrastructure*. Epistemic objects raise curiosity and acquire emotional and social binding among their creators by embodying "*what one does not yet know*". In a case study, they describe a novel bioreactor as epistemic object of a cross-disciplinary research project. Similarly, activity objects motivate interaction and direct manipulation among observers. Typical examples are early prototypes that allow exploration of different options and discussion of design evolution (in the sense of Gutierrez 1989, Doll 2009, Houde and Hill 1997, Rosson and Carroll 2002). Lastly, objects that perform subtle background work such as e-mails or phone calls are subsumed under the term material infrastructure. In closing, Nicolini et al. (2012) postulate that researchers shall examine how people work toward and with these different classes of objects in practice to develop a better understanding of their activities. Neyer and Maicher (2013) follow this call and examined objects of interactive innovation, concluding that this pluralist approach contributes to a deeper understanding of "*what works when"*. However, while descriptive research on boundary objects contributes a lot to describe and understand the nature of the complex interactions associated with innovation, it leaves undone the task of developing sound change programs (cf. Gregor and Jones 2007, Van Aken 2004, p.220). Hence, we identify a lack of systematic investigation on formulating practitioner-oriented guidance regarding the design and application of innovation artifacts that are directed to the future. We argue that both researchers and practitioners will benefit from complementing existing description-driven research with prescription-driven research that provides targeted instructions for innovation artifacts. The next section illustrates how we aim to close this gap.

# 3 Research Design

## 3.1 Exploratory field study

To answer our research questions, we conducted an exploratory field study with one of Switzerland's major banking software providers (in the following termed BITS – Banking IT Solutions). Founded in the 1990s, the company rapidly grew to an international market leader in the banking software sector, until 2008's financial crisis increased the pressure to innovate and diversify its solution portfolio.

Today, around 1300 employees in two development centers and seven subsidiaries worldwide collaboratively innovate with customers (mostly private, retail, and universal banks), partners (specialized units e.g. for technical or outsourcing problems), and universities. It is therefore an excellent subject for examining how employees exchange ideas across boundaries through innovation artifacts. After having captured a detailed snapshot of the innovation activities at BITS, we reflected on our findings and elaborated a set of more general guidelines that are applicable to a broader class of problems. The following sections present the single steps in further detail.

## 3.2 BITS dataset

We ground our analysis on three data sources: 1) interviews with 32 experienced innovators affiliated with or employed at BITS, 2) innovation artifacts that we collected throughout the study, and 3) further firm information collected from websites, intranets, and pre-study project reports. The data was collected and processed in a team of four researchers who were in continuous exchange with the participants of the study and further BITS representatives. To strengthen the validity of our data, we consulted existing literature on innovation management and boundary objects (cf. section 2) to form a-priori constructs. This also helped us to prepare an interview questionnaire, and a short exposé that was used to inform participants of the topic.

The interviewees were selected after a thorough examination of the organizational configuration at BITS. Executives helped us to contact experienced deciders, sponsors, innovators, and also external partners from different departments and different roles. On average, our interviewees have 7.9 years of working experience with BITS. All 32 interviews were semi-structured interviews of approximately 90 minutes duration, conducted by one or two researchers. Baseline questions include 1) educational background and previous working experience with innovative projects at BITS, 2) a precise description of innovation artifacts the person created, including to whom an artifact as targeted, why the artifact was created in that form, and depending on which contextual condition the person decides on an artifact in general, 3) a precise description of situations where an innovation artifact functioned well or poorly to propagate an idea, including the assumed reason for success or failure, 4) the person's experiences regarding cost and benefit when creating innovation artifacts, and 5) which innovation artifacts the person prefers for deciding over an idea. The interviews were recorded and transcribed by all four researchers following a denaturalized approach (Weston et al. 2001), which focuses on meanings rather than on accents of the interviewees. To increase internal validity, we crosschecked the transcriptions among the research team, and analyzed the cases for discrepant evidence (Weston et al. 2001). During the interviews, we also took field notes to memorize the important aspects on artifacts. The real-life observations allowed us to understand the complex interactions between generating ideas, creating innovation artifacts, communicating them to relevant stakeholders, and realizing ideas.

We then imported the raw transcriptions into the qualitative data analysis software MAXQDA. Two researchers developed a codebook with 201 codes, and crosschecked their codings to increase intercoder agreement (DeCuir-Gunby et al. 2011). Two additional researchers carried out coding checks to ensure intercoder reliability and develop a shared conception of reflection (Weston et al. 2001). We further elaborated the codebook in weekly focus groups (Krueger 2009) to identify themes from various interviews and derive new codes *in vivo* from the data (DeCuir-Gunby et al. 2011). Basic coding dimensions included: 1) the purpose of creating an artifact 2) the involved actors (e.g. a co-worker, customer, superior, or sponsor), 3) the form of the artifact 4) the interviewee's judgment of an artifact (positive or negative), and 5) the innovation process stage in which it was applied (idea generation, screening, experimentation, commercialization, diffusion – cf. Desouza 2011). The coded units were phrases, sentences, or paragraphs (Weber 1990). The codes also helped us to find relevant snippets quickly using MAXQDAs code retrieval tool.

Simultaneously, we also collected the artifacts that were mentioned during the interviews. Some interviewees took us to their desk and gave us the artifacts directly afterward, others sent them via mail. Additionally, we were allowed to collect further related artifacts from BITS' intranet. The artifacts are no stand-alone entities, but related to various recent innovative projects at BITS. We are provided with an extensive set of artifacts from various projects (e.g. the e-banking project mentioned in 3.1) and with different degrees of maturity, ranging from whiteboard sketches over diagrams, wireframes, structured documents, PowerPoint slides, and prototypes. In consultation with BITS executives and interviewees, the artifacts were stored on a shared storage, where the four researchers could thoroughly analyze them. In total, we collected and analyzed 216 innovation artifacts. We relied on guidelines for case-based theory building (Eisenhard 1989, Eisenhard 1991), and particularly on genre analysis (cf. Richter and Riemer 2013, Riemer and Filius 2009, Yates and Orlikowski 2007) to classify the artifacts, whereby we inductively identified the following ten categories:

1) Informal speech: Well-prepared oral descriptions, e.g. elevator pitch, Daily Scrum discussion
2) Handwritten sketch: Pen and paper, whiteboard, post-it or flipchart.
3) Usage description: Describe users, along with their goals, activities, and expectations from a system, e.g. user stories, scenarios, or storyboards (cf. Rosson and Carroll 2002)
4) Design sketch: Focus on the user interface (UI) and the interaction between the end user and the system, e.g. wireframes, UI mockups, or screenshots (cf. Sefelin, Tscheligi and Giller 2003)
5) Software diagram: Conceptual model of a system, e.g. a drawing in the unified modeling language (UML), or business process modeling notation (BPMN) (cf. Cherubini et al. 2007).
6) Issue: A functional customer request, e.g. a ticket in an issue tracking system or a JIRA story
7) PowerPoint presentation: Slideware created in MS PowerPoint (cf. Yates & Orlikowski 2007)
8) Structured text document: Template with predefined sections, e.g. a software specification
9) Business case: A quantitative extrapolation addressing the questions how many resources have to be invested, and how much return on investment can be expected over a period of time.
10) Prototype: An early sample of an innovation used for exploration of possible solutions (cf. Doll 2009, Gutierrez 1989, Houde and Hill 1997)

The process continued throughout informing Bits executives of our findings by collaboratively writing a project report, which also served as basis for this paper. The report findings were continuously refined through presentations and discussions in workshops and meetings with Bits representatives. Subsequently, we further advanced our sense making of the extensive data set using causal analysis (Gregor et al. 2013), as the following section illustrates.

## 3.3 Research methodology

Our study can be classified as design science research (Peffers et al. 2007, March and Smith 1995) in that we seek to develop a prescriptive, practitioner-oriented design theory (Gregor and Jones 2007, Walls et al. 1992) that solves an important business problem (Hevner et al. 2004). We started with an extensive literature research on innovation management and boundary objects, as described in section 2. Building on existing studies in the area of our interest, we wanted to find out what innovation artifacts are used to communicate ideas in a corporate environment, but also why, with whom, and in which situations an artifact is a useful medium. These kernel theories not only helped us to ensure that the study is framed correctly, but also provided *justificatory knowledge* (Gregor and Jones 2007) for developing our nascent design theory. Acknowledging guideline 2 from Hevner et al. (2004), we could also verify that the executive board of BITS considers poor support for employees in realizing ideas a serious business problem. The outcome of our research is an information systems design theory in the sense of Gregor and Jones (2007), of which we will present the following components in this paper.

The *purpose and scope* of a design theory constitute a set of goals that specify the type of artifact the theory applies to. We extract the purposes of innovation artifacts from our dataset by building on the

work of Gregor et al. (2013), who propose a framework for developing design theories through inductive processes of reflection and abstraction. In this context, reflection refers to the process of learning from experiences made in the past, and abstraction describes the process of deriving generic features from observed instances of artifacts. In the light of the uncertain nature of innovation, reflective judgment helps to identify essential conditions that are applicable to a broader class of problems (Lee et al. 2011). Against this backdrop, Gregor et al. (2013) argue that design theorizing operates in an instance domain and an abstract domain (cf. Lee et al. 2011), and that design theory can be extracted from instances of artifacts through three intertwined types of causal analysis (Gregor and Hovorka 2011). This approach helps us to identify *principles of form,* i.e. enabling conditions of an artifact's characteristics and its context of use, as well as *principles of function*, i.e. deliberate acts or interventions that facilitate achieving these goals. Gregor et al. (2013) demonstrate the applicability of their framework via a simple illustration of extracting design theory from a jug, which we summarize in the following.

Firstly, *creative causation* helps to reflect on the *purpose and scope* by focusing back on the source of novelty of a design idea for an artifact. For example, a creative idea might have struck a potter to create a better artifact for pouring liquid (i.e. a jug) by adding a handle and spout to a container with an opening. Secondly, *active causation* helps to reflect on *principles of function* by analyzing the way an artifact operates to initiate the trajectory of a change, e.g. adding liquid through opening, lifting the jug by the handle, and pouring liquid through the spout. Thirdly, *passive causation* helps to reflect on *principles of form* by focusing on an artifact's affordances, i.e. essential material properties that facilitate the performance of some action in a specific use context (Markus and Silver 2008, Gregor and Hovorka 2011). For example, a jug's principles of form may be seen as 1) choosing a shape that has the capacity to hold liquid, 2) providing an opening through which liquid can be added, 3) providing a handle that allows picking up the jug, and 4) providing a spout that facilitates pouring liquid. It is further argued that collecting field notes throughout the design process may facilitate these three types of analysis (Gregor et al. 2013). In that sense, we regard a large share of our collected innovation artifacts as traces of a design process, enabling us to reconstruct problems the innovators faced, but also how they performed deliberate actions to master these challenges. Acknowledging guideline 5 from Hevner et al. (2004), we apply this abstraction framework rigorously to inductively extract design theory from our dataset. To make the analysis more transparent, we list the reflective questions that help identifying the design theory components at the beginning of each respective subsection in section 5.

# 4 Results

By means of an exemplary analysis, this section demonstrates how we apply causal analysis to extract design theory from our dataset. The sample artifacts presented in this section are ordered by their degree of maturity in which they represent an idea, ranging from low-maturity whiteboard sketches over more elaborate diagrams and documents, up to functioning prototypes.

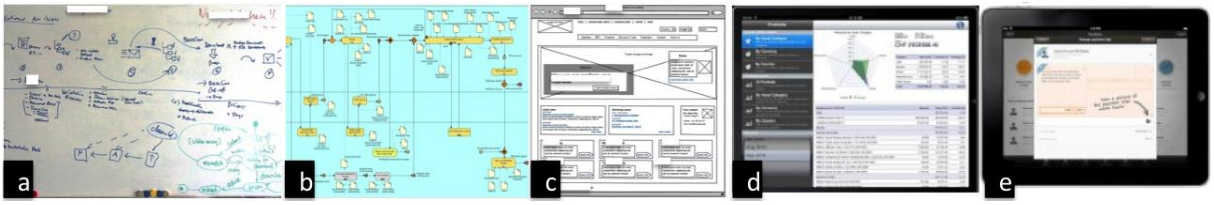


*Figure 1. Exemplary trajectory of an innovation with corresponding artifacts at different degrees of maturity. From left to right: Whiteboard sketch, BPMN diagram, wireframe, UI mockup, prototype.*

As we learned from the interviews, whiteboard discussions are a typical setting at BITS in which groups of software engineers, software architects, lead developers, business analysts and product managers meet often to brainstorm, develop and structure new ideas, explore new topics, breakdown large topic blocks and exchange specialized knowledge. One lead developer regards this as "*the simplest and most efficient way to build consensus and develop a common understanding*" (*I6)*. Some project teams regularly conduct two-hourly, weekly sessions where current ideas are discussed and further developed via whiteboard sketches in small groups: "*I find it most efficient to meet in small teams and discuss new ideas on the whiteboard. […] Simply draw some rough sequences of screens, doesn't really matter how it looks like*", a software engineer states (cf. figure 1a, *I1*). It is therefore not surprising that most department managers prefer whiteboard sketches when new ideas are communicated to them. One should reportedly not spend too much time on large texts, diagrams or prototypes, but rather provide a well-prepared oral description and discuss the idea as early as possible in a whiteboard discussion. To convince c-level management, however, one reportedly has to present more elaborate artifacts such as PowerPoint slides. Once a consensus is reached, the sketches are often photographed and put in structured documents like software specifications (cf. IEEE 1984) or intranet wiki pages. Some use computer-based modeling tools to redraw the sketches beforehand, such that they can be reused as working artifact for further developments (cf. figure 1b). In this regard, several interviewees from different organizational units emphasize that adhering to a standardized modeling notation such as UML or BPMN is crucial to ensure a common understanding, especially in communication with external partners or new employees with little or no firm experience. Such diagrams, however, are reportedly misplaced in communication with customers or non-technical partners, as they generally do not understand the notation.

In subsequent phases, many interviewees reported of having created more elaborated artifacts to gather quick feedback from external partners or customers. For example, one project team discussed early ideas with external interaction design specialists based on a first software specification for a tablet app, which should assist financial advisors in client consultation. In most units of BITS, software specifications are created on the basis of standardized document templates with predefined sections and mandatory content descriptions, which force the authors to write ideas out precisely. Based on this specification, the designers created a set of wireframes (cf. figure 1c), i.e. rough schematic representations of UI screens that assimilate line drawings. These wireframes were used to perform a customer walkthrough of a typical financial advisory encounter. This was reportedly a suitable instrument to discuss the raw ideas and get an overall impression whether the proposed system could be helpful in practice: "*We prepared an advisory use case from A-Z, such that one can sort of click through the wireframes. This went down quite well. In general, actually, feedback only comes when they see it graphically in front of them. Most of our customers cannot imagine what it means when they just read text. A specification doesn't help much there. The desired feedback only comes when they really see it"*, a software engineer reports (I1). Similarly, interviewees from other units reportedly draw wireframes on paper to structure their thoughts and think an idea through for themselves before they start to implement it, because it helps to "*strike out all the bad things about an idea*", one release manager states (I11). This interviewee calls for a more elaborate innovation process that demands concrete artifact deliverables. Thereby, the awareness of employees and managers to create innovation artifacts could be increased and the process could be more structured.

Some interviewees, however, also warn of the incompleteness of wireframes: "*When I talk to someone who has a certain technical understanding, then I can use UI mockups. Something more vague, and it can contain omissions. As soon as I go to someone who doesn't work with computers regularly, I can't do that. They don't understand the abstraction. We have seen that several times",* a lead developer contends (I6). Similarly, another software engineer reports on a project where the team got tangled up in long discussions with customers about sample screens for a portfolio management view (cf. figure 1d). As a seemingly illustrative example, the screen had visualized the financing plan for purchasing a house, using simple pie charts, bar graphs, and line diagrams. But the private bank advisors protested

that this wasn't an actual use case, because their customers can buy houses in any event and do not need such a financial plan in their portfolio. They would rather be interested in optimizing cash flows. "*Transferring the exemplary financing of a house to doing the same thing with cash flows turned out to be difficult. Hence, the closer to the real life situation of the advisor, the better*", the software engineer concludes (I1).

A functioning prototype can help to overcome this challenge. One interviewee describes a positive experience with a click-through prototype in communication with customers: "*The prototype didn't have much functionality, it simply visualized a portfolio in simple pie charts. But it was insofar helpful as the customer could see 'ah, that's how it could look like, these are the possibilities, if you turn the iPad around you can visualize more information.' The sole looking and touching helped to understand what we wanted to show the customer."* (I1) However, choosing the right degree of fidelity and polishedness is crucial when using prototypes in communication with customers, because they tend to confuse an early prototype with the final solution. *"Very often, we get tangled up in extremely tedious discussions about things that are completely irrelevant. Things like, if we build that in green or blue does not matter. Then again, some things are not even brought to the table because the customer thinks that's easy",* a system architect says (I12). Other interviewees describe situations in which prototypes stimulated their own creativity. For example, one interviewee reports on an idea that struck him while evaluating the mobile payment module for a smartphone prototype: "*It bugged me that you had to typewrite the 20-digit reference number*[1]*, even though there's a built-in camera*." (I29, cf. figure 1e) So he tried out image recognition frameworks and built a prototype to scan and automatically process payment slips. He occasionally demonstrated the progress to his colleagues, and at some point, the project management granted resources to build this module for the productive system. In more specialized areas, such as credit check, trading, taxation or core banking in general, prototyping is more difficult, because more specialized domain knowledge is needed before an idea even evolves. Yet still, two experienced software architects report that they regularly create "*Excel sheet prototypes*" to demonstrate how the system would calculate a new formula (I20, I14).

However, one product manager contends that in many projects, there are hardly any possibilities to try out too many things due to tight schedules. When time pressure is high, a business case can be more useful than a prototype, he states, because the respective deciders on the banks' side are mainly interested in the actual savings the new software provides. While the costs of a development can be estimated quite precisely, one challenge is to estimate the benefits as well. A well-prepared business case can master this challenge. In this context, the business case is mostly used to persuade c-level management of an idea. One critical long-established employee however warns of the tempted reduced complexity that is signaled by a business case, because the rather quantitative nature of business cases does not fit the "*spirit of the idea itself" (I24).* This interviewee criticizes the belief that the feasibility of an idea can "*be proven on an Excel sheet*". According to this interviewee, it would be more helpful to "*really believe in the essence of the idea*". In his experience, market predictions based on prototypes can actually be much more accurate, especially if they create excitement and the wish to fulfill the idea among observers.

Other interviewees concur and describe their positive experience with a prototype app for the iPad, for which extraordinary persuasion efforts came into operation: All CEOs and CTOs of BITS' customers received an iPad with the said prototype app installed as a Christmas present. However, as the aforementioned interviewee states, this was not yet all, "*because we wanted to present something. So we created a photo storyboard, defined use cases, storylines, and roles, and imagined one day in the life of these personas with all the cool features we want to build. We put all that into the photo storyboard and this was enormously persuading, the customers were excited. They understood: There*

[1] The *reference number* is a transaction identification code on the Swiss *Einzahlungsschein Orange* (orange payment slip).

*are people with ideas here*." (I24) Reportedly, this visual and appealing representation of the future product helped the bank CEOs to anticipate how the banking industry could change in the future, and was a successful means to persuade further investment in the project.

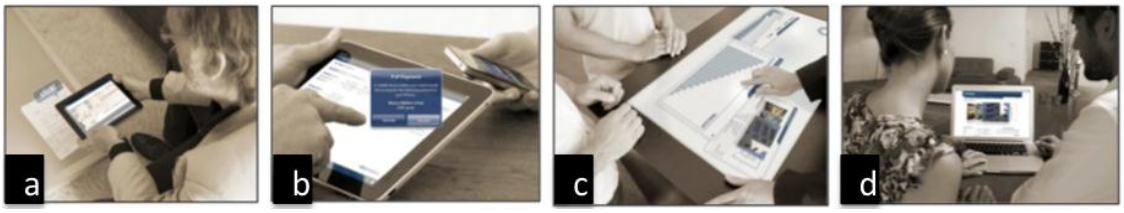


*Figure 2. Excerpts from the photo storyboard prospecting future mobile banking products. From left to right: Payment slip scanner, Peer-to-peer payment, financial advisory, web banking.*

The photo storyboard was reused in various contexts. Not only was it presented in internal tech talks to inform other units of the company of current developments and recruit collaborators. Reportedly, it also turned out to be more persuading for sponsors than the respective business case that was elaborated beforehand. Furthermore, the photo storyboard was frequently used by marketing and sales personnel, for example in brochures and websites.

To summarize, we have captured numerous situations where practitioners collaboratively construct and exchange innovation artifacts, such as handwritten sketches, usage descriptions, software diagrams, design sketches, PowerPoint presentations, structured documents, or prototypes. The dataset contains precise description of the purposes for which the interviewees created artifacts, the rationale behind choosing the respective form, and the actions that were necessary to get the artifact to work. The presented data provides a detailed snapshot of innovation in a software provider, and constitutes essential information for constructing our design theory, which we present in the following section.

# 5 A Design Theory of Innovation Artifacts

In this section, we delineate a nascent design theory. In the process of writing this paper, we repeatedly went through the coded interviews and collected innovation artifacts. To structure our analysis, we adapted the reflective questions included in the abstraction framework proposed by Gregor et al. (2013, cf. section 3.3), which are listed at the beginning of each section in italics.

## 5.1 Purpose and scope

To identify purpose and scope, we reflected on the original problem-solution space the innovator faced when creating an innovation artifact, answering the questions: "*What was the problem* [the innovator] *originally perceived? What is the goal of the artifact? How did the original design idea come about? Can you give the design idea a name?*" (Gregor et al. 2013)

The purpose of the proposed design theory for innovation artifacts is to provide practitioner-oriented guidance on how to create and use artifacts to communicate emerging ideas purposefully. From an employee's perspective, the guidelines constitute a valuable instrument on how to exploit the potential of tangible representations for realizing an idea. From a manager's perspective, the design theory may facilitate better structuring of innovation processes by demanding concrete artifact deliverables. Our design theory is built from data collected at a software provider, and is therefore likely to best suit the innovation practices of the software industry.

As our study shows, innovation artifacts can bring about change in a variety of situations. They may serve as a communicational bridge when people across technical, functional or organizational boundaries communicate potentially valuable ideas. We observed that innovation artifacts are used as

a means to propagate an emerging idea, and to create tangible representations of envisaged products or services. Reportedly, innovation artifacts such as handwritten sketches or wireframes can be useful in a private space, confronting the innovator with a first prospect of a new idea, thereby advancing the chain-of-thoughts and inspiring further development. These early innovation artifacts give the creator an impression of the potentials and constraints that emerge when the idea meets the realm of reality. As the idea matures, more elaborate innovation artifacts such as structured documents or prototypes reduce uncertainty, complexity, and the number of possible outcomes. In addition, we learned that an innovation artifact can be used to promote sensemaking when communicating ideas to another person, collect input or even create a social coalition of advocates. Finally, innovation artifacts such as business cases can support complex decisions and be an important tool to transgress the many quality gates that are associated with innovation processes. This means that the innovation artifact can be a crucial tool to persuade important stakeholders along the innovation trajectory like peers, superiors, gatekeepers, sponsors or customers.

## 5.2 Principles of form and function

To identify principles of form, we reflected on an innovation artifact's provided affordances to identify design characteristics that facilitate the achievement of its goals, answering the questions: "*What material properties did the designer deliberately build into the artifact to enable it to achieve its purpose? What contextual conditions are observed to enable the emergence of the desired affordances? Which user groups perceive which functional affordances of the artifact?"* To identify principles of function, we reflected on reported series of actions necessary to facilitate the achievement of an innovation artifact's goals, answering the questions: "*Which acts or interventions have to be performed in order to reach a specific goal? Who are the agents? What are the observed effects? Why are they necessary (is there underlying support from justificatory knowledge)"?* (Gregor et al. 2013)

In brief terms, innovators should purposefully design and use innovation artifacts to persuade and collaborate with relevant stakeholders. While pursuing these goals can be intertwined (cf. Petty and Cacioppo 1984), it is important to bear their distinctiveness in mind, as we outline in the following.

**Principle 1: An innovation artifact should help persuade relevant stakeholders through proof-of-value and proof-of-concept.**

Innovation is by definition risky, because the outcome is unpredictable and substantial investment is required before the desired benefit can be achieved. Hence, an innovation artifact should facilitate persuasion of decision makers to grant sufficient resources for realizing an idea. To be persuasive, the artifact should make clear what exact problem is to be solved, and what would be the potential impact of the idea it represents, including the cost of not adopting the idea (cf. Desouza 2011). Concisely elaborating both a proof-of-value and proof-of-concept can master this challenge.

A proof-of-value addresses doing the right things. Persuading sponsors requires the innovator to illustrate that an idea is valuable and generates a clear benefit for a relevant target group. A concise management summary comprising a distinguished problem statement and the main contribution in few sentences can meet this requirement, as well as a well-prepared business case. Additionally, persuading relevant stakeholders also calls for a certain degree of enthusiasm. As we learned from the interviewee's experiences with the photo storyboard (cf. figure 2), the presenter should visibly believe in the essence of the idea that is represented by an artifact and guide observers to really believe in this essence, too. Choosing an appealing and vivid representation for the artifact can create emotional attachment to the idea among observers, and awake the desire to fulfill it (cf. Smith and Shaffer 2000, Taylor and Thompson 1982). This proposition is consistent with action models in which beliefs about the future guide subsequent individual and organizational action (cf. Grégoire et al. 2010).

A proof-of-concept addresses doing the things right. Safeguarding long-term stakeholder commitment for granting resources calls for demonstrating feasibility of an idea. Pursuing completeness and consistency of decision-relevant information is vital in this context. Hence, an innovation artifact should reduce complexity by highlighting the important aspects of an idea while leaving out the dispensable ones, thereby reducing the number of possible outcomes. A functioning prototype can meet this requirement. The financial advisory app (cf. figure 2c) falls into this category.

**Principle 2: An innovation artifact should help fuel collaboration by acting as boundary object and activity object.**

In today's corporate environment, ideas are constructed and negotiated in social interaction and collaboration, rather than elaborated by a genius mind in a quiet chamber (Desouza 2011). However, while most organizations do not lack ideas, resources for realizing them are often scarce. In the face of daily business responsibilities, an innovator will hardly be able to set an idea in motion without investing a substantial amount of spare time in it. Hence, an innovation artifact should facilitate creating a coalition of advocates with relevant expertise, and making the idea tangible to collect quality feedback quickly. That means an innovation artifact should provide high interpretive flexibility, i.e. the extent to which an artifact multiple interpretations about how it should be used (Fichmann 2004, Orlikowski 1996). Providing affordances of activity objects and boundary objects (Nicolini et al. 2012, cf. section 2.2) can master this challenge.

Innovation artifacts that act as activity objects facilitate interaction among peers through embodying a certain degree of incompleteness. In doing so, they enable collaborators to create new tangible manifestations and take an idea to higher degrees of maturity. Hence, innovation artifacts should serve as working basis and contain targeted instructions on how something should be done. In contrast to "closed" artifacts like PowerPoint presentations or software specifications, more "open" artifacts like quick design sketches, wireframes, or whiteboard sketches can meet this requirement. The whiteboard sketches and wireframes (figure 1a, c) fit into this category.

Innovation artifacts that act as boundary objects facilitate preserving an idea's integrity in different contexts through adhering to a shared language. These innovation artifacts maintain coherence and create a common understanding across technical, functional, and organizational boundaries, thereby promoting sensemaking and mental model matching among allies. To meet this requirement, an innovation artifact should be compatible to the receiver's mental model, and transport an idea's essence even without the presence of the author. UML and BPMN diagrams can meet this requirement, as well as structured document templates that force the authors to concisely elaborate an idea, especially when complementing the text with meaningful visual representations or powerful analogies. To conclude, we argue that innovation artifacts embody a lot of valuable knowledge that emerges during the process of constructing and negotiating an idea. This embodied knowledge should be preserved, as it can be a fruitful source of inspiration and research afterwards. In this regard, the photo storyboard (figure 2) also fits into this category.

# 6 Conclusions and Future Work

These days, ever more companies recognize the potential of user-driven innovation and seek to support employees in realizing ideas by establishing innovative organizational conditions. Against this backdrop, we argue that the innovative capacity of a company can be significantly enhanced through providing structured guidance on communicating ideas through innovation artifacts. Whereas previous studies provide suitable theoretical lenses to understand the complex interactions associated with these tasks, explicit prescriptions for designing and using innovation artifacts are still scarce. We seek to close this gap by conducting an exploratory field study in a banking software provider. To answer research question 1, we focus our study on examining how experienced innovators create and use innovation artifacts. In particular, we asked our 32 interviewees what ideas they communicated to

whom, through which innovation artifacts, in which situations, and which factors decide over success or failure of an artifact. We build on boundary object literature to understand these complex interactions, and introduce the term *innovation artifact* itself as a more specific conceptualization. Innovation artifacts are defined by their ability to create an underspecified representation of an envisaged solution that is used to communicate an idea across intersecting social worlds. This conceptualization helps us to focus our discussion on the role artifacts play in realizing ideas. To answer research question 2, we rely on causal analysis to inductively extract a nascent design theory from the collected innovation artifacts (Gregor et al. 2013, Gregor and Jones 2007). The range of identified innovation artifacts is broad and comprises whiteboard sketches, software diagrams, usage descriptions, PowerPoint slides, prototypes, and business cases. In brief terms, innovation artifacts should enable innovators to persuade and collaborate with relevant stakeholders.

Our findings have to be seen in the light of some limitations. Firstly, although our dataset is very extensive, it has been gathered in a single company, and therefore needs further empirical work. Secondly, this contribution presents only the quintessence of our theory and requires further refinement. To address these issues, we currently prepare a comparative study with an additional software company to validate, extend and refine the design theory. Additionally, we develop an innovation coaching concept to evaluate the design theory. This includes querying the perceived persuasiveness among stakeholders with various levels of expertise of an idea that fulfill the two design principles to various extents (cf. Guadagno et al. 2011). We believe that our nascent theory will provide a substantial theoretical contribution, because it facilitates consolidating innovation management and boundary object theories, which both have an essential impact on IS research. To the best of our knowledge, our study is the first one to inductively develop a design theory from innovation artifacts collected in a corporate environment. In doing so, we illustrate via a practical example how inductive processes of reflection and abstraction leverage extraction of a design theory (Gregor et al. 2013).

We retain that extending this work with guidelines for formulating remaining design theory components would be a fruitful topic for future research. We follow the call of van Aken (2004), who advocates for more prescription-driven research that provides solutions for practical innovation problems. Similar recent research projects indicate a growing popularity of that approach (e.g. Ahlemann et al. 2013). However, description-driven research still dominates in our field of interest. This approach provides indeed a better understanding of these problems, but leaves undone the task of developing sound change programs. In line with other authors (e.g. Müller and Thoring 2011), we therefore argue that future research should place a stronger focus on innovation artifacts to better understand the complex interactions in innovation, and link the findings back to existing conceptualizations of innovation management and boundary objects.

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