The Role of Design Concepts in the Development of Digitalized Industrial Services

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Abstract: B-to-B industrial manufacturing organisations are moving the focus from designing products to services. This transition challenges the management of innovating, which is increasingly collaborative and networked. Organisations need to be able to tackle the related uncertainty in order to prepare, secure, and plan their use of resources. Design concepts are known to have various beneficial roles in product and service development in various development contexts. In this article we study how design concepts were utilised within, and between, three development projects in a Finnish company in the context of B-to-B industrial manufacturing. Eight roles for design concepts are identified in the 11-month study, and these are presented as stories concretising how design concepts functioned. Design concepts were utilised in 1) anticipating future, 2) implementing design, 3) training, 4) engaging in dialogue, 5) setting goals, 6) establishing vocabulary in organisation, 7) planning and securing resources, and 8) linking projects.

Keywords: Design concept, concept design, industrial service design

1. Introduction

Traditionally the role of the design concept has been described as means to define the desired outcome of the product development process (Seidel, 2007). The product concept is perceived as an outcome of the front-end process of product development, guiding the following product development work by defining the product to be developed (Cooper, 1990). However, undergoing goods-services transition in manufacturing companies challenges practices of development and development work extends from products to services (Gebauer, Krempl, Fleisch, & Friedli, 2008; Kindström & Kowalkowski, 2009). In this paper, we study how design concepts were utilised in three service development projects in B-to-B industrial manufacturing company with a traditional focus on product development.

There exist different conceptions of what a design concept is. For example, Clark, Johnston, & Shulver (2000a, p. 73) define service concept as a *"picture or statement that encapsulates the nature of the service business and captures the value, form and function, experience, and outcomes of the service."* By design concept we refer to an entity that describes a design object (e.g. product or service) on a fundamental level distinguishing it from possible alternatives. It may contain visualizations or other physical elements to form a shared foundation for understanding (Keinonen, 2006). Minimally a design concept expresses the name for a design concept, its purpose, and the principles (or design drivers) that guide its subsequent realisation (Ylirisku, 2013).

Design concepts have been reported to have multiple roles in service and product development. The role of service concept is described to guide the development of a service system and a service process (Edvardsson & Olsson, 1996). Service concept serves as a foundation upon which the components of the service delivery system are built (Goldstein, Johnston, Duffy, & Rao, 2002). Design concepts can function also as a tool for anticipating what is needed from the organisation in the future, as well-defined product concept allows a clearer understanding of development time, costs, required technical expertise and the right development team (Kim & Wilemon, 2002). Design concepts are also utilised to support discussion of how a product fits an organisation's business strategy and to compare the development intent with other products and ongoing projects (Khurana & Rosenthal, 1997). Murphy & Kumar (1997) argue that product concept serves especially the gaining of organizational support for the development. They studied front-end development activities in fifteen high-technology companies and conclude that demonstrating a fit with management's strategic vision was the most important activity in gaining credibility for a proposed R&D idea.

Khurana & Rosenthal (1998) studied the front-end development process in Fortune 500 companies and found that once management has decided that a new product opportunity is worth exploring, product concepts are created to serve as a basis for planning and scheduling a product development project. In these companies the product concept was utilised to support analysis of the market and the financial prospects for a new product. Keinonen (2006) argues that concept design can interlink technical development and translation of market research into design opportunities and that they are used for internal decision-making (e.g. on using new platforms, investing on technical development, and on entering new markets). Concepts that are not utilised in product development can form an idea bank for future projects and even establish a vocabulary that helps the organisation to prepare for different kinds of future situations (Ibid.).

Keinonen (2006) argues that concept design can help an organisation to develop new competences. It can support the organization to learn about new technologies and business opportunities and to explore new modes of cooperation outside the department, company or industry. Part of this learning is the work to translate and shape concepts into the particular language that is used within the company. Seidel (2007) discovered that components of initial product concepts in radical innovation cases - stories, new vocabulary, and prototypes - provided a starting point to begin the process of product development, and that concept components are changed during the development. New concept components initiate and reinforce a new course of development and a concept description enables the commitment to development (Ibid.).

New service development has been studied for over 30 years (Papastathopoulou & Hultink, 2012), and service design concepts have been utilised and studied for almost two decades by now, see e.g. (Clark et al., 2000; Goldstein et al., 2002). However, to the best of our knowledge, there are no studies on how design concepts are utilised in service development projects in the context of industrial manufacturing organisation. The current study is conducted in the context of B-to-B, and

we investigate how design concepts were used within, and between, three completed industrial service development projects. We identify eight roles for design concepts transcending the development effort within the studied B-to-B practice. The key new results are the identified uses of design concepts within a single organisation in-between the projects to interlink them and to achieve cooperation and organise interaction.

2. Research method and data

We conducted an in-depth study covering multiple development projects in a single B-to-B organisation, which we here call BMC. It is a Finnish B-to-B manufacturing company of approximately 350 employees as of 2015 and offers machinery, software and services for product manufacturing industry worldwide. The study employed research through design approach (Frayling, 1993; Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011), where the researchers actively participated in the studied activities as design practitioners. The first author participated in concept design practices and in project meetings as a senior industrial designer from an external Research Organisation (RO). RO's project team consisted of an industrial designer (the first author), a consumer researcher, and a service designer.

The collaboration between BMC and RO was initiated in partially state-funded research project settings[1]. Collaboration consisted of seven design projects in 2015, three of which were selected for an in-depth study. The here-investigated data were collected between January 2015 and November 2015. The three projects are here called the *Simulation project, the Application project, and the Software selection project* (see Table 1).

The data cover in total 14 meetings between BMC and RO. The data include audio recordings and notes from the meetings, the senior industrial designer's (first author's) diary, design concepts, and related emails. The length of the audio recordings is 33 hours and 20 minutes. We transcribed in total 6 hours 20 minutes, resulting in 103 pages of transcript. The data were approached with a thematic analysis (Coffey & Atkinson, 1996). Analysis began by transcribing data from audio recordings and coding in-vivo (Saldaña, 2015) using a coding software. The coding used actual phrases that participants of the project had said. The categories utilised in the coding were iteratively developed, and the main themes are expressed here in the form of stories presented below. Once we had the themes emerging, we began to work with literature, and the final manifestation of them as presented in this paper is also informed by the relevant literature.

Table 1. Three design projects selected for a case study

Project name	Simulation project	Application project	Software Selection project
Topic of the project	Simulation and reporting tool.	An application to promote solutions and support collaboration	Uncertainties in custom software.
Focus of concept design	The tool to be designed, the data to be presented to the different user groups, visualisation of data to the groups	Content and appearance of an application that supports collaboration between customers and their customers	Service opportunity, making different types of software projects manageable and understandable for sales personnel and customers

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[1] The aim of the research project was to study how design thinking renews the innovation culture in SMEs and was funded by TEKES and companies.

Time-frame	Jan – Oct 2015	Sep – Oct 2015	Oct – Nov 2015
Studied meetings (in 2015)	18/1, 16/2, 18/3, 8/4, 21/4, 27/4 (workshop), 15/9 and 30/10 (workshop).	21/9, 7/10, 16/10 and 30/10 (workshop).	7/10, 16/10, 22/10, 27/10 and 5/11.

RO participated actively in concept design practices in the studied projects. Concept design was carried out within research project settings. RO had an agenda and a role to promote service design and to propose service opportunities for BMC. The agenda had an impact on concept design in the Simulation project where RO challenged BMC's vision for simulation tool. RO proposed additional concepts of how simulation tool could be seen as a service and could provide value for customers. Additional concepts were used by BMC in later phases to integrate projects as described in the Story of linking projects. This role would not have been likely without proposing additional concepts in the Simulation project.

RO's research agenda did not affect significantly on concept design in the Application project and Software Selection project. BMC defined the goal for concept design and expressed what the expected role of design concepts is (e.g. to guide implementation). RO mainly accepted the goals and the expected role, as they were perceived coherent with the research agenda. The first author had a major role in generation of design concepts, but their use was open for BMC to pick up.

3. Eight stories of Roles for Design Concepts

3.1 The Story of Anticipation

In the last meeting of the software selection project on the 5th of November 2015, the R&D manager, Ryan, described the innovation projects, and the business in overall, as a preparation for war and warfare. He explained that when facing difficult, conceptual problems, which need to be turned into a project, it is important to anticipate what kinds of resources and assets are needed and at which stage. There is no need to create a detailed view of the solution, but rather to outline an impression of how the problem would be dealt with and where the project would go. He stated that a vision helps to assess whether an approval from the top management is required, or whether it fits into the frame of the ongoing projects. If it does not fit, the vision is presented to the top management in order to gain resources and approval. Ryan described the role of concepts in anticipation of an uncertain future:

> Ryan: If I need a proxy, or we need more resources on this, then I can prepare an underhand plan so that I can get the resources. Actually this is because we should get an impression of where this is leading. And in principle, we don't need to know the details. But we need to know where I should go for shopping. Should I buy tanks or air forces? Everything is like preparation for war. We need to know where this is leading, so that we can confirm ourselves what kind of assets are needed and in which phase.

The R&D manager considered that it is essential to create such visions of the future that enable one to better prepare for what can be anticipated. This is directly related to the story of acquiring resources, as it may be a precondition to gain access to particular resources that particular anticipatory scenarios can be prepared.

3.2 The Story of Training

The company's sales resources were seen as insufficient after one software project had caused significant losses. BMC's sales network is geared to sell machines effectively, but problems typically arise when custom software and related services are being sold. A new concept of a coloured passport scheme featured an idea to train the sales network according to a newly designed process:

> Ryan: In principle, all the things we do here are a good way to teach internal people, like "Now you are on the green passport path, this is how you are supposed to act." We will make visual training video so that it becomes clear for everyone how one should act there.

The design concept seemed to support training of sales people who have insufficient knowledge about custom software. The design concept captured the essential features of the new process and the roles in a way that were easy to understand, communicate, implement, and act on. It expressed the new process and roles in a way that is adaptable to the capabilities of the organization and the customers. In short, the design concepts supported the organization in learning to act according to a particular way.

3.3 The Story of Implementation

Design concepts were expected to guide the detailed development work in all three projects. In the first meeting of the Application project on the 21st of September 2015, the R&D manager outlined the following role for concept design:

> Ryan: And your [RO] role could be to think about the content and appearance of the application. The plan is that we will build up a proof-of-concept prototype on this platform. And if everything goes well, then Software Company could continue with implementation.

The R&D manager perceived concept design and implementation as separate subsequent phases. Implementation was projected to follow concept design in all three projects even though implementation was not guaranteed during the concept design, e.g. an approval from top management was needed in the Software selection project. For BMC, design concepts were generated principally to define the service or application for implementation. Design concepts became later used as guiding material in implementation.

3.4 The Story of 'Ball Play'

Design concepts were also used to engage in informal dialogue with staff to clarify vague challenges and to generate preliminary proposals (e.g. about service opportunity). In the meetings on the 5th and 16th of October 2015, the R&D manager, Ryan, brought out uncertainties related to custom software and pondered how to approach the problem. In the next meeting on the 22nd of October 2015, four proposals were presented by RO. The idea of approaching 'Software Selection as a Journey' became selected and elaborated. Then, Ryan reflected on what actually happened when he brought out this ambiguous task. He calls it "throwing balls".

> Ryan: I think, what happens in this kind of solving a ball, I think what is sure is confusion, "what the hell is...", or kind of finding out the clarity. And that is basically like conceptual design.
>
> Many times I do this when I am in a hurry, I throw balls, or challenges. [..] I don't know if I am lazy. I do this because I don't have time to solve all the issues by

> myself. I just throw the ball and I take the risk. Let's say, if nothing comes back [..] I throw a ball, I loose the ball, because nothing comes out.

Ryan had adopted the term throwing a ball to express how he brings out ambiguous or vague challenges in order to get feedback. The feedback would help Ryan to clarify the focus of design work and approach to the challenge, yet knowing that there is a risk that nothing comes out. Here, the design concept can be seen as means to quickly and informally clarify vague challenges and opportunities.

3.5 The Story of Elaborating the Goal

BMC started to use names of the design concepts in talk after concept presentations. RO presented a set of three design concepts in the second meeting of the Simulation project on the 16th of February 2015. Design concepts were versions of a simulation tool in relation to expected customer value, and the concepts were presented as a roadmap. The first concept was named the 'Selling tool,' the second concept was called the 'Collaboration tool' and the third concept proposed a 'New Service'. In this meeting, the R&D manager refers to the 'Collaboration tool' concept and suggests thinking about how the tool could be used together with customer:

> Ryan: Is this a tool just to show or is it something to play with? How far should it go? I think we did not think it in the beginning because I think we were just simply thinking about the report, but now I think that you [RO] raised the question of what it should be.

Here, Ryan referred to the 'Collaboration tool' concept and suggests to think about the collaboration aspect in the simulation tool. The design concept was used to focus discussion on topics proposed in the design concepts.

In the same meeting, the concept presentation surfaced various goals into discussion, and design concepts were related to these goals. The R&D manager Ryan and the sales director Dirk pondered how concepts relate to high-level goals:

> Ryan: [..] I think we were thinking about the selling tool, but I think that the Technical University Partner was promoting the collaboration tool.

> Dirk: [..] industrial internet is part of this project and the number three is basically that.

> Ryan: Basically number three is what was written on the high goal of the project plan.

The examples illustrate how design concepts were adopted to discussion in the development meetings. The design concepts surfaced relations between design concepts and high-level goals and were used to focus discussion on certain topics.

3.6 The Story of an Emerging 'Notion'

A design concept functioned in clarifying an ambiguous situation and in providing shared vocabulary and helped in outlining a common goal. In the Software Selection Project on the 5th of November, Ryan described how the core idea of the concept became clear for decision-makers after he presented the two-coloured passport scheme, and how they have started to use names of the concept:

> Ryan: Now, one week has passed and I have discussed about this issue with a couple of people, asking about it afterwards. **Many people have started to talk about these coloured passports. It really became a notion and now this basic idea**

> **is clear for everyone**, this idea what is up there that we will start to modulate software components and functions.

The design concept of coloured passports supported negotiations about what should be developed and designed. Design concept clarified ambiguous situation and provided shared vocabulary and a common goal.

3.7 The Story of Acquiring Resources

Design concepts functioned as negotiation tools when the manager was acquiring resources for his projects. In the Software selection project on the 5th of November 2015 R&D manager Ryan described how he utilised a visualised design concept to convince decision-makers to get forward with his proposal. The decision-makers included members from the steering group of the company, quality management, and a manager from a key software supplier. The concept is a coloured passport scheme for categorising software projects with clients:

> Ryan: I was not nervous, but I was pondering how people would react to this kind of comic-thing. [..] And there is this allocation-thing, it got full approval, really, and people understood it and everyone understood this green passport path. And then **I got a proxy or an opportunity to advance this thing**.

With the mandate from the top management, the manager was able to hire one person for a couple of months to implement the training material, involve quality management, and to start working on training the sales network. The presented design concept apparently supported the manager to get the approval from the top management to initiate a new project.

3.8 The Story of Linking Projects

A design concept that was generated for the Simulation project worked as a base upon which an idea of the Application project became drafted. RO presented a set of three design concepts in the second meeting of the simulation project on the 16th of February 2015. The third concept was considered being out of the project scope and was not implemented in the Simulation project.

After 18 weeks of their presentation, Ryan raised the set of three concepts on discussion again, and he associated a new application under development with the third concept:

> Ryan: Last Saturday I had this obligation to clean my house, and I was like vacuuming and then I figured out how we can advance to number three [third concept]. [..]
>
> And when thinking about the steps of this project, I thought that your role could be to sketch a content and appearance of this kind of application. When that is clear, then Maurice, who has been working on this analytics, will join this and take part on operational phase. Then there would be this Software Company and one student who works for us on part-time basis.

Here, the R&D manager was actually starting to outline a new project with a new goal and with the different composition of the design team in comparison to the previous Simulation project. In addition, Ryan integrated people and their knowledge from other projects into the new project based on the concept. The design concept worked here as a tool to integrate ongoing projects conceptually and outline direction for the new project.

4. Conclusions

In this paper we studied how design concepts were used within and between projects in a Finnish B-to-B company. We identified eight roles design concepts played in the B-to-B service development practice and presented them as stories from the field. The identified roles for design concepts were not limited to a certain phase in development but they turned out valuable within and between the projects. The roles were about 1) anticipating future, 2) implementing design, 3) training, 4) dialogue, 5) goal setting, 6) emergence of a 'notion', 7) resources, and 8) linking of projects.

All of the identified roles of design concepts are documented already across a variety of contexts, however, not in the context of creating novel services in the B-to-B manufacturing network. We utilised a bottom-up thematic analysis and the findings arose from the data without us having an a priori scheme to map the data to. Our study supports design concepts' role in *anticipating* and preparation for a particular future, a role that was expressed by the R&D manager "We need to know where this is leading". This is widely documented and directly related to production planning, scheduling and guidance for *implementation*, see e.g. (Kim & Wilemon, 2002; Khurana & Rosenthal, 1998; Ulrich & Eppinger, 2003). The studied design concepts were also used in *gaining organisational support* especially from the higher management, a role of design concepts promoted by Murphy & Kumar (1997). This allowed the R&D to secure resources to proceed working further with the design concepts. The design concepts were used in pre-project phase to anticipate resources that are needed for a new project and were presented to top management to acquire organizational support, approval and resources.

The design concepts in the studied projects were also such that captured the essential features of the new service process and the roles in a way that was easy to understand, communicate, implement, and act on. This not only supported the adoption of the concepts into common language within the organisation, but also the training of the various related people, such as sales. A service concept was shown to guide the development of a service system, which is a matter not only the training of the staff who deal with a new service, but also of their management. These roles for design concepts were identified already by Edvardsson & Olsson (1996).

The design concepts were used to quickly and informally clarify vague challenges and opportunities. This supports existing knowledge of product concepts used for planning the project and anticipating required resources after the management has decided that a new product opportunity is worth exploring (Kim & Wilemon, 2002; Khurana & Rosenthal, 1998). A design concept that was generated for one project worked as a tool to interlink ongoing projects conceptually and guide how a new project was outlined. Design concept supported cooperation between projects and in organizing interaction between projects. This role became visible in the final phases of our study, as it was clear how the concepts, which had emerged in previous phases, were utilised in coordinating projects and resources. This resembles the role of the product development roadmaps in the context of innovation work in organisations. Design concepts became used in the development meetings to set topics and questions, and to elaborate the goal and to relate it to higher-level goals. The management did not explicitly state this role, but it surfaced in the analysis.

Our dataset is limited to a set of meetings within one organisation working in a network of businesses. Further studies are needed to elaborate how design concepts are used between projects in service development.

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