

Designing Smart Textile Services through value networks, team mental models and shared ownership

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Abstract

The goal of Smart Textile Services is to integrate existing knowledge from the separate domains of textile (soft materials), technology and services. As no single actor can meaningfully understand and realize the creation of Product Service Systems multiple actors need to team up with relevant partners. The contribution of this paper is to describe the initiation of a bottom-up approach aiming to co-design Smart Textile Services in collaboration with partners from the Dutch textile and technology industry, service providers, creative hubs and academic institutes. The concepts of *value networks*, *team mental models* and *shared ownership* are used to design and analyse two co-design workshops that took place within the consortium: a co-reflection and a co-creation workshop. We will use the same concepts to reflect on how a bottom-up approach can be used for designing Smart Textile Services, and how a designer can contribute to this process. Further, we will indicate how we are planning to pursue this bottom-up approach in future research.

KEYWORDS: Product Service Systems, Co-creation, Innovation, Designerly Approach, Smart Textiles.

Introduction

The role of products and the design process has changed tremendously in recent years. The transitions from the industrial economy to the experience economy and currently the knowledge economy to the transformation economy (Brand & Rocch, 2011) require businesses to keep adapting and revalidating their value propositions (Morelli, 2009). In management studies this is also visible in the transition from goods-dominant logic (G-D Logic) to service-dominant logic (S-D Logic) (Vargo, Maglio, & Akaka, 2008), which changed how a total value proposition relates to services. Because of these transitions, companies have to adopt new networked innovation methods, which requires people, who not only come from different disciplines, but also come from different organizations and companies to design together (Bergema, Valkenburg, Kleinsmann, & de Bont, 2010). This is the case of the STS CRISP project. Within the framework of the Dutch Creative Industry Scientific Program (CRISP, 2011), we have started to create the structure that will support the development of innovative Product Service Systems in the context of Smart Textile Services (STS). The combination of soft materials and high technology is the area of smart textiles. The European textiles and textiles-related industry is dealing with increasing price competition coming from lower cost regions, Smart Textile Services can give the industry an added value, which enables it to keep its competitive position in the world. The goal of STS CRISP is to integrate existing knowledge from the separate domains of textile (soft materials), technology and services.

For the development of Smart Textile Services we initiated a bottom-up approach. In this article we will describe a co-design process, in which a co-reflection workshop and a co-creation workshop are activities focussing on the collective creativity of users and stakeholders (Mattelmäki & Sleeswijk Visser, 2011). The co-reflection workshop helped us to define a collaboration space and the co-creation workshop helped us to come to a first set of design descriptions. We will reflect on the role of these workshops using the concepts of *value networks*, *team mental models* and *shared ownership*. Finally, we will discuss how this bottom-up approach will be continued in the next phases of the project and the role of the designer in this process in more detail.

Value networks, team mental models and shared ownership in Product Service Systems

As point of departure we use the definition of Product Service Systems (PSS): "tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs" (Tukker, 2004). In a PSS, companies often extend their product chains into *value networks* existing from several companies created for the development of specific products and services (Pawar, Beltagui, & Riedel, 2009). Challenges for these networks can be the need of unification of before discrete product and service elements, and also the need of firms with competing motivations to vertically integrate or outsource activities (Williams, 2007). This vertical integration is further illustrated by the different layers in Figure 1. We further define PSS by focussing on the challenge in the field of design in which the 'one-person – one product' approach is slowly being transformed in favour of the 'multiple-nodes' approach of complex systems (Frens & Overbeeke, 2009). As illustrated in the middle layer of Figure 1, the challenge is not only in the design of these multiple-nodes (or "touch points"), but the ability of the nodes to adapt to the interconnections with other products, with other services and the different users: the total experience.

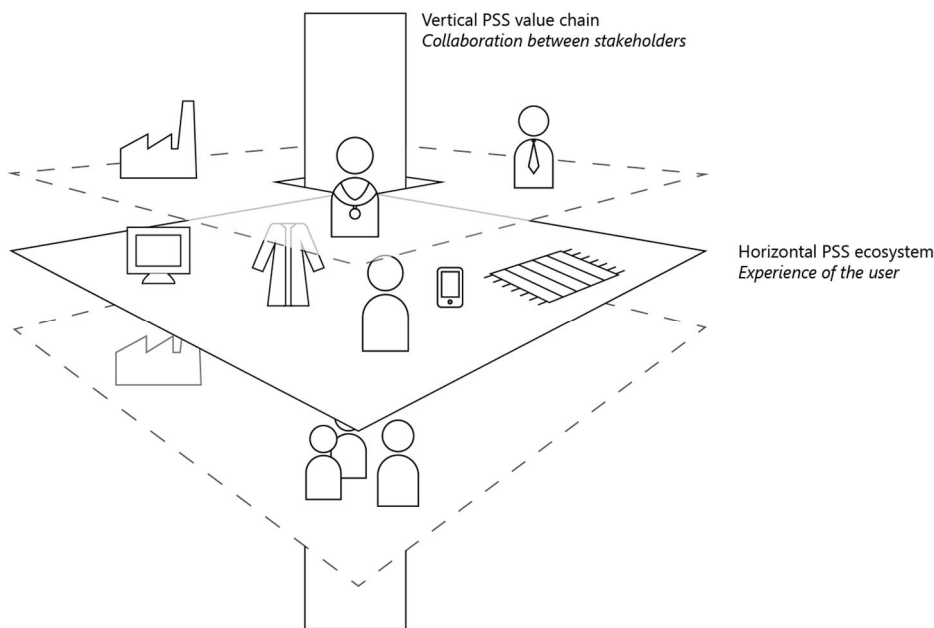


Figure 1 An example of vertical and horizontal connections in a PSS

In literature of Product Service Systems most classifications make a distinction between three main categories (Tukker, 2004): a) product-oriented services (products are sold, but extra services are added), b) use-oriented services (product is not the centre of the business model, product in ownership of provider, product can be shared by multiple users) and c) result-oriented services (client and provider agree on a result, no pre-determined product involved). Product Service Systems already exists in the textile industry for a longer period. For example, the damask weaving company "W.J. van Hoogewou & Zonen" was offering product-oriented services since the mid-19th century (Pel, 1997). Besides production, customization and selling of table clothing and napkins the company also had a laundry service. For an additional fee the clients could bring the product back to the company where everything was professionally cleaned, ironed and packaged. An example of result-oriented services are companies specialized in hygiene services, for example Initial Hokatex (Initial Hokatex, 2011) and Lips Healthcare (LIPS, 2011). These companies offer a more hygienic environment for their clients as a service. To achieve this goal textile products are included in the service, for example by providing pick-up/drop-off, cleaning and maintenance for the textiles.

Smart Textile Services are PSS that incorporate smart textiles. There are more and more examples of wearable accessories that integrate technology. For example WakeMate (Perfect Third Inc., 2011) is a wristband which monitors wrist motion and translates this into sleep data, the wristband is made from textile and connects through Bluetooth to an application on a mobile phone. The application calculates the ideal wake-up time closest to the alarm setting of the phone of the user. This data is uploaded to an online platform that compiles an overview of the sleep statistics. It is our goal to push these Smart Textile Services further than a combination of textile and technology. The goal is to integrate the design and production processes of textile, technology and services. To create such a value network it is needed that partners from different areas and with different expertise are able to collaborate. Collaboration between these partners will require a sense of common ground: "a common representation that could serve as a touchstone for coordinating the members' different perspectives

on the problem" (Schwartz, 1995). A concept which further describes common ground, in the specific area of design teams is the *team mental model*, which describes how knowledge is constructed and shared by a team to enable goal-directed actions (Mohammed, Ferzandi, & Hamilton, 2010).

For people to participate in and co-develop the value network it is necessary to create the conditions that will engage people to participate in the collaboration. Ownership is perceiving something as belonging to yourself. It is a feeling of possessing something, such as the research results or interpretations over these results (F. Sleeswijk Visser, 2009). When this feeling of ownership is shared by stakeholders in the value network it can become a factor of engagement, because it enables stakeholders to become co-authors (Mongiati & Snook, 2007). In participatory design practices it is known that *shared ownership* can be elicited for example from the site selection, the language and the participatory prototyping elements of the co-design sessions (Muller, 2002).

In the next chapter we will describe two co-design workshops that were conducted to initiate the bottom-up approach for designing Smart Textile Services. We will use the *value network*, *team mental model* and *shared ownership* concepts to describe the design and results of these two co-design workshops.

Co-design activities with multiple stakeholders

Partners in the consortium come from five different fields: academic (TU/e Department of Industrial Design, Design Academy Eindhoven, TUD Department of Industrial Design Engineering and Saxion Universities for Applied Sciences), public (Audax Textile Museum, De Waag Society, V2_), textile production (MODINT, Contact Groep Textiel), interactive product design and engineering (Unit040 Ontwerp bv., Metatronics) and a service provider (De Wever). In our bottom-up approach we are looking for methods to engage the partners early in the design process of Smart Textile Services. For this purpose we organized two workshops in which most consortium partners participated. The co-reflection workshop had a focus on the exchange of expertise and expectations and took place in Eindhoven University of Technology. The co-creation workshop focussed on the exchange of project directions and skills through making. This workshop was organized in collaboration with Saxion University of Applied Sciences in Enschede and the Fab lab of Enschede.

Co-reflection workshop

For the first meeting with all the consortium partners we had several goals in mind, an aim for the *value network* (to encourage relationship building between the consortium partners from different disciplines), a *team mental model* aim (to create a narrative for the project to continue in), an aim for the *shared ownership* (to explore how people relate to the work created in collaborative sessions) and a pedagogical aim (to let participants experience the work of a designer). Co-reflection is an especially interesting technique for the involvement of stakeholders during the design process as it fosters co-operation through sharing, inter-subjective understanding and relationship building through collaborative critical thinking (Tomico & Garcia, 2011). To start the co-reflection process we prepared initial material to reflect on that we collected by visiting each partner. Together with every participant we created a short video to introduce themselves, their company or institute and their work. In addition, the participants were asked to bring an object to the workshop that would demonstrate their expertise or could be related to the project in another way (some of the objects are shown in Figure 2).



Figure 2 The table with objects brought by participants, post-it notes and name-cards

The workshop itself was divided in four parts. First, the introduction video was shown about every participant, this would ensure the introduction time would fit in the planned schedule. Secondly, the participants introduced shortly the objects which they brought to the workshop and added orange post-it notes to explain their expertise and green notes for their expectation and goals related to the project. Then the object and notes were placed on the table. The placement of the object was a collaborative effort that would determine the relation to the other things already on the table and would lead to an emerging structure of the project. When all the objects were placed on the table the workshop continued to structure the results by inviting participants individually or in small groups to create descriptions and define the areas that were formed.

Results

This structuring activity resulted in six areas that we defined later as the *collaboration space* of the project and is shown in Figure 3. The collaboration space consisted of six areas: *outcomes and valorisation* (the design or the development process from which we gain knowledge on how we come to this outcome), *friends* (workshops to share knowledge in depth, field days to explore opportunities for smart textiles, reflection to look at the development of the project and the relations created), *societal impact* (bridging technology to applications, make and deploy new experiences), *technology exploration* (use design to explore, share and use the knowledge from the different partners), *creative vs. constraints* (how constraints from the user, market, production make the project develop and change) and *entrepreneurship* (developing Smart Textile Services with a strong market positioning and value for society).

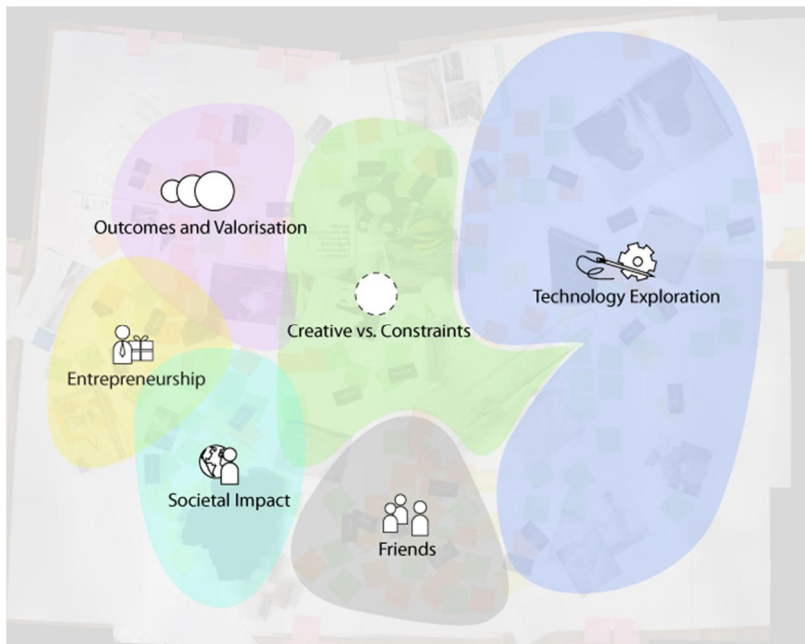


Figure 3 The collaboration space that emerged during the co-reflection workshop

Participants added cards with their name to the areas to indicate in which areas they were interested to continue working in (Figure 2 shows the name cards next to the objects). And finally, two participants for each area continued discussing the definition and finished by pitching their understanding of the essence of the area to all participants.

The areas in the collaboration space can be considered as the start of the design narrative. It is knowledge that all the participants share, the *team mental model*, and because everybody added their name cards to certain areas it also lead to a feeling of commitment and *ownership* of the areas shared by the people participating in the workshop. Regarding the *value network* aim we observed that the technology exploration area and the friends area were very popular because people recognized their expertise and goals. This will introduce a challenge for the development of the Product Service System. Many technology partners have as a goal to explore the societal impact, while their expertise is in the technology exploration area. It will require a balance from participants to switch between what they are used to do and what they want to learn. Summarizing, the workshop helped us to find out what everybody has in common, which converged the scope of the project. Further, we learned how our skills can be used fully and how we can complement each other. Importantly, the workshop helped to define common language for future collaboration.

Co-creation workshop

The co-reflection workshop previously described contributed mainly to the narrative of the design process, the *team mental model*. The *value network* and notion of *shared ownership* were developed less elaborately because the step from the collaboration space to the definition of design directions had not been taken previously. In the second workshop the goal was not only to define these design directions (continue defining the *value network*), but also to exchange skills, understanding the value of each partner for the project, and experience the difficulties of working with textiles and technology (expanding the *team mental model*). Making was the main approach to achieve these goals during the workshop, also to increase the notion of *shared ownership* (Sanders, 2000).

The consortium partners were asked to do a sensitizing pre-task before the workshop to describe ideas they had regarding smart textiles. These could be supported by drawings, images, materials, etc. The workshop started with 17 participants presenting 33 ideas to each other. After the presentation the ideas were grouped in corresponding topics on a wall (showed in Figure 4). We used the same method as in the co-reflection workshop to define ownership of the groups, by participants placing their name on the ideas they were interested in to develop further. By choosing the ideas and topics most people were interested in, eventually five project teams emerged in which participants from different disciplines teamed up to continue working on a project idea. By experimenting with the materials and tools available (Figure 5 shows one of the participants integrating technology and textile) the teams created prototypes ranging from visual mock-ups to working models (of course with very limited functionality). After each team presented their prototype a rough plan of action was made which would help the teams to translate their idea into a further developed product and service.



Figure 4 The wall with idea descriptions grouped in four types: product proposals, application area (elderly care), approach (old crafts and new technology) and technology

Results

Reflecting on the project directions created with the participants we can discover different types of projects. Some of the projects were very concrete problem solving *product proposals* (for example a bed sheet that can monitor patients health), other projects proposed an *application area* (connected textile objects in the domain of elderly care), a third type was a *design approach* (mixing old crafts with new technology) and then there were projects which started from *technology* (a modular textile prototyping kit). Although the project ideas were basic, what is important is that they showed that there are different ways to create common ground between participants. Participants could connect to each other from different levels but still meet in the mutual understanding of the project definition and build a *team mental model*.

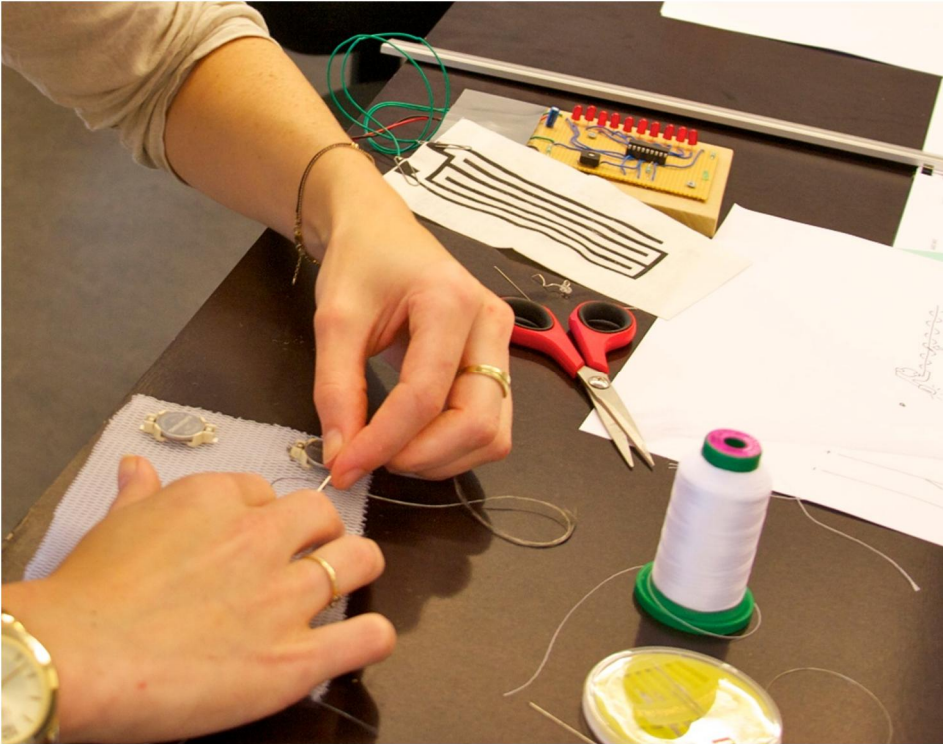


Figure 5 Example of making prototypes during the workshop. One of the participants using basic textile and technology tools to create a prototype

Since the workshop was hosted in the Fab lab (a small-scale workshop offering digital fabrication) the tools for prototyping and making were at hand. The context contributed to the second part of the workshop in lowering the threshold to start making. However, the process of making did not develop without frictions and frustration. The challenge to translate abstract ideas into concrete tangible prototypes, as well as the ability of people to use the available materials were barriers. These frictions created new input for the creative process; participants needed to work together to create a shared end-result (shared ownership) and the concreteness of creating a tangible outcome enforced the participants to consider the details of their project. Feedback from the participants showed that this approach indeed provided new insights in collaboration (better insight in the *value network*) and the approach of other people (better understanding of the *team mental model*). The service provider partner commented that the workshop showed new ways of looking at things and a new approach to solve problems. One of the technological partners commented that this is a much more creative way of finding new opportunities for smart textiles than they are used to.

Discussion

By doing the workshops we are starting to see the contours of a new *value network* in the context of Smart Textile Services, designed bottom-up in a collaborative effort with all the partners. The narrative that develops because of these activities is an important element of the co-design process. The workshops are following-up on each other and provide a *team mental model* between the consortium partners who participate.

In both workshops we encouraged the participants to place their names on directions or themes they were interested in. This was an important step for the co-design process since it enforced the partners to take sides, position themselves, give credit, and get responsibility; it helped to create feeling of *ownership* shared by all the partners. Most participants participated in the first workshop as well as the second workshop. But since the process is dynamic, it is possible for new partners to join at any given moment. This happened during the second workshop and resulted in an interesting observation: the partners who were new in the second workshop communicated the introduction about their expertise and expectations within the description of their initial ideas. This resulted in proposals in line with the larger topics within the company of the partner (for example the public partners who proposed “co-creation” and “technical craft”, already existing research lines in their organisation) and already further developed product ideas for which specific partners were needed (one of the partners was developing a monitoring bed sheet and needed partners). This insight teaches us that we will need to think about how to involve new partners in the process and how to include them in this value network. The *team mental model* is a dynamic body of knowledge, which changes based on any interactions within the value network.

Another challenge is in the involvement of production partners in the process. The knowledge of these people is necessary to come-up with relevant and feasible Product Service Systems. Because these companies are often highly specialized it is harder to show the value of such a broad development process and the need for them to be involved early in the process, for this a sense of *shared ownership* needs to be triggered in possibly different ways than in the workshops as they were organised. A limitation of the workshops is the focus on products instead of services in this stage. In some project directions it is easier to discover the service component than in others. By thinking about who to include in the *value network* and involving partners from different disciplines we can make sure that the ideas we develop involve both vertical and horizontal connections (when thinking back of the representation in Figure 1). One of the characteristics of the bottom-up approach to develop PSS is the possibility to add new partners, new services and even new application areas to the system at a later point in time. By starting from a basic configuration and by showing the experience of individual touch points it is possible to convince people to join the momentum.

Future research

The changing role of the designer leads to new questions and discussion points. We learned from the co-reflection workshop that it is not easy to create a value-network that can be sustained after a collaborative activity. Which roles are necessary to support such a *value network* in its growth? Can a designer take these roles? We experienced in both workshops that every activity within the value network contributed to the *team mental model*. This poses questions such as, how to deal with new partners in the value network, how to transfer knowledge from activities undertaken with a smaller group of partners to the larger value network? During the workshops we noticed that *ownership* between the partners is useful to distribute responsibilities and to find out what people are really interested in. But can this shared ownership also be carried further after the workshops? How can the ownership be mitigated when the direction is becoming less relevant? What happens with the value network when designers develop directions further after the workshops?

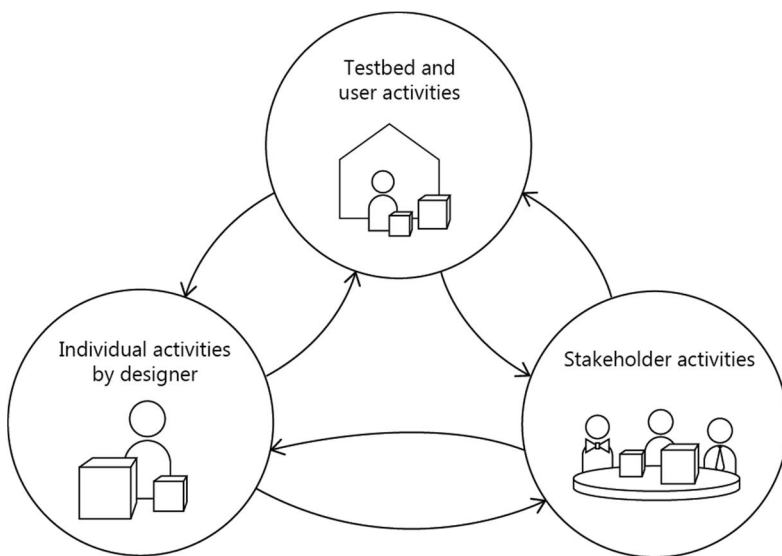


Figure 6 Vision for a bottom-up process for designing Smart Textile Services

Designers can add value in the design process of PSS in various ways (Han, 2010), for example by having a leading role (entrepreneur, strategist, analyst), facilitating role (workshop facilitator, storyteller, contextual expert) or producing role (industrial designer, user researcher, engineer). Designers switching between and functioning as “glue” between disciplines introduce a whole new issue of complexity to the design profession. There have been efforts in the field of design research to address this, for example with the reflective transformative iterative process (Hummels & Frens, 2008), which enables designers to handle complexity by switching between design activities and reflection on action.

In the workshops we placed the designer on the same level as the other participants. This was a conscious decision as we were trying to yield input from the consortium partners. As Figure 6 shows, we do see this as one step in the development process. At some point the designer needs to integrate the information, envision the PSS and concretize the value proposition. We will continue this work by switching between this primacy of the designer, co-design but also to test the PSS experience in the context of the intended user and application area, as currently being implemented in test bed settings (van Gent et al., 2011). In our future research we will further investigate these possibilities and raised questions through continuing with this bottom-up approach for designing Smart Textile Services.

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