

SPACE MODELLING AND SCENARIO PLAY - MASTERING COMPLEXITY IN THE DESIGN OF PRODUCT NETWORKS

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Abstract

When we start to design product networks used by communities of users, the design task becomes increasingly complex and spatial. Traditional sketching supported by discussions becomes quickly insufficient and too limiting when the aim is to get a rich and persistent understanding of the use context and the relations that are part of it. In this paper we present four cases from education and industry, where space modelling and scenario play were used. Space modelling and scenario play, both in full-scale and small-scale, are strong means for addressing complexity in the design of product networks. Space modelling and scenario play helps design teams to see and understand the different relations and activities in a spatial way. It helps bringing forth new concepts for shaping future work practice. Small-scale modelling helps to keep a context perspective on the design task; full-scale modelling helps to develop empathy and presence for the use context. Both full-scale and small-scale modelling combined with scenario play is experienced as fun and they naturally stimulate a shared ownership and involvement in the design team.

1 Introduction

Much design research today focuses on the design of single products. Recently, however, the network capability of computing technology has made it highly interesting to research into the concurrent design of multiple products operated by communities of users rather than singular ones. Research communities within fields like computer science and engineering design are currently addressing the huge technical challenges associated with seamless system integration and architectures suitable for distributed and mobile product networks [1]. There is still not much research done on how this focus on networks affects both the designer's way of working and the design of user interfaces. Instead of thinking individual product first, we believe it is time to apply a balanced approach to product design, which empathizes both networks and individual products that are part of the network.

One of the major problems in industrial organizations is that the designers are too remote from the context they are creating solutions for. User contacts are handled by sales representatives and marketing. A focus on product networks adds significantly to the complexity of the design task and dramatically increases the necessity for designers themselves to engage with user communities, rather than relying on digested information. But time constraints within the industrial organization prohibit the individual product designer to stay long-term in the use context. Therefore, alternative ways of bridging the gap must be found.

The use of scenarios throughout the design process to envision work and technology has been widely accepted within systems development, both for expressing broad visions of a project, and for capturing specific work practices and goals, contributing directly to concrete requirements and design possibilities [2]. Burns et al. extended the use of scenarios from envisioning use to experiencing use [3]. They introduced a technique called informance design, in which design teams build a full-scale model of the use context in order to act out and improvise future scenarios. Binder moved scenario play out into the real use context, to engage users in inventing new conceptual designs through the use of props and artefacts [4]. Lerdahl has shown how scenario play can be used to express and communicate abstract, shared visions and moods for potential new products [5]. All these approaches have in common that the scenario has been framed by a specific use situation, with a single product and user in mind. We will argue that designing product networks based on pervasive computing technology requires a frame for simultaneously activities, rather than a frame based on an isolated sequence of actions. We also believe that the use of scenario play serves as an important element in the designers' preparations for later encounters with the use context. One of our sources of inspiration, is the training ground that anthropologists within the field of rapid rural appraisal use as preparation before they engage themselves in the context, they try to understand in order to change [6].

A major challenge when designing product networks is to establish a context perspective of the use context, in order to maintain a focus on relations between people. As part of the Contextual Design approach, Beyer and Holtzblatt recommend five models to organize and describe data collected at the customer's workplace [7]. A flow model, sequence model, artefact model, cultural model, and physical model. Interpretation Sessions are recommended where the team of investigators use post-it notes to structure and generalise findings. These diagrams provide a rational, abstracted understanding, but they hardly give the team a shared experience anchored in use context. We see two other problems with such diagrams, namely that users have not verified the models, and that the diagram format does not lend itself easily to experimentation. Pedersen and Buur recommend the use of game playing and movie making as a framework for engaging users as co-designers, and report how the use of rough foam pieces as game pieces and props allows quick experimentation [8]. Matthews et al. report on the power of using 'brick games' as boundary objects to ascertain and develop understandings of the concepts in a non-confrontational way [9]. In line with this we want to investigate how small-scale space modelling can support design teams in establishing a context perspective suitable for further exploration of networks and relational aspects in the design task at hand.

We present two cases of full-scale modelling and two cases of small-scale modelling both from industry and education. At the Mads Clausen Institute we have a strong tradition for user centred design processes [10]. The examples presented are all events nested in larger user centred design processes.

2 Full-scale space modelling

By full-scale space modelling we mean 1:1 cardboard models based on observations from field studies or on-site modelling sessions. The full-scale model, serve as a stage for team enactment. Foam blocks serves as props. The following two cases show the use of full-scale modelling of a local tailor shop and a pump station.

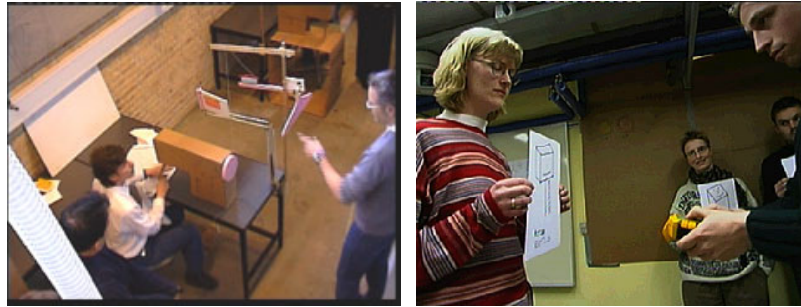


Figure 1. To the left a tailor shop modelled by students to act out scenarios. To the right a design team acting out components in a mock-up of an intelligent pump station

2.1 The tailor shop

In the IT Product Design programme at the University of Southern Denmark, 10 students joined a project seminar on Pervasive Computing. The aim of the project was to propose a product network that would support crafts people in doing their work. The field of craft was selected, because it is one of the places where computing technology only to a limited degree has been introduced. PDA's, personal computers and electronic sewing machines have helped to automate and ease up supporting tasks but have not directly influenced the craftsmanship. This example focuses on the design for a local tailor shop mainly producing gowns for priests and uniforms for soldiers in the Danish National Guard.

The students built a full-scale cardboard model of the tailor shop they had visited on video field studies. In the beginning the modelling activity served as a means to create common understanding of the design context within the team. The students modelled, discussed, and acted out to make decisions on what to model and what to leave out. Gradually they started to act out scenarios of how things are done today. As the design process proceeded, they started to use rough foam blocks as props. The model gradually changed into a future tailor shop. The students proposed an intelligent hanger that followed the order from fabric to final gown. It was baptised through a sketchpad linked to the order system. Workstations altered their configuration according to the hanger. In the final presentation the full-scale model was used as a scene to act out future scenarios to illustrate their pervasive computing proposal.

Standing on the sideline it was remarkable to see how the shop came to life. The activity was open for outsiders to mirror their layer of interest. The most used way of acting out a scenario is to focus on specific use situations, but due to the number of actors on the scene, it was in this case also possible to see how multiple use situations related to each other. In the course evaluation the students reported that scenario play and a cardboard model of the tailor shop helped the team to get a better understanding of the central relations and factors in the workshop. Furthermore it was of great help for the development of ideas.

2.2 The intelligent pump station

In a recent project at Danfoss the aim was, from a user's perspective, to develop product visions for the water treatment area. In countries with mixed rainwater/sewerage nets, pump stations are the first to detect a heavy rainfall. Heavy rainfalls pose a serious problem to the treatment process, because of overflow in the basins and poor de-segmentation of sludge. To protect the treatment process, the flush needs to be routed to the overflow. In the water vision project we used this scenario as a starting point for exploring how components could handle this situation if they could negotiate intelligently.

Based on observations from field studies, the team of 8 decided to build a full-scale mock-up of a pump station in a dedicated basement room. Cardboard was used to model the physical characteristics of the pump station and real components were added to get a sense for the existing instrumentation. One of the team members took the part of the operator; the rest acted industrial components: Frequency converters, flow metres, sensors, and a valve, see figure 1. It was decided to act out different scenarios to get a feeling of the dynamics and potentials of different problem solving strategies e.g. negotiation or master-slave control. After a short time people got used to their roles. Through acting they both added to the atmosphere and challenged the web of components by introducing small changes to see the reaction of the other components and in which direction the scenario would proceed. After some time for rehearsing, each scenario was video recorded for documentation.

It was interesting to observe how people got confident in their new role and how they then expanded it. As in the tailor shop example all team members participated. When trying to obtain empathy for users in networks you need several people, so the qualities of the modelled network appear e.g. traffic and communication in parallel. In addition, it made the experience shared by the whole team, an important precondition for using the experience as a common reference and argument in future design discussions.

When design teams build and act out scenarios in a full-scale model of use context, they not only obtain empathy in the people in use context. They also experience the abilities of products in networks, which by nature are invisible and spatial. In addition, the designers are given an opportunity to prepare themselves for later meetings with users. In a secure setting with room for reflection.

3 Small-scale modelling

The next two cases show the use of small-scale modelling used on-site in a Norwegian kindergarten and a Danish supermarket. By small-scale space modelling we mean the activity of building a scale model of the ground floor while sitting where the action is. Foam pieces are used to model objects and people. The outcome is a physical model that represents a context perspective. The idea is to create models that can be modified easily to serve as a game board later in the design process.



Figure 2. To the left, students use a model to discuss kindergarten life with children and employees, and to the right, designers use a model to elicit work stories from supermarket employees.

3.1 Norwegian kindergartens

In an innovation course at the Institute for Product Design, NTNU, in Trondheim, 20 students were asked to develop product concepts for 3 different kindergartens. To increase the understanding of everyday life in kindergartens, each group visited a kindergarten. After they observed and interviewed children, parents, and employees they found a place to sit down and modelled the physical layout of the place using cardboard, glue, pens, wood sticks etc. In this way they established a common understanding within the group. Back in the design studio the model was used to recall and share stories and observations from the visit with the other groups. Before returning to the kindergarten, each group created a new model of the kindergarten, based on the initial one. This version functioned as a game. The physical layout served as a game board and different types of bricks were included to represent people or physical objects. Two of the groups made bricks that were simple representations of humans and objects in the kindergarten. The third group made bricks that represented more abstract qualities, like sensing, smell, pleasure, intimacy etc. In the kindergarten the revised model served as a basis for dialogue, scenario play and interaction with the children, parents, and employees.

In their evaluation the student groups mentioned that the model was useful to get a better understanding of the use context. The model was enriched and it evolved during the design process. Through the making of the models and games the students understood more of the context. When returning to class the model helped to recall experienced situations and to keep memory alive. Different areas in the model could be related to different stories and observations. The making of the model helped the students to develop an increased involvement, focus and empathy with the user's context. It also helped to get an overview of the kindergartens. Furthermore the models or games helped so that the users could tell stories and start to reflect over their own practice. The models also helped the users to get a distance and overview and reflect over their daily practice. It was not so scary to talk about themselves and their practice, since they had a medium to talk through.

The bricks in the model were tangible and could be moved around. This was central for catching stories and presenting scenarios. The group with the bricks of abstract qualities experienced that these bricks functioned very well for starting a dialogue. Two users were supposed to place a brick in the model and this created good discussions. The students wrote: "Abstractions created possibilities for associations and development of their fantasy... By moving a bit away from reality you can avoid that one gets caught by details, and can more easily find the essence of the problem". The models were dynamic and developed over time

from being mostly representations of own understanding to becoming games for involving users and their own imagination and experiences.

3.2 The Supermarket

As part of user studies in the refrigeration control division of Danfoss, it was decided to visit a supermarket to observe work around refrigeration furniture and cold stores. The team consisted of a marketing engineer, a text writer, a project leader, and a usability engineer.

After a warm-up meeting the team arrived at the supermarket. The appointment was made with a technician, responsible for maintaining the technical installations and a shop employee. Both were asked to give a guided tour showing the 'flow of frozen goods' - from delivery truck to shopping basket. Every time a new story was told, it was given a name and noted for later use e.g. "The problem with hard frozen milk" and "The shop personals' sense of temperature". After following the guided tours, the team asked for a space to work by themselves near one of the busy points in the storage area. The technician helped by providing a camping table and four camping chairs. The team started to build a mock-up of the supermarket using prefabricated parts and objects brought along in a suitcase. When the structure of the supermarket was modelled, each team in turn re-told the stories they had noted and placed each of them on the specific spot where they were told. In this way every story was shared. Some of the stories had been told by both of the users, revealing different viewpoints. Later when the users returned, the team asked them to verify the model and make corrections. The users were asked to repeat the 'frozen milk' story. One of the designers acted as puppet master, moving the puppet pieces around while the users went through the situation step by step. If they skipped something, often because it seemed unimportant to them, the model made the team aware of it and questions for further explanations were posed. After the enriched story was told one of the team members put aside the puppet piece of the technician - and the shop employee explained how he would have reacted on the different situation. The outcome on this event was validated stories centred on refrigeration and refrigeration control. It gave a shared team experience manifested by the small-scale model. It was a model suitable for serving as a game board in later design discussions, like in the Kindergarten case.

The second time the story was told, it was richer in details. Partly, because the model made the story visible and triggered questions from the designers. Partly because of the presence of two people who was part of it. It was clear, that the model was owned by the design team, and not by the users. The users did not look at the model during the discussion, because they knew the context by heart. However when experimenting with the stories they used it to point at. It worked fine as a boundary object.

4 Full-scale and small-scale space modelling

Both the small-scale model and the full-scale model have their strength as representation of the intended context. With a full-scale model or mock-up one can act out in the environment directly, using one's own body and senses. The scenarios that unfold are rich in details. Characteristics of the environment, interactions between people, and personal gestures becomes apparent. It is therefore easier to establish empathy and involvement with people in the context. In addition simple props can make a scenario real and engaging [12]. On the other hand with a full-scale model one loses the larger overview and context perspective.

Scenarios will largely be played within a room or limited space. Furthermore, making a full-scale model may take more time, especially if one desires to model specific details.

In a small-scale model, small bricks represent users, and it is up to the ‘players’ to project personality into them. This gives a distance that can be both strength and a weakness. With a distance the player is less exposed and less frightened to start acting out scenarios. It is easy for the player to switch between different roles, using the bricks. But at the same it is harder to make an engaging scenario, to establish empathy in people, and experience the contextual environment. In a scenario like this, the talking is separated from the character, and therefore it is easier to be descriptive, rather than acting out stories and situations. A two level dialogue arises. One level centred on the enacted situation, another level centred around the discussion between the players. Small scale models more easily gives an contextual perspective, but details are lost. The small-scale model is easy to take move around, due to its size. The small-scale model focuses on location of stories and events, central for getting hold of underlying values. In table 1 some of the qualities of full-scale and small-scale model are listed.

Full-scale model	Small-scale model
Empathy	Context perspective
Presence	Projection
Taking one role	Easy shift of roles
Many players	Few players
Permanence	Flexibility
Experience focus	Location focus
One level dialogue	Two level dialogue

Table 1. Qualities of full-scale and small-scale model

4.1 Space modelling for framing the design task

Deciding on what to model and on what to leave out is quite central for the final outcome. The mock-up or the model is reflects the elements and factors in the context, which are viewed as central. What you model reveals your understanding and priority in the design task. In the kindergarten case in Trondheim the students modelled the kindergarten house and the outdoor area of the kindergarten. They did not model a representation of the car the parents are using to drive to the kindergarten, their office or where the family lives. In the tailor shop case the students did not model the operator, who was keeping track of the ordering, located in another city. We are not stating that one should necessarily model all relations and elements, but we are claiming that what you are modelling will influence the design direction and design proposals.

4.2 Modelling values and stories

A central factor for making strong concepts is a good link between abstract qualities and concrete representation [5]. Besides modelling physical space and objects the modelling of abstract values and qualities physically is very beneficial, especially when using small-scale models. Such bricks can be used to trigger and get hold of stories and values, like in the kindergarten example. They can also be used to represent stories and values that are linked to certain areas in the model. In such a way they are more easily recalled, like we observed in the supermarket case. One materialises essential qualities and stories that otherwise are hard

to catch, since they by nature are immaterial, even though they are linked to concrete objects and areas. It is our belief that abstract qualities need to be linked to concrete objects or areas to become operational.

4.3 Space modelling to support exploration

In play the model functions as a physical “mental laboratory”. It is a way to make the “what if” physical. By manipulating, dropping, changing and exaggerating different relations in the model one can provoke the thought process in new directions. Since it is externalised others can observe the move. The change in the model can be directly communicated to others. When drawing one of the team members more easily owns the process, while with a model the representation is directly shared. A central question is then how detailed a model and its elements should be. If the elements are abstractly represented they can more easily change quality and thus more easily obtain different meanings. It is easier for players to put their own imagination into the elements and bricks. This is central for experimentation and exploration. A central factor is furthermore the flexibility, how easily one can change and move the elements in the model, like the walls, the objects etc. If model is too rigidly constructed it is hard to improvise and easily make changes. At the same time if all the elements are completely free and not attached, there may be too many loose ends. The elements in a model should therefore stick to the board, but at the same time be easily moveable. Therefore it can be useful to have prefabricated materials and elements before creating the model, like in the supermarket example.

The model will have direct influence on the scenario play. By making changes in the spatial relations one will also change the scenarios. So one can use a change in the space model to trigger and provoke new thoughts and ideas in relation to the scenario with the use of networks. Equally, when one is consciously changing the roles, activities and scenarios this will have an influence on the surroundings and on the model. In a session for developing ideas and better understanding different relations, both physical and social, one can therefore use the change in the modelling to influence the user scenario and visa versa.

5 Shared and grounded experiences

If the outcome of activities like space modelling and scenario play shall support an argument within the team on future design decisions it is important that the event itself does not lose credibility. It needs to reach a state where it is sufficiently detailed and grounded to indicate new paths for further design work. We have identified the following elements that influences how sound a space-modelling event will be for later use:

- ❑ *Grounded in use context*; the model needs to be grounded in context. If the team builds associations on associations it is too fragile.
- ❑ *Ownership to the activity*; lack of ownership will result in half hearted participation.
- ❑ *Shared experiences*; the majority of the team needs to participate to establish a common understanding within the team.
- ❑ *Reflection*; in order to serve as a springboard for further design, conclusions need to be drawn.
- ❑ *Accessibility*; It is highly important that there is a physical link to the shared experience. No obstacles to recall and work with the shared experience.

We believe that space modelling in combination with scenario play are promising means for mastering the increased complexity when designing product networks. However, further research is strongly needed to explore how to apply a balanced approach to product design, which empathizes both networks and individual products that are part of the network.

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