

A Case Study of How User Interface Sketches, Scenarios and Computer Prototypes Structure Stakeholder Meetings

Maria Johansson
Findwise AB
Theres Svenssons gata 15
SE-41755 Göteborg, Sweden
+46-736127811
maria.johansson@findwise.se

Mattias Arvola
Södertörn University College
Campus Haninge
SE-13640 Haninge, Sweden
+46-733621993
mattias.arvola@sh.se

ABSTRACT

In stakeholder meetings during an interaction design project, prototypes are commonly used for creating shared representations of design ideas. It can, however, be difficult for designers and meeting facilitators to know which prototyping technique to use. In this case study we compare user interface sketches, scenarios, and computer prototypes, and analyse video material from six stakeholder meetings. The scenario did not facilitate a focus on aesthetic or ethical perspectives, nor did it facilitate operational or perceptual issues. The prototype did not facilitate discussions on the overarching concept of the design, to the same extent as the sketches did, but it did facilitate operational issues. The sketches gave the broadest discussion. The groups also approached the design differently; for example, the system developers constantly returned to a constructional perspective. This means that the choice of prototyping technique should be made based on the composition of the group and the desired focus of the meeting.

Categories and Subject Descriptors

H.5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces – *prototyping, theory and methods.*

General Terms

Design, Human Factors.

Keywords

Stakeholder meetings, interaction design, prototypes, design representations, sketches, scenarios.

1. INTRODUCTION

One of the greatest problems in design is the communication between designer and client [22]. Clients and designers bring different perspectives to a stakeholder meeting. The designer comes into a group of stakeholders as an outsider to their work and organization, with an idea of the design that is abstract in relation to the parts of work the designer yet does not

understand (e.g., history and culture of the organization). The clients instead have the perspective of an insider of the organization, at which the design becomes a specific, local and personal part of the history and culture of the organization. They also talk about visual representations and prototypes in different ways. Designers tend to talk about the design in formal terms, while clients can ascribe the prototypes historical, political and cultural values. Furthermore, designers talk about the design process differently when they talk to clients compared to when they talk to other designers. The two groups construct different opinions and perspectives on what seemingly is a joint project, and this indicates that there is a fundamental instability in the relation between the two communities of clients and designers [13].

In interaction design, prototypes are commonly used as shared representations of design ideas to bridge the gap between the communities. It may, however, be difficult for designers, facilitators, and clients to know which prototyping technique to use to express the design ideas.

1.1 Prototypes in Interaction Design

It is common to distinguish between two types of prototypes in interaction design: low fidelity and high fidelity prototypes [21]. The term 'fidelity' describes how well it resembles the final product. A low fidelity prototype differs from the final product in things like interaction, visual expression or level of detail [27]. Such a prototype can, for example, be made out of paper rather than screens on a computer. A prototype with high fidelity is instead built in a material that is similar to the final product. It usually has more realistic interaction and communicates the possibilities of the design to a higher degree [27]. The purpose of different prototypes may also differ; it can prototype role, implementation or look-and-feel [15]. The role is the function of the product in the users' life, and what use it is to them. The look-and-feel is about how the users experience the product and what meets the senses. The implementation is about the construction. A prototype can explore one or several of these dimensions. When choosing what kind of prototype to make, the designer should consider the audience [15]. Some prototypes also work better in some organizations, since different organizations develop different prototyping cultures [15, 23].

1.2 Representing the Design

Much of the work of designers is to develop representations of design ideas. There is a manifold of sketching techniques used in interaction design. In this paper, we focus on scenarios, user

interface sketches, storyboards and dynamic computer prototypes.

1.2.1 Scenarios

Scenarios are narratives, usually in written form, that describe how users use the conceived product to perform a certain task. They highlight the goals of people that will use the product, what people will do with the product, what works and what does not work, and how people interpret what happens when they use the product. Scenarios describe people acting in an environment according to specific goals. A good scenario is a scenario that brings key issues concerning usage and utility to light, or that proposes new design ideas [8]. Many scenarios are, however, too abstract and attempt to capture everyday use, and they often omit details concerning history, motivation and personality of users. This makes them less engaging than real stories, and it makes it more difficult to identify with the main characters. There is, therefore, a need to write more personal scenarios [11].

1.2.2 User Interfaces Sketches

User interface sketches are drawings that show how the user interface of the product is supposed to look. Interface sketches presuppose that you can be specific on detailed questions regarding form and interaction: things you do not have to deal with in a scenario. Sketches contribute extensively to facilitating communication between designers and clients [22]. If you put several sketches in a series after each other, you get a *storyboard*. It is a combination of sketches and scenarios in a comic-like representation.

1.2.3 Computer Prototypes

Dynamic computer prototypes look and act like the future product. Due to their high fidelity they are commonly used to make detailed prototypes. There is a risk that the prototype is experienced as final, at which it may become difficult to generate new design proposals. Earlier comparison between high fidelity prototypes and low fidelity prototypes made of paper and made on computer show only small differences in the kinds of usability issues raised. It is therefore possible to argue that one should choose a prototyping technique according to what is most practical for the situation [27].

1.3 Research Problem

Previous research on prototypes in interaction design has focused on the medium in which the prototype is made (physical, paper or computer) [27], the degree of detail in the prototype [15, 27], and how close it is to the final product (high fidelity or low fidelity) [21, 27]. In this paper, we focus on how different kinds of prototypes (user interface sketches, scenarios, and computer prototypes) structure the conversations in different stakeholder groups of an interaction design project.

2. THEORETICAL FRAMEWORK

To analyze how different design representations structure conversations in different stakeholder groups, we need to contextualize our study object in a theoretical framework. For this we use the concepts of structuring resources, communities of practice, and boundary objects.

2.1 Communities of Practices

All people participate in several loosely held-together groups with shared practices, so called communities of practice [28]. Every stakeholder group in a design project constitutes of at

least one community of practice. Participating in communities is important for our identity, and our everyday life is organized around our communities [24, 10]. People make sense of the world based on their own communities of practice, and bring different perspectives into, for example, a product development team [10]. Every community also has its own ways of perceiving things and its own ways of communicating them [6, 14].

2.2 Boundary Objects and Structuring Resources

Boundaries between communities (e.g., developers and users) can obstruct communication [6]. Objects that bridge the boundaries are called 'boundary objects' [26]. When communities meet, different concepts are used to talk about the same object, at which the object becomes decontextualized (abstracted from its naturally surrounding discourse). Boundary objects in the form of, for example, documents can, however, facilitate coordination of work between communities of practice [6]. Boundary objects are malleable enough to be adapted to specific needs and constraints that different groups may have, and at the same time they are robust enough to retain an identity in different areas of use and different groups of people [26].

The boundary object mediates the discussion and can be seen as a structuring resource for the participants. All activities take place in an environment that, together with various artefacts, structures the activity. These environments and artefacts become structuring resources. Accordingly, boundary objects are a certain kind of structuring resource. Structuring resources have bearing on what aspects of the situation we perceive. They also make some actions salient and influence what actions are perceived as possible to perform. We also define activities differently depending on the presence or absence of particular structuring resources. For example, we do not consider it to be the same activity to do math in a grocery store, and do math at school, even though we solve the same mathematical problem [17, 18].

Based on the concept of boundary objects and structuring resources in conversations between communities of practice, we will analyze conversations in stakeholder groups in an interaction design project. To do this, however, we also need a framework for what aspects of interaction design people talk about, in terms of perspectives and themes.

2.3 Perspectives on Interaction

Interaction with technology can be seen from several different perspectives disclosing different aspects of a product, system or service (e.g., practical, social, aesthetic, constructional, and ethical) [2, 3]. Take the design of a knife as an example. The practical perspective highlights aspects of how well it fits its instrumental purpose: cutting into a particular material. The social perspective highlights aspects of how the knife is used in relation to other people: what it says about the owner, or how the knife could shape interaction and communication between people. The aesthetic perspective highlights aspects of how the knife is experienced during usage and as an aestheticized object of attention: how it feels in the hand and its proportions, for example. The constructional perspective highlights aspects related to the construction of the knife: its strength, how it is assembled, or the choice of material. Finally, the ethical perspective highlights moral aspects of how the knife is used or can be used and misused to cause harm to people and environment, or affect human rights like freedom of speech.

2.4 Themes in Interaction Design

To analyze what themes people talk about in relation to an interactive system, we have also developed several models built on the idea of levels of detail and abstraction in an interactive system [2, 4, 5]. In this article we think about the design of the interactive system as having different themes. We distinguish between the conceptual theme, the functional theme, the structural theme, the operational theme, and the perceptual theme. These themes cannot be seen as independent in reality, but are rather analytical distinctions. In fact, what designers need to do is traverse the themes in order to judge the consequences of a decision; for example, the consequences of changing the speed of an animation (perceptual), for how content should be ordered (structural).

2.4.1 Concept

The conceptual theme is *what* the product *is*. It can be thought of as the design idea in terms of its purpose and intended use. This is what the product should do and be; it includes the definition of its audience and users. The overarching character of the system [1, 2], the genre [19], and the posture [9, 29] are all elements of the conceptual theme.

2.4.2 Function

The functional theme is *what* the product *does*. It is the functions and the information content needed to fulfil the purpose and intended use of the design concept. This is equivalent to the object-action model of the system [25].

2.4.3 Structure

The structural theme is *how* the product is *ordered*. It is the arrangement and organization of functions and content in time and space. The structure can be flat or deep. It can be hierarchical, networked, linear, or circular. Things like task structures, wireframes, flow charts, and site maps belong to this domain.

2.4.4 Operation

The operational theme is *how* people and products *interact*. What people do with the functions and contents and how people navigate the structure to make use of functions, access or manipulate content, and fulfil the intended use. This is the theme for operations that both the interactive system and the users perform.

2.4.5 Perception

The perceptual theme is *how* the product is *presented*. It is both the physical and visual form, as well as the behaviour of the product. It is the look and feel of the product. This is what meets the senses; this is what needs to be interpreted in the situation of use. This is the graphical and animated part of a graphical user interface. Issues of style and layout become important here.

To summarize the theoretical background: we see the prototypes as structuring resources in the communication within the groups. The different stakeholder groups belong to different communities of practice, and the prototypes function as boundary objects between the groups and the designers. Analyzing conversations in stakeholder groups, we also employ a framework for what themes of an interactive system people talk about and what perspectives they use.

3. METHOD

We conducted a qualitative case study of the design of a payment authorization function in an intranet at a private healthcare company. Videos were recorded during six meetings with three different communities of practice in the company (users in the client organization, users in the developer organization, and system developers in the developer organization). These groups had conversations around three different kinds of design representations: user interface sketches, scenarios, and dynamic computer prototypes. The video material was transcribed and analyzed in terms of themes and perspectives.

3.1 The Case Study

Our case study was the design of a payment authorization function in a company portal at an international healthcare company. In this case study, one of the researchers was also an acting interaction designer. Stakeholders from various subsidiaries within the healthcare company participated. The company wanted to investigate how payment authorization functionality from the enterprise management system could be linked to their company portal, and how the new functionality should be designed.

The design process started with contextual inquiries [7] where the designer got to know the domain to get a base for the design during the initial sketching. Sketches were then evaluated during focus group sessions with three different communities of practice: (1) hospital staff, (2) information and IT staff, and (3) system developers and system administrators. Based on data from the first round of focus groups, design objectives were set using use-quality analysis [2, 3]. A functional analysis was also performed based on data from the contextual inquiries and the first round of focus groups. The sketches were further developed and new design representations were created. At later stages, written scenarios and dynamic computer prototypes were evaluated in focus group sessions with the three stakeholder groups.

3.2 The Design Representations

The user interface sketches were drawn by hand and depicted screen images from the payment authorization (Figure 1). The sketches were ordered in a sequence in the form of storyboards, but no actions were represented in the sketches.

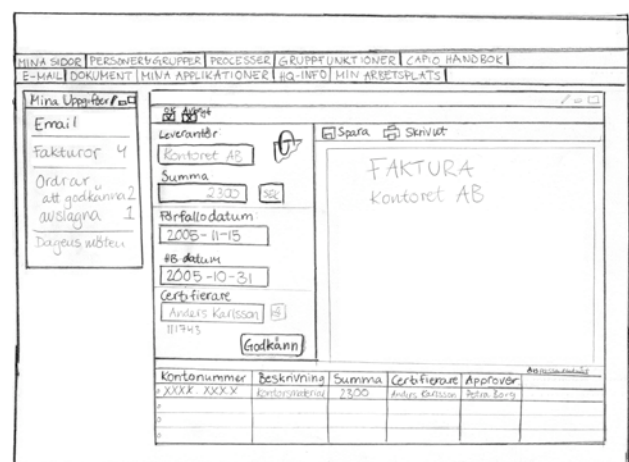


Figure 1. One of the user interface sketches.

Scenarios were used to describe how the users worked with the system. Both roles as well as the users' main tasks were described in the scenarios. Two scenarios were used to illustrate

the work, the functions and the problems encountered by two users. Below follows an example from one of the scenarios:

Scenario 1. Anna is 45 years old and a nurse. She works at the surgical ward, where she is manager during five years. One of her responsibilities as ward manager is performing the final authorization of all the invoices. She has just met the last patient for the day and has now time left for some paperwork before going home for the day. She sits down by her computer and logs in on the portal. She can see under My Task that she's got three new invoices. Anna opens the first invoice and looks at it. She looks at the pdf-image of the scanned invoice to get a picture of what it is. But she is not sure whether the invoice really is accurate. The best thing to do is to write a comment and ask if this invoice really is correct. Eva made the reception of the goods on the invoice so she should know. Anna chooses Eva's name in the address field and sends the invoice. She then takes a look at the next one. She can see from the image that it is a lab result. Peter has written in the comment that it is a collected invoice for all lab results from the last two months and that explains the unusually large total amount. But the invoice has been put down to the vaccination account. That must be a mistake. She changes the account and then she approves the invoice.

A dynamic computer prototype built in Runtime Revolution was used to give the users a chance to interact with the system (Figure 2). The prototype was a vertical prototype where only the main functions had been implemented.

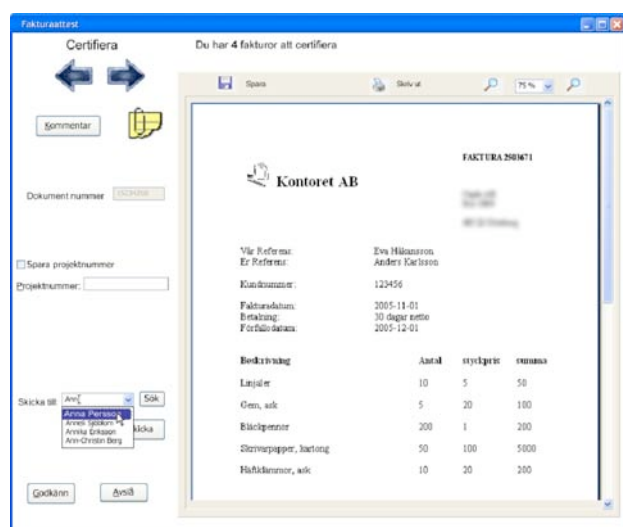


Figure 2. Screen dump from the computer prototype.

3.3 Focus Groups

Twelve different people participated and the focus group sessions varied in size between three and five persons. There were three stakeholder groups:

1. The participants from the hospital staff included a ward manager, administrative staff, and financial manager.
2. The participants from the information and IT staff at the main offices included an IT-manager, an information manager, as well as personnel from the two departments.
3. The third group was the system developers and the system administrators.

Two sessions with each of the three communities of practice was held. In the first session, which lasted one hour for every group, the user interface sketches were discussed. In the second session, which lasted two hours for every group, the scenarios

were firstly discussed before the computer prototype was discussed. Accordingly, six sessions were held. Video was recorded at which nine hours of video, in total, was recorded.

Every session was organized in the same way. The session started with a brief explanation of the design, the participants could then review the material themselves and ask questions. We used a funnel approach in the focus groups [20] where the group got the opportunity to talk freely about the design, before specific questions were covered. During the more specific phase we used a guide to secure data on the conceptual theme, the functional theme, the structural theme, the operational theme, and on the perceptual theme. We also wanted to cover several perspectives on interaction (practical, social, aesthetic, constructional and ethical). The designer in this project (the first author of the paper) had the goal of considering and moving between all themes of interaction design from all perspectives in the theoretical model. As a facilitator in the focus groups, however, she did not want to be dominating since that would interfere with the effect of the prototyping techniques. A passive role was therefore chosen, where the facilitator asked open questions and answered questions about the design.

3.4 Data Analysis

The video material from all sessions was analyzed using thematic analysis [12, 16]. The first step was to get familiar with the material. The second step was to find meaningful episodes in the text where participants expressed their view on the interactive system or its usage. The third step was to concentrate these episodes to short phrases that expressed a central theme from the perspective of the participant and this theme was noted in the margin. The fourth step was to transcribe and time stamp the chosen excerpts and surrounding context. The fifth step was to categorize every utterance according to the themes of the interactive system that the participants talked about, and according to the perspectives the participants used. Utterances that could not be categorized according to the model were put aside for further analysis and generation of new categories. As categories were accumulated the sixth step was to thematically organize categories in higher-level categories. Finally, the seventh step was to put together the material for presentation based on the different communities of practice, based on the themes of the interactive system, and based on perspectives used. The thematic analysis was inductive-deductive in nature, starting as bottom-up from the empirical material to identify meaningful episodes and generate new themes, while also using themes derived from the theory to code the material.

4. RESULTS

The results demonstrated that the choice of prototyping technique structure which themes of the interactive system are discussed. For example, when the hospital staff discussed the sketches, they dealt with the concept and talked about the idea of the portal as such, about what kinds of systems there should be in the portal. They talked about the importance of being able to work fast and easy. When they encountered the scenarios they talked more about how the functionality related to different organizational roles, and how the tasks were structured (functional theme at a general level). They did not talk much about the main design idea (the concept) when discussing the scenarios. Finally when they encountered the computer prototype at the next meeting they talked more about flow of interaction (operational theme) and functionality at a detailed level. Figure 3 illustrates the degree to which the themes were discussed in the conversations around the different prototypes.

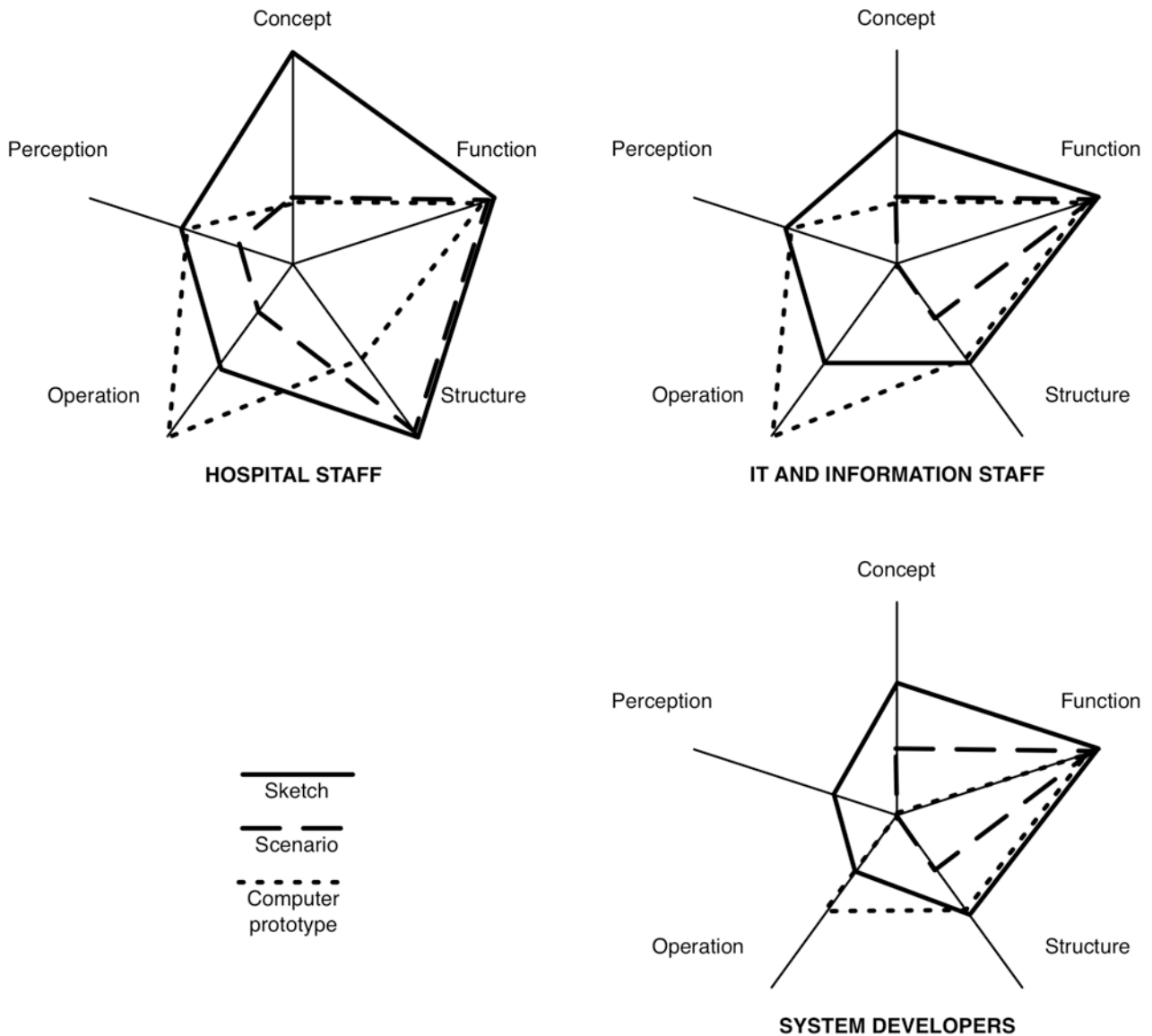


Figure 3. Star plots of themes covered by the different groups.

If the conversation was focused on a theme, the star plot in Figure 3 shows the outermost position on the scale for that theme. If the participants talked about a theme, but did not focus on it, the position is closer to the centre of the star plot. If the participants took up a theme only when prompted to do so, the mark on the scale is even closer to the centre. Finally, if the participants did not have anything to say about a theme, even when asked by the facilitator, the centremost position of the star plot was used.

Looking at the strengths and weaknesses of the different prototyping techniques used in our case we noticed that the design was covered on most themes when the user interface sketches were discussed. This implies that the sketches do not structure the discussion towards a specific focus, but contain the necessary elements for discussing all themes. The conceptual theme, concerning the main idea and purpose behind the product, was mainly discussed when the groups talked about the sketches, while the operational theme was dealt with more when the dynamic computer prototype was discussed. Around scenarios, functions were discussed, but at a rather general level

compared to the user interface sketches and the dynamic computer prototype. The following excerpt comes from the hospital staff discussing the scenarios:

“So that I very easily, now I have some time, for time is such a factor for everybody who works with this, that now I have dedicated some time for this and then it must be super easy to log in on the portal and get started.”

Compare the general level of the statement above to the rather more specific statement in the excerpt below, from the hospital staff discussing the dynamic computer prototype:

“Can’t you get the place of cost in the description? I miss that today, that it doesn’t say ‘Eyes, office supplies’ [...] that’s how we put it down to the wrong account.”

The different communities of practice discuss almost the same themes, even though the system developers focused primarily on functionality, and the hospital staff had the broadest discussion. There is, however, a clear difference in the perspectives with which they approached the themes (Figure 4).

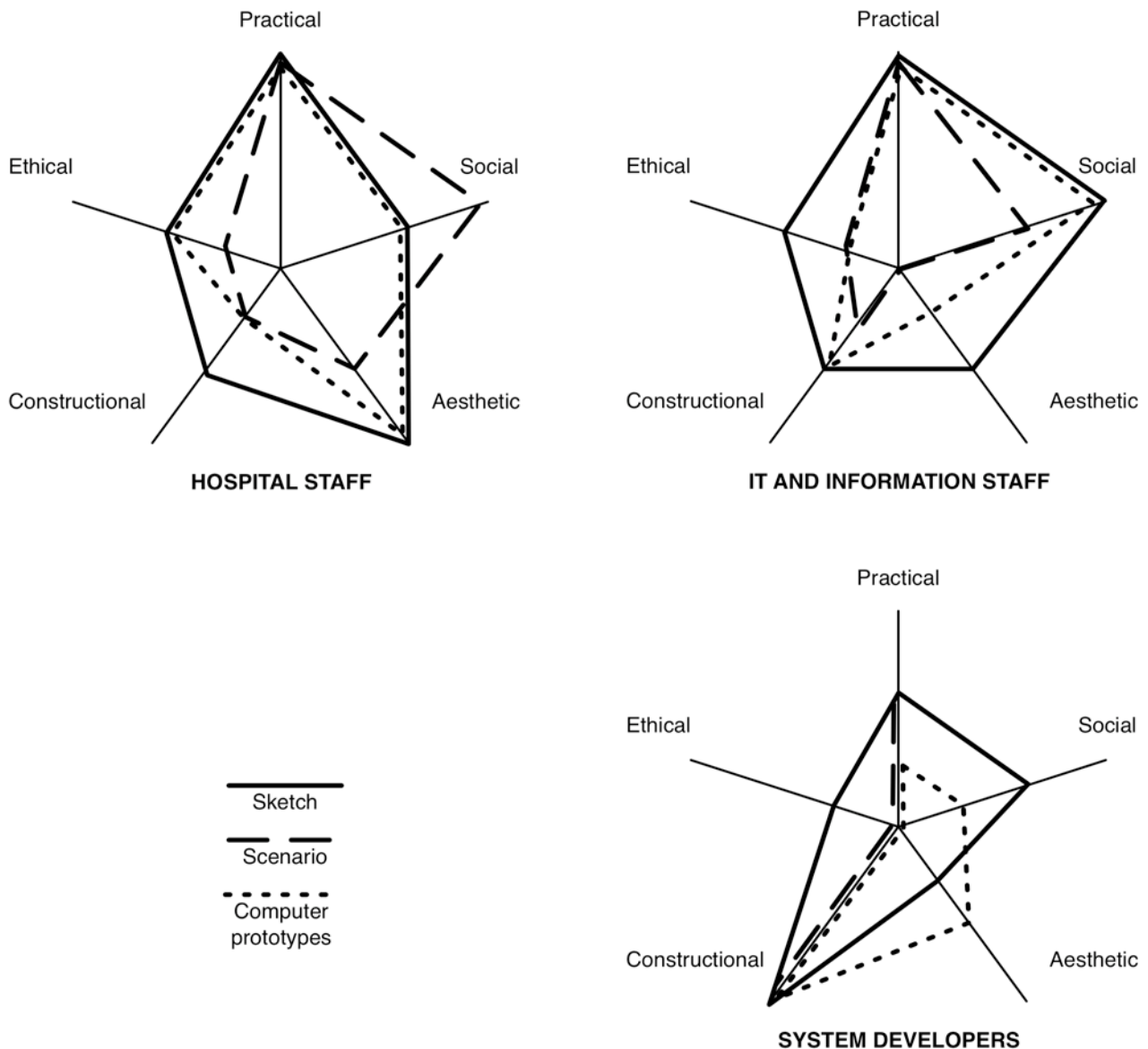


Figure 4. Star plot of the perspectives used by the different groups.

The most interesting part of Figure 4 is that the system developers' and system administrators' discussions were completely dominated by a constructional perspective, where half of all themes were expressed using a constructional perspective. The excerpt below is typical of that:

"You cannot send it back to [Patrik], because the certification field is locked when the certifier certifies"

"Can you have a flow so you know where the invoice is, so you can stop the certifier?"

"But you cannot be approved before the certifier is done. There is no approval by definition before the invoice is ascribed to an account."

The two other groups were more alike, and used a broader spectrum of perspectives. The hospital staff, however, talked more about the aesthetic experience of product interaction:

"When you read this, I feel, it looks as if it is very easy to juggle things back and forth. I mean, it's very much this comments to the other and you write comments back and so. And I hope it is that easy."

To summarize the results, the star plots can be translated into visual weights, as in Figure 5, where the scores on the scales of the star plots (0, 1, 2 or 3) has been added together and mapped to a greyscale and size of the circles. For example, system developers on the social perspective scale score 3 (2 for sketch, 1 for computer prototype and 0 for scenario) at which the circle is 30% black, and 3 mm in diameter). In this figure we can see that all communities, regardless of prototyping technique, put weight on functionality. The hospital staff primarily used practical, social and aesthetic perspectives on functionality and structure. The information and IT staff primarily used practical and social perspectives on functionality. The system developers primarily used a constructional perspective on functionality and did not use an ethical perspective, and they did not consider operational and perceptual themes. All prototyping techniques facilitated discussions from a practical perspective, but the scenario did not encourage the participants to take aesthetic and ethical perspectives, and it did not facilitate discussions on operational and perceptual issues. The computer prototype did not facilitate discussions on the overarching concept of the design, but it did facilitate discussions on operational issues.

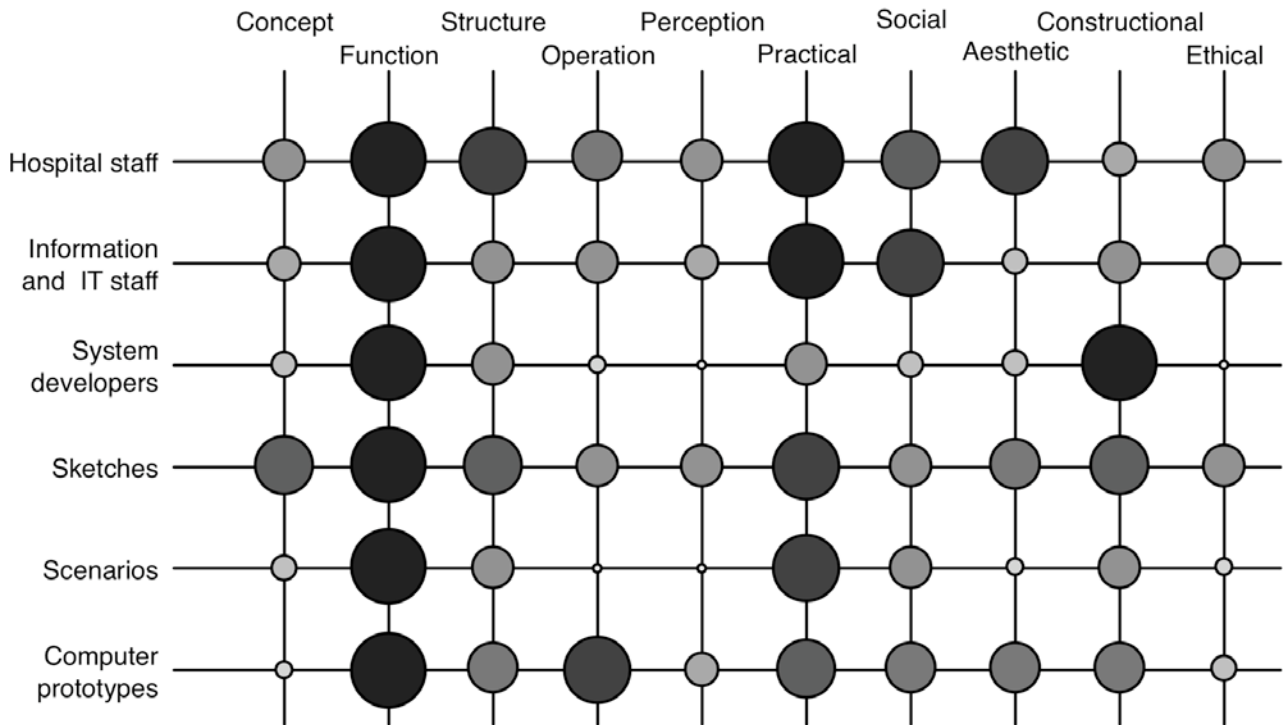


Figure 5. Visual weights where the scores on the star plots is mapped to greyscale and size of the circles.

5. DISCUSSION

Our results show that the boundary objects in the form of prototypes worked as structuring resources for the focus groups. The differences were rather in the perspective they applied to the themes; the system developers and system administrators constantly took a constructional perspective, rather than a practical, social, aesthetic or ethical perspective, regardless of prototyping technique. The other communities were applying a broader perspective on design issues. The source of this difference is the decontextualization of the design that the groups do, at which they communicate differently around it [6]. The perspectives and practices of the communities hence also affect the interpretation of the prototypes and accordingly also affect the conversation. People focus on their own work context and the objects of care that are important for their work. The system developers and system administrators in our study were firmly rooted in their perspective and tended to filter out other perspectives. This also corroborates earlier studies [6, 10, 24].

User interface sketches support for communication has also been emphasized in earlier research [22]. The sketches have the necessary elements to support a broad discussion and they are not experienced as final at which the stakeholder groups are encouraged to discuss also the functionality of the future system. The sketches combine graphical elements that give cues from the work context of the stakeholder group, and their sketchy appearance promotes discussion.

We observed that the scenarios were pure role prototypes. They promoted discussion concerning structure, and function at a general level including social and organizational aspects. To be more tangible, the scenarios can be complemented with graphs and sketches. The advantage of scenarios is that they do not require any technical knowledge [8], but that is also their disadvantage. People with a technical background may have difficulties relating to the narratives. Turning to the sketches, they prototyped role, but also look-and-feel, while the dynamic

computer prototype also prototyped implementation. Interaction is covered in detail during discussions of the computer prototype, and this is because it is a form of expression where the users get to experience the interaction. It can, however, be experienced as final, which takes focus away from basic functionality and the purpose of the design concept.

5.1 Future Research

Our results are so far based on a case study research, and should be regarded as working hypotheses. Additional case studies or experimental evidence could either corroborate them or falsify them. The next step is to investigate what structuring resources are working best to support communication in multidisciplinary groups. This type of research could further investigate the role of shared representations in the design process. Future research needs to address not only the communicative function of sketches and prototypes, but also the cognitive functions: how the sketch drives the thinking of the designer. There we may be able to identify issues of interest with regard to the designer's and client's perspective on the same project.

5.2 Conclusion

We observed that the prototypes structured the conversation in the groups. To facilitate discussions from a practical perspective all three prototyping techniques worked well. The scenario did not facilitate a focus on aesthetic and ethical perspectives, and it did not facilitate discussions on operational and perceptual issues. The computer prototype did not facilitate discussions on the overarching concept of the design to the same extent as the sketches did. The computer prototype did, however, facilitate discussions on operational issues and interaction. The user interface sketches gave the broadest discussion. The designer could, therefore, have made the choice of prototyping technique based on what results he or she wanted from the discussion.

The set-up of the groups affected the conversation more than the choice of prototyping technique. The results show that the largest difference between the groups was not what themes of interaction design they covered, but rather the perspective they used. Our informants talked about the same object, but they talked about it in different ways. The conversations of the different groups reflected their perspectives on the design, which has been noted in earlier research [10]. Accordingly, the designer also needs to consider the audience of the prototype.

We conclude that the choice of prototyping technique can be made based on what the designer wants the stakeholder meeting to focus on. It is also important to know one's audience and adapt the choice of prototyping technique accordingly.

6. ACKNOWLEDGMENTS

Our thanks go to our participants at the healthcare company, Stavros Asimakopoulos, Henrik Artman and Per Sökjer.

7. REFERENCES

- [1] Arvola, M. The interaction character of computers in co-located collaboration. In *People and Computers XVII – Designing for Society (Proceedings of HCI 2003)*. Springer, London, UK, 2003, 37-51.
- [2] Arvola, M. *Shades of Use: The Dynamics of Interaction Design for Sociable Use*. Ph.D. Thesis, Linköpings Universitet, Linköping, 2005.
- [3] Arvola, M. A use-qualities approach to judgements in interactive media design. In *The virtual 2006: Designing digital experience*. September 14-16, 2006, Rosenön, Dalarö. Haninge: Kommunikation, teknik och design, Södertörns högskola, in press.
- [4] Arvola, M. Interaction design patterns for computers in sociable use. *International Journal of Computer Applications in Technology*, 25, 2/3 (2006), 128-139.
- [5] Arvola, M., and Artman, H. Enactments in interaction design: How designers make sketches behave. *Artifact - Journal of Virtual Design*, 99999, 1 (2006), 70-83.
- [6] Bechky, B. Sharing meaning across occupational communities: The transformations of understanding on a production floor. *Organization Science*, 14, 3 (2003), 312-330.
- [7] Beyer, H., and Holtzblatt, K. *Contextual Design: Defining Customer-Centered Systems*. Morgan Kaufmann, San Francisco, CA, 1998.
- [8] Carroll, J. *Making Use: Scenario-Based Design of Human-Computer Interactions*. MIT Press, Cambridge, MA, 2000.
- [9] Cooper, A., Reimann, R., Reimann, R. M., and Dubberly, H. *About Face 2.0: The Essentials of Interaction Design*. John Wiley, New York, NY, 2003.
- [10] Dougherty, D. Interpretive barriers to successful product innovation in large firms. *Organizational Science* 3, 2 (1992), 179-202.
- [11] Ericksson, T. Notes on design practice: Stories and prototypes as catalysts for communication. In J. M. Carroll (ed.), *Scenario-based design envisioning work and technology in system development*. John Wiley, New York, 1995, 37-58.
- [12] Ely, M. *Doing Qualitative Research: Circles in Circles*. The Flamer Press, New York, 1991.
- [13] Fleming, D. Professional-client discourse in design: Variation in accounts of social roles and material artifacts by designers and their clients. *Text*, 16, 2 (1996), 133-160.
- [14] Goodwin, C., and Goodwin, M. H. Seeing as situated activity: Formulating planes. In Y. Engeström and D. Middleton (eds.), *Cognition and communication at work*. Cambridge University Press, Cambridge, UK, 1996, 61-95.
- [15] Houde, S., and Hill, C. What do prototypes prototype? In M. Helander, T. K. Landauer, and P. Prabhu (eds.), *Handbook of human-computer interaction (Second completely revised edition)*. Elsevier, Amsterdam, The Netherlands, 1997, 367-381.
- [16] Kvale, S. *Interviews: An Introduction to Qualitative Research Interviewing*. Sage, London, 1996.
- [17] Lave, J. *Cognition in Practice*. Cambridge University Press, Cambridge, UK, 1988.
- [18] Lave, J., and Wenger, E. *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, Cambridge, UK, 1991.
- [19] Lundberg, J. *Shaping Online News: Genre Perspectives on Interaction Design*. Ph.D. Thesis, Linköpings Universitet, Linköping, 2004.
- [20] Morgan, D. *Focus Groups as Qualitative Research*. Sage, Newbury Park, CA, 1988.
- [21] Preece, J., Rogers, Y., and Sharp, H. *Interaction Design: Beyond Human-Computer Interaction*. John Wiley, New York, 2002.
- [22] Röhmer, A., Pache, M., Weißhahn, G., Lindemann, U., and Hacker, W. Effort saving product representations in design: Results of a questionnaire survey. *Design Studies*, 22, 6 (2001), 473-491.
- [23] Schrage, M. Cultures of prototyping. In T. Winograd (ed.), *Bringing design to software*. ACM Press, New York, NY, 1996.
- [24] Schön, D. *The Reflective Practitioner: How Professionals Think in Action*. Arena Ashgate, Boston, MA, 1996.
- [25] Shneiderman, B., and Plaisant, C. *Designing the User Interface: Strategies for Effective Human-Computer Interaction (4th. edition)*. Addison Wesley, Reading, MA, 2004.
- [26] Star, S. L., and Griesemer, J. R. Institutional ecology, translations and boundary objects: Amateurs and professionals in Berkeley's museum of vertebrate zoology. *Social Studies of Science*, 19 (1989), 387-420.
- [27] Walker, M., Takayama, L., and Landay, J. A. High-fidelity or low-fidelity, paper or computer? Choosing attributes when testing web prototypes. In *Proceedings of the Human factors and ergonomics society 46th annual meeting (HFES 2002)*. Human Factors and Ergonomics Society, Santa Monica, CA, 2002 661-665.
- [28] Wenger, E. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press, Cambridge, UK, 1999.
- [29] Van Welie, M., and Van der Veer, G. C. Pattern languages in interaction design: Structure and organization. In *Proceedings of the IFIP conference on Human-computer interaction (INTERACT 2003)*. IOS Press, Amsterdam, 2003, 527-534.

