

# EXPLORING DESIGN FOR DYNAMIC USE

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## ABSTRACT

Products that are used by varying users, for varying purposes in varying contexts (dynamic and diverse use situations) are difficult to design because it is hard to predict the situations in which the product will be used and consequently what this requires from the design. In our research we develop guidelines and the Envisioning Use workshop to support designers in dealing with dynamic use. The basic idea of both support tools is that an overview of possible users, goals and contexts serves as an evolving frame of reference for use evaluations in the design process. In the course 'Design for Dynamic Use' of the master Industrial Design Engineering (IDE) of the University of Twente students applied the developed workshop and guidelines to the design of a carrier bike for a real client. This paper describes the application and evaluation of the workshop technique by students. From this can be concluded that the workshop results in a structured view on the broadness of use situations and use issues. Therefore it is a valuable tool in setting the basis for a frame of reference of product use. For research purposes, a company was involved in the project to provide a real case. While this led to useful research results, students benefited from the collaboration as well by being able to do an exercise in a realistic design context and learning how to deal with client demands. Moreover, the company benefited from the involvement in education by gaining new ideas and insights.

*Keywords: Usability, user experience, dynamic use situations, product design, design education*

## 1 INTRODUCTION

Smart phones are used by many different people for varying purposes in different environments. We define this variety of users, purposes and environments as dynamics and diversity of use situations. Designing for dynamic and diverse use situations is difficult because it is hard to predict which situations the product will encounter and consequently what this will require from the product design [1]. For example designers could have anticipated the use of smart phones in cold weather with gloves, but that some South Korean people would use sausages (see figure 1) under those circumstances to control the phone was probably unforeseen! Products that are used in dynamic and diverse use situations will also have a varying level of usability and user experience. Although in literature the importance of the dependence of usability and user experience on the variance of use situations is acknowledged (for example [2-3]) it is difficult to find guidance on how this issue can be taken into account in the design process of consumer products. Therefore our research is aimed at supporting designers in dealing with dynamic and diverse use situations [4]. The goal of this support is not to broaden the scope of use of a product, but to make designers more aware of the target use situations and take it into the design process. Since the success of this support depends on the extent by which it fulfills the needs of practitioners, we involved practicing designers in both an analysis of the design problem and the development of the support. In this paper we describe the evaluation of the support in the course 'Design for Dynamic Use' by master students Industrial Design Engineering. To increase the validity of this student evaluation we also involved a company in this project that had the role of a client.

We will firstly describe the development of the design support for dealing with dynamic use situations. Then we will present the results of its application to the master course. Finally we will conclude with the evaluation of the support and a short evaluation of our experiences with the collaboration with the company.

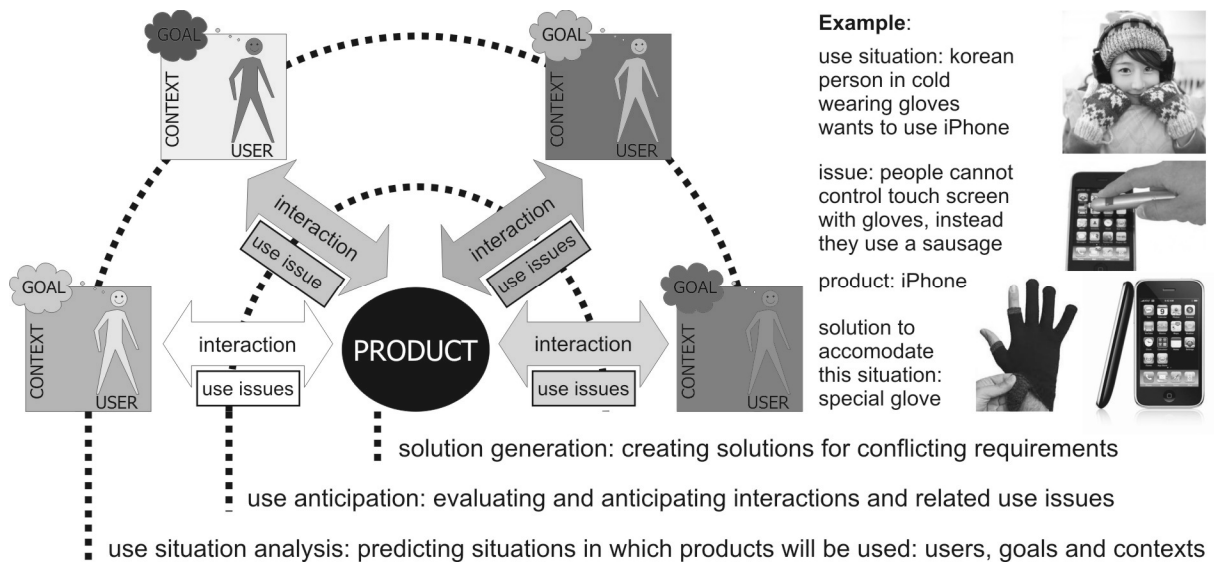


Figure 1. The design activities for dealing with dynamic use situations

## 2 SUPPORTING DESIGN FOR DYNAMIC USE

To be able to develop a useful support tool we firstly studied how designers currently deal with dynamic use situations by means of a retrospective analysis of three design cases in practice. This study resulted in different strategies to design for dynamic use situations [5]. The strategies were categorized in three groups of design activities (see figure 1):

- Use situation analysis: how designers get insight in the situations in which the product is used.
- Use anticipation and evaluation: how designers evaluate what this variety in use situations means for the interaction with a product and resulting usability and user experience (use issues).
- Solution generation: what kind of solutions designers generate to accommodate the product to conflicting requirements from the different use situations.

The main problem found in practice with regard to dealing with dynamic use situations is that in most cases the use situation aspects that play a role are not made explicit. Therefore in user tests, the diverse use situations are not reflected in test conditions. Moreover, insights on dynamic use situations are often not shared between design team members. For this reason we developed two support tools.

The first tool is a set of guidelines aimed at developing a frame of reference of product use which makes dynamic use situations explicit. An appropriate format of this frame of reference still needs to be explored. The second tool is the 'Envisioning Use' workshop technique which is aimed at gathering and sharing knowledge on (dynamic) product use. This technique was developed in collaboration with researchers from the 'Design for Usability' research project [6]. We developed the technique by executing and evaluating the workshop in multiple iterations with practicing designers. However, the application of the workshop to a complete design process could not be evaluated in practice yet.

In the course 'Design for Dynamic Use' master students will explore the format of the frame of reference of product use and evaluate the application of the workshop technique to a complete design process. The next section will explain the basic principles of the guidelines and the workshop.

### 2.1 Basic principles for design for dynamic use

As mentioned above, the main problem in practice is the lack of an overview of use situations and the consequences of the variety of use situations for design. Therefore we propose to develop an explicit frame of reference of product use that captures knowledge about these use situations. Generated solutions can then be compared to this frame of reference in evaluations to be able to make decisions about those solutions. The different design activities relate to the frame of reference as follows:

- Use situation analysis updates the frame of reference with data about use situations
- Use anticipation and evaluation updates the frame of reference with data about consequences for design and uses the frame of reference to set test conditions.
- Solution generation uses the frame of reference as inspiration

Use situation analysis is about predicting which users and contexts the product will encounter and what different situations require from the product. As Redström [7] has argued designing is not about

determining the use of objects in detail. There will always be a difference between intended use and actual use. Therefore use cannot be predicted completely. However, an estimation of future users, goals and environments can be made by analyzing the use situations of comparable products and markets, for example by means of consulting experts, personal knowledge or after sales feedback. Likewise, anticipating what will happen when a designed product will encounter those situations is also not completely predictable. Just information about user and context characteristics alone will not give any insight in the actual actions that the user will perform. This is shown for example in a study of Kanis [8] who showed that user characteristics can set boundary conditions by indicating what users will not do, but they do not give insight in what users will do. User testing then is an obvious way of getting insight into variations of use actions. These use evaluations can be executed throughout the design process and should use the frame of reference to set test conditions and objectives. Solution generation is aimed at creating solutions that fit the different use situations. The guidelines do not contain direction on this creative process, so designers can apply their own techniques. Apart from the design activities mentioned above, the frame of reference can also be used for communication purposes, for example in deciding with the client which solution to choose or which use situations to target.

## 2.2 Frame of reference of product use

The frame of reference contains an overview of possible users and contexts (use situations) that a product can encounter. Moreover it contains use issues surrounding those situations that describe what can, should or should not happen when a product encounters those situations. The issues consider usability, user experience and desired functionality. Finally it contains a target which defines which use situations and issues will be taken into account in this design process. Figure 2 shows the relationship between use situation aspects and use issues. The frame of reference can have different representations such as a complete overview of use situations and aspects, scenario's or user profiles. This format should accommodate the design activity for which it is used.

Apart from different formats, the content of the frame of reference also changes during the design process. It can be updated with new results from use situation analyses and use evaluations and in meetings with the team or client it can be decided to change the target. Therefore the frame of reference evolves during the design process.

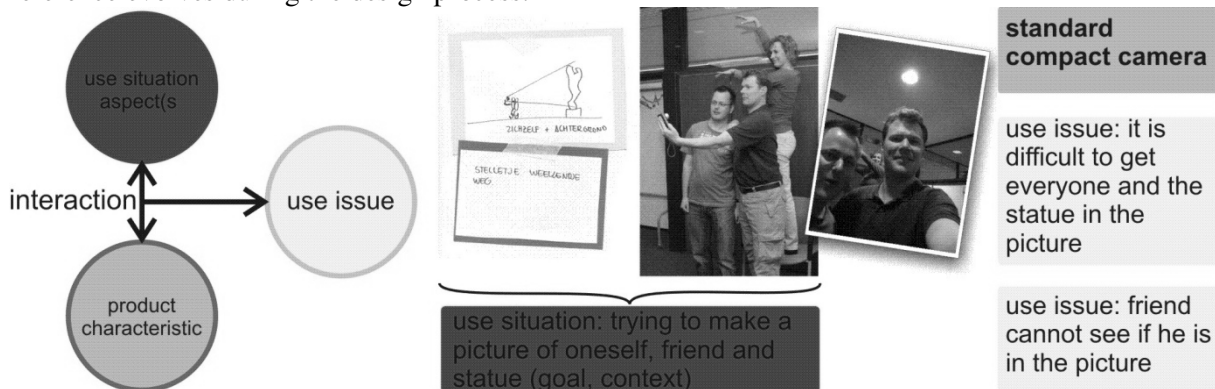


Figure 2. Relation between use situation aspects and use issues and an example from a role-play in the knowledge gathering workshop

## 2.3 The Envisioning Use workshop

Our analyses of the application of usability techniques in practice [5, 9] showed that practicing designers use knowledge about product use from previous projects or their own personal experiences. They apply this knowledge as a frame of reference in informal techniques such as testing with colleagues, family or themselves. However, their knowledge often remains implicit and is not shared with team members. Therefore we developed a half-day workshop technique [6] in which members of a design team make their personal knowledge and assumptions about product use explicit. This knowledge can serve as a basis for the frame of reference of product use.

As mentioned above, the frame of reference contains knowledge about use situations and about related use issues. In the workshop, participants make both types of knowledge explicit by writing them on

post-it notes. They then sort the post-its on a flip-chart wall into clusters they themselves decide on. We call this the ‘product use mind map’. In the workshop participants go through the following steps:

- Remembering: recalling personal or design experiences (figure 3a)
- Imagining: assuming hypothetical use situations and experiences based on associative materials
- Experiencing: role-playing new experiences with mock-ups or related products (see figure 2)
- Targeting: indicating target use situations and issues by means of stickers (figure 3b)
- Envisioning: creating and evaluating new solutions (figure 3c)
- Questioning: reflecting on the frame of reference they have created and indicating which knowledge and corresponding research activities would be necessary to complete it.



*Figure 3. Remembering and imagining (a), targeting (b) and envisioning (c) in practicing the Envisioning Use workshop in the course.*

The workshop was developed in collaboration with designers in practice in multiple iterations of execution and evaluation. The reactions of participants were generally very positive. However, until now we could not evaluate the impact of the workshop on a complete design process. The work of students in the course ‘design for dynamic use’ will be used to achieve this goal. An additional research objective is to explore the format of the frame of reference to take into the design process.

### **3 ELECTIVE COURSE ‘DESIGN FOR DYNAMIC USE’**

In the elective course ‘design for dynamic use’ students apply the techniques to a design case from practice. The case was provided by the company BonGo Innovations B.V. who are currently introducing their first carrier bike to the market. The motivation for the company to collaborate in this course is that they hope the student work can support them in thinking outside the box and lead to improved products for the user. The course therefore has three goals: teaching students about dynamic use, offering new ideas to the client and getting answers to our research questions.

#### **3.1 Course set up**

The course is aimed at making students aware of the dynamics and diversity of use situations and what this means for use issues such as usability, user experience and desired functionality. Furthermore, students should gain insight in sources to analyze use situations of current products and learn how to structure a frame of reference for dynamic use. Finally they should gain experience in designing for dynamic use by applying the iterative design cycle: framework creation – creating design solutions – evaluate solution – adjust framework – etc.

The guidelines and workshop ‘manual’ are provided in a workbook and explained in two half day lectures/workshops. Students then apply the workshop and the guidelines to the case in a project of seven weeks. The assignment is to analyse the dynamics and diversity of the use of the BonGo carrier bike and to design a new version of a (part of) the carrier bike or an accessory that fits a specified scope of the use situations. A carrier bike (‘bakfiets’ in Dutch, figure 4c) is a bike with a large box which in the Netherlands is mainly used to transport children. Furthermore students are asked to reflect on the format of the frame of reference.

## 4 RESULTS

Four groups of five students participated in the course. The Envisioning Use workshop was taught by executing the workshop with students on a fictional case (a compact camera, see figure 3). They then had to apply it to the carrier bike. An important difference between the fictive case and this case is students did have experience with the compact camera, but did not have personal experience with carrier bikes. Therefore they needed other input for the workshop. They were encouraged to gather stories of use of carrier bikes online before the workshop.



*Figure 4. Adding quotes (a) and pictures (b) of 'online stories' to the frame of reference, role-play with the carrier bike (c) and part of a mind map of the frame of reference (d)*

Generally the workshop went quite well. Students had no problems in independently setting up the workshop, although it turned out to be difficult for some groups to execute the workshop in half a day. Students indicated that they found it useful to spend a half day on sharing ideas and investigating the issues that play a role in carrier bike design. They also found it very useful to explicitly indicate 'gaps' in the frame of reference by means of questions which needed to be answered in subsequent steps.

The students' lack of experience with carrier bikes was compensated by gathering stories of users from internet sources such as fora, review sites, YouTube and consumers' association sites. Quotes and pictures from stories were used to represent issues (figure 4a and b). Students mentioned that they found this useful, but that it was difficult to judge the value of the stories. Only after self experiencing the carrier bike in the role-play (figure 4c) they got a better feeling for the priorities in the issues and then it was also easier to imagine other issues and use situations. Two groups executed similar workshops later in the design process when they gained more knowledge about the subject or when they wanted to adjust the target.

The first format of the frame of reference in the design project was the product use mind map (the flip chart wall) that was created in the first workshop. Groups used mind mapping software (figure 4d) or other graphic software to digitize the complete frame of reference. Some students indicated that they were overwhelmed by the large amount of information while others indicated that they appreciated the structure of the frame of reference. The guidelines suggest creating a simplified version of the frame of reference to inspire solution generation and for communication purposes, for example the most important issues, user profiles and/or scenarios. This was definitely necessary in the student project. The complete mind map was found useful by some groups to structure results of use situation analysis and to define the set up of use evaluations. However, other groups indicated they only created a mind map because it was asked for in the assignment, without actually using it in the project. Those groups indicated that it was more useful to keep the frame of reference 'alive' in the project by executing the workshop multiple times and re-using the physical version (flip-charts) of the product use mind map. To inspire solution generation some groups preferred to use storyboards and visualized user profiles. This top-down 'scenario view' on the frame of reference also proved to be more effective in communication with the client compared to the 'bottom-up' digitized mind map.

In the presentation of the assignment the company had already suggested some issues that would be interesting to investigate. One was related to introducing the carrier bike to new (business) markets. Since the original workshop was aimed at gathering current knowledge on use of the product, some groups had difficulties in integrating those 'future use situations' in the workshop. One group was even quite disappointed because they already decided to investigate this new market before doing the workshop, but they still aimed the workshop at current use of the product. Therefore they gained relatively little insight in this new market. Another group explicitly used the imagining step to imagine how the carrier bike would be used in new situations. This worked quite well. Although the groups were given complete freedom in choosing a target, three of the four groups chose to further investigate

the ideas suggested by the company, some even without considering if these were good ideas or not. While it is a pitfall to listen to the client without further investigation of the design problem, it is also something students should learn because these issues occur in design practice as well.

## 5 CONCLUSIONS

In this paper we described the application of the Envisioning Use workshop and a frame of reference of product use aimed at designing for dynamic use in an elective IDE master course. The workshop proves to be a valuable tool to set the basis for a frame of reference of product use. However, the exploration of future use in new markets needs to be stressed more in the 'imagining step' of the workshop. The mind map format for the frame of reference of product use is useful to steer use situation analysis activities and set up use evaluations. However, a simplified version is necessary for communication purposes and to inspire solution generation. For communication purposes the frame of reference can also be updated in similar Envisioning Use workshops later in the design process.

The collaboration with a company had multiple benefits. Firstly students were confronted with a realistic case and they learned how to deal with client demands, secondly the client gained fresh ideas and insights and finally the teachers/researchers gained useful and valid research results.

In future work the findings of these evaluations will be used to adjust the workshop and guidelines. They will be presented in a workbook that will be evaluated in the same elective course in the next study year.

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## REFERENCES

- [1] van der Bijl-Brouwer, M. & M.C. van der Voort Designing for Dynamic Usability: Development of a Design Method that Supports Designing Products for Dynamic Use situations. *Design Principles and Practices: An International Journal*, 2008, 2(1), pp.149 - 158.
- [2] Shackel, B. (1984). The concept of usability. In J.L. Bennett, et al., Editors (Eds.), *Visual display terminals: usability issues and health concerns* (pp. 45-85). (Prentice-Hall).
- [3] Green, W.S. & P.W. Jordan *Pleasure with products : beyond usability ed. by William S. Green and Patrick W. Jordan*, 2002 (London etc. : Taylor & Francis).
- [4] Brouwer, M. & M.C.v.d. Voort Design for Dynamic Use Situations, First Steps in the Development of a Design Method that Supports Designing for Dynamic Use Situations, *Proceedings of Wonderground 2006*, 1-4 November 2006, Lisbon, Portugal. (CEIADE)
- [5] van der Bijl - Brouwer, M. & M.C. van der Voort Strategies to design for dynamic usability, *Proceedings of IASDR2009 Design Rigor & Relevance*, Oct.18-22 2009, Seoul, Korea. (Korea Society of Design Science)
- [6] Van der Bijl-Brouwer, M. & S. Boess From remembering to envisioning product use: an informal design technique, *Proceedings of the 7th International Design & Emotion Conference 2010*, October 4-7, 2010, Chicago (IL, USA.)
- [7] Redström, J. Towards user design? on the shift from object to user as the subject of design. *Design Studies*, 2006, 27(2), pp.123-139.
- [8] Kanis, H. Usage centred research for everyday product design. *Applied Ergonomics*, 1998, 29(1), pp.75-82.
- [9] Boess, S. Experiencing product use in product design, *International conference on engineering design, ICED'09*, 24-27 August 2009, Stanford University, Stanford, CA, USA.)