

A Concept for a Usability Focused Design Method

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Abstract: Many user-centered design methods (UCDM) have been developed within the last decades. However, industry increasingly demands for a new-generation UCDM since only few of the existing UCDM seem to be applicable to the daily design practice. This paper first discusses the main criteria regarding such new-generation UCDM. These criteria are based on literature research. Based on the formulated criteria, the paper discusses the characteristics of a proposed road map based concept for such a new-generation UCDM afterwards. The UCDM's concept enables designers to define a specific design approach which fits best to the specific characteristics of the design problem and the design context in which the design activities take place. Finally this paper discusses an outlook on the further development of the proposed UCDM's concept. The next step will exist out of specifying the roadmap. Afterwards supporting the designer in using the toolbox will be the object of research.

Key words: *User-centered design, Usability, Design method.*

1. Introduction

Industry notices a general increase of usability problems within the last decade. Manufacturers are more and more confronted with complaints which do not relate to technical or functional failures, but to usability problems. In here, usability refers to the measure of whether the functionality of a product in principle can do what it needs to do as well as the measures of how well end-users can experience that functionality. Because of this manufacturers notice an increase of consumer service costs and dissatisfied customers because of this lack in usability.

Therefore usability's rate of importance in product design is increasing. Where in the past usability often was seen as an afterthought, nowadays product developers increasingly use it as a key-driver in the design process. Unfortunately, most of current (user-centered) design methods do not provide enough support to designers in design practice. There is a need for a new generation integral design methods that focus on product usability and enables designers to identify and incorporate future use practices, user preferences and company interests early in the design process.

This paper focuses on the development of such a new user-centered design method (UCDM). It first discusses the most important literature-based guidelines for a new-generation UCDM. Afterwards, this paper goes further

into the characteristics of a recently developed concept for such an UCDM. Finally the paper discusses an approach for further development of the UCDM's concept towards a new UCDM.

2. Guidelines for new-generation UCDM

2.1 Overview of guidelines

Hoolhorst and Van der Voort [1] discuss guidelines for new-generation UCDM. Table 1 gives an overview of these guidelines. The guidelines are based on literature research which focused on trends within the design practice and the critics on existing (user-centered) design methods. This section discusses the two most important guidelines of this survey.

Table 1: Overview of guidelines for new-generation UCDM

A supporting user-centered design method should:

1. Take usability as a key-driver during the whole design process and should discuss how it relates to other relevant design aspects.
 2. Provide designers support in:
 - a. Taking the characteristics of the specified users, the specified users' goals as well as the specified use environment into account during usability-related design tasks during the whole design process.
 - b. Predicting the product's impact on its users and the environment in which it is used during the whole design process.
 - c. Tailoring a design approach to a unique design problem in order to create a usable design solution.
 - d. Predicting whether a solution-focused design approach or a problem-focused design approach is most appropriate to adopt during a particular design step.
 - e. Specifying the unique characteristics of an ill-defined design problem as well as simultaneously creating visions regarding the design solution during the whole design process.
 - f. Exploring and addressing possibilities for extending the design problem's scope. In here the designer's rate of experience should be taken into account.
 - g. Adjusting and managing of the design context parameters to the specific characteristics of the design problem during the whole design process.
 - h. Identifying design context needs based on the characteristics of the ill-defined unique the design problem during the whole design process.
 - i. Managing a (multi-disciplinary, inter-organizational) design team during the whole design process.
 - j. Creating a common understanding within the design team about the meaning of usability within the design project as well as its effects for the (design) tasks of each team member individually.
 - k. Recognizing and addressing fixation problems during the design process. In here, a supporting user-centered design method should take designer's rate of experience into account.
 3. Unambiguously describe the qualities of the (intermediate) results as well as how these results can be achieved.
 4. Be based on verified observations of the design practice in order to be fully applicable in design practice.
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2.2 Guideline 1: A supporting UCDM should take usability as a key-driver during the whole design process.

Vanka [2] mentions that usability becomes increasingly important, because of two reasons.

Firstly, globalizing markets cause an increased competition. The increased competition makes markets shift from a technology push to a market pull situation. This involves that, in order to be successful on the market, manufacturers need to gain an extended understanding of the users of their products. Gaining such an understanding is difficult since markets become more diverse due to the same market globalization. Products have to satisfy a wide scope of users.

Secondly, technologies that are applied to products evolve quickly and become more advanced. Besides also the number of technologies that are combined in one single product increases. This offers a wide scope of new

opportunities for increasing the amount of functions within a product. Furthermore an increasing amount of products become part of a complex system that exists out of many hardware products, software and/ or devices. This makes the use many products and system often complex. Furthermore, these complex systems are often used by multiple users who strive for multiple goals within multiple different use contexts [3]. Consequently products must be able to adapt to the personal usability needs of its user.

Designers need supporting UCDM in order to deal with usability during product development. Literature discusses many UCDM. Unfortunately most of them lack on this criteria, because of several reasons.

Firstly, most existing UCDM only focus on usability. However, in design practice, designers have to consider multiple design aspects (at the same time). Therefore supporting UCDM at least should discuss how usability relates to other design aspects. Besides supporting user-centered design methods should discuss how they can be used next to other design methods.

Secondly, Schuffel and Roelofsma [4] stress that existing UCDM do not support the complete design process. They particularly support designers in analyzing the usability problems during the analysis phase. During the materialization phase they particularly support evaluating almost finished design solutions by means of usability tests. This involves that designers discover rather late in the design process. Consequently there are often no possibilities for necessary (fundamental) design changes anymore. New-generation UCDM should therefore support the whole design process. They should also support designers in translating usability needs into design solutions during concept development and materialization. Besides, new-generation user-centered design methods must support designers in controlling if the production model preserves the intended degree of usability as the final prototype.

Thirdly, most UCDM neglect the environment's influence on the product-user interaction, since most of them find their backgrounds in human computer interaction. Computer systems are mostly used under the same kind of physical circumstances which hardly influence the system-user interaction. Therefore most UCDM only focus on specified users who want to achieve a set of specified goals while using a (computer) system. However, in contradiction to computer systems, most products are used in various environments which significantly can influence the product-user interaction. Therefore new-generation UCDM must also support designers in taking the environment in which products are used into account during the design process.

2.3 Guideline 2: A supporting UCDM should support designers in tailoring a design approach to a unique design problem in order to create a usable design solution.

Many (user-centered) design methods have been developed within last decades. Most of them focus on most efficiently fulfilling design tasks which relate directly to the design problem. They prescribe, regardless of the design problem's characteristics as well as the context in which design activities takes place, which design steps to take or which design results to achieve during the design process. However, in daily design practice designers do more than that. They also define the usability focused approach and manage the conditions which are required to follow this approach [5, 6]. Current UCDM hardly support these activities. Managing these conditions means that designers organize and manage the design team which is involved in usability related tasks. It also means that designers create and manage the environment in which this team performs their design tasks. Defining and managing the design approach and conditions asks for a good understanding of the specific design problem's characteristics as well as their interrelations. In addition designers must have insight into how these

characteristics relate to usability. Therefore supporting UCDM should also support these high-level design activities. The next three sections will discuss the aspects that influence these activities in order to gain better understanding of these high-level design activities. These sections focus on the characteristics of the design problem, the designer and the context in which design activities take place.

The design problem

Each design problem is unique. Therefore designers need to specify or adjust an approach in order to tailor it to find a solution for this unique design problem. For this purpose, designers need to have both a clear view of the design problem as well as ideas regarding the intended qualities of the design solution. However, getting this is often difficult since most design problems are ill-defined and wicked [7-11].

At the start design problems are ill-defined. They consist of ambiguous and incomplete descriptions. At this stage often little relevant information about the stakeholders and their interests in solving the design problem is known. The descriptions of the design problems also give less insight into stakeholders' ideas regarding the solutions direction of the design problem. Furthermore information regarding the boundary conditions on the design approach needs to become clear. Regarding usability specifically, at this stage design problems often poorly specify (1) who will use the product, (2) why they will use the product, (3) under which conditions they will use the product and (4) what impact the product is expected to have on the user and environment in which it is used. The design approach should therefore aim at clarifying these design problem's aspects during the design process.

Design problems are wicked, because they interrelate with the design solution [7]. It is not possible to think about the design problem without referring to the design solution and conversely. This means that the design problem evolves and becomes more specified as the design solution arises during the design process. Because of this it is hardly possible to predict when a design problem has been solved at the start of a design project.

Therefore supporting UCDM should be adjustable to address a unique design problem and must support designers in specifying relevant design problem's aspects as well as generating visions regarding the solution at the same time during the whole design process.

The designer

The designer's role can be defined as to create solutions for ill-defined design problems as well as managing a satisfying context and approach that enable them to solve the stated design problem. Design practice shows differences in the way designers fulfill their role.

Firstly, designers adopt different design approaches. Cross [12] subdivides design approaches into (1) solution focused design approaches and (2) problem focused design approaches. Analysis of design practice shows that designers generally adopt a solution focused design approach [12]. Solution focused design approaches exist out of many iterative steps, also known as 'basic design cycles' [13]. While using a solution focused design approach, designers continuously jump between the temporary solution and the (changing) design problem until they achieve a satisfying design solution and a clear view on the design problem. However, particularly in cases in which designers have little experience or have little pre-knowledge of a certain topic, designers adopt a problem focused design approach [10, 12, 14, 15]. Here they tend to explore all facets of the design problem in advance and start creating solutions as soon as they have complete survey of the design problem. Designers tend to adopt

a design approach that is neither purely solution focused nor purely problem focused since they are usually not fully inexperienced. A supporting UCDM should therefore support designers in predicting which type of design approach is most appropriate to adopt during each design step as well as combining these approaches most appropriately.

Secondly, depending on their rate of design experience, designers have different needs regarding UCDM to hold on to. Where inexperienced tend to hold on learned design methods and follow the described design steps literally; experienced designers tend to adjust UCDM to the specific characteristics of the design problem. Therefore, depending on designer's rate of experience, UCDM should provide designers both the opportunity for following steps of the design method literally as well as the opportunity for adjusting particular design steps to the specific characteristics of the design problem.

Thirdly, designers define the scope of the design problem differently. Where inexperienced designers tend to narrow down the design problem scope; experienced designers tend to extend the domain in which they work and search for new design approaches. It is often more effective to extend the domain of the design since designers often learn from other (design) disciplines. Inexperienced designers might not be aware of the possibilities for extending the design problem's domain or they face problems in dealing with extended design problem domains. Therefore UCDM should support designers in exploring the possibilities for extend the design problem's scope.

The design context

Since each design problem is unique, designers need to tailor the design context to the specific characteristics of the design problem in order to create a satisfying design solution.

Peters et al. [16] suggest that designers have to consider the following parameters while tailoring such a design context: (1) design strategy, (2) common information, (3) multidisciplinary input, (4) design review, (5) design control, (6) communication, and (7) information management. It should be recognized that generally designers are bounded by an environment in which these parameters are partially unchangeably predefined.

Nevertheless, UCDM should support designers in tailoring and managing the design context to the specific characteristics of the design problem during the design process as far as possible. This involves that UCDM should support designers in indentifying the specific needs regarding such a design context first. Afterwards, based on this identification, UCDM should support designers in exploring and selecting possibilities to adjust the design context parameters to the identified design context needs.

3. A concept for a new usability-focused design method

Based on the previously discussed literature based criteria for new-generation UCDM, this chapter discusses a new concept for such a UCDM. Figure 1 shows the UCDM's concept. In contrast to most existing UCDM, this UCDM's concept does not prescribe which design steps a designer should take or which design results should be achieved during the design process. The UCDM's concept instead enables designers to define and manage a specific design approach which fits best to the specific characteristics of the design problem and the design context in which the design activities take place. In here managing a specific design approach refers to an iterative process of tailoring the initial defined design approach to the most actual achieved design results and design environment parameters. Therefore the UCDM's concept is based on a roadmap. Figure 2 shows this

roadmap. The roadmap subdivides the design process into four design phases. These phases are (1) analysis phase, (2) concept phase, (3) materialization phase and (4) product implementation phase. The analysis phase focuses on gaining insights into the product's future use(s). These insights result into design specifications regarding usability. The concept development phase aims at exploring solutions for the design problem. It results in a base design proposal that meets the formulated usability specifications. The design materialization phase focuses on technical detailing of the base design proposal's construction. In addition diverse tests give better insight into the usability and technical performance of the product design. Finally the design is made ready for production during the product implementation phase. Within this phase it is important to check if the production model preserves the intended degree of usability as the final prototype.

Besides design phases, the roadmap distinguishes overviews of the following three design approach parameters within each of these design phases: (1) results, (2) (sub-)design tasks and (3) tools. In here, results refer to a description of all possible (intermediate) design results at the end of each design phase. The term 'design tasks' refers to the set of tasks which designers can perform in order to achieve their expected results. The term 'tools' refers to an overview of possibilities of how to execute specific design tasks.

The UCDM supports designers in defining a user-centered design approach in several steps. The first step (step 1A and step 1B) focuses at exploring the characteristics of the design problem and the design context. Regarding the design problem designers explore what is known about the stakeholders, their interests in the design project and their vision towards possible solution directions. Furthermore exploring which role usability will play within the design project is important to do. Regarding the design context designers determine the available time, the people who can be involved within the project and the resources which can be used to solve the design problem. Furthermore designers need to explore the formal (inter-) corporate procedures regarding topics as (usability focused) design strategy, internal and external communication as well as information management.

The second step focuses at defining the characteristics of the most promising design solution for the design problem. Besides there is a focus on defining the characteristics of the intermediate design results which should lead to this design solution. In here designers have to consider the opportunities and limitations which the design problem and the design context provide to solve the (usability related) design problem.

The third and fourth step focuses on determining what to do to achieve the defined (intermediate) results as well as determining how to achieve these (intermediate) results by selecting the right tools and techniques. Furthermore also designers also draw relations between (user-centered) design activities. In here designers need to consider the design context' characteristics in order to explore the possibilities.

The final step focuses at assigning the design context parameters to the earlier defined (user-centered) design tasks. Here designers determine who to involve in the design process and what their role will be. They also determine the time and the resources that will be available for the user-centered design tasks. Furthermore designers determine how internal as well as external communication will take place as well as how to manage (design) information during the design process. In here designers need to consider the formal (inter-) corporate procedures regarding these topics.

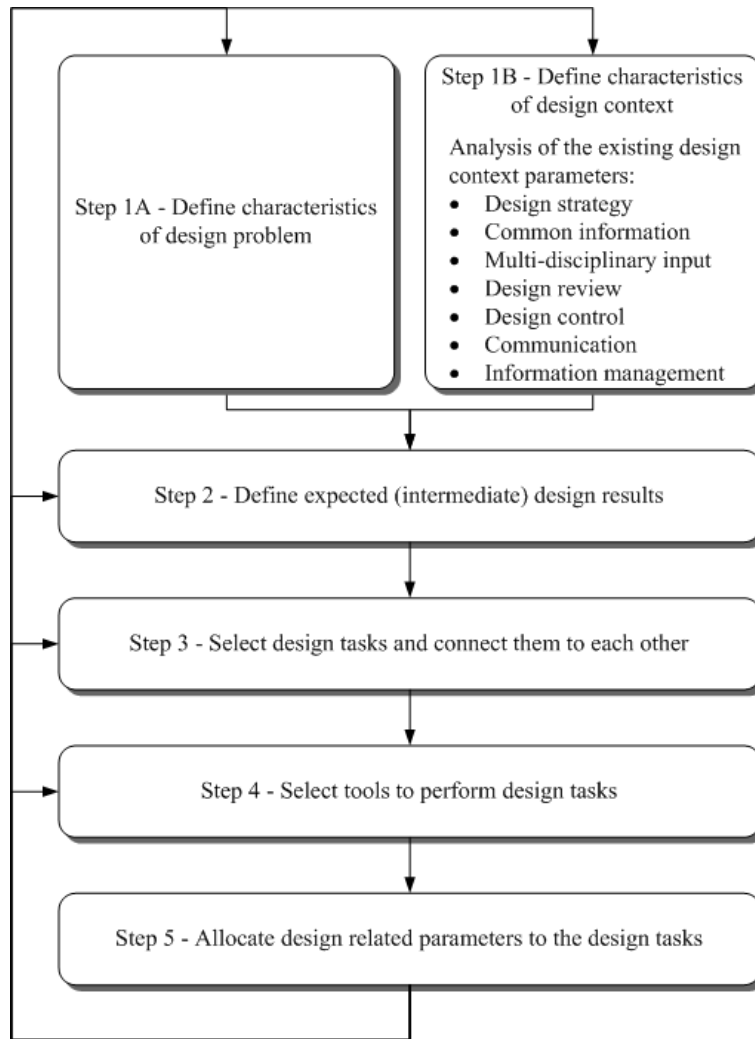


Figure. 1 Concept of a user-centered design method

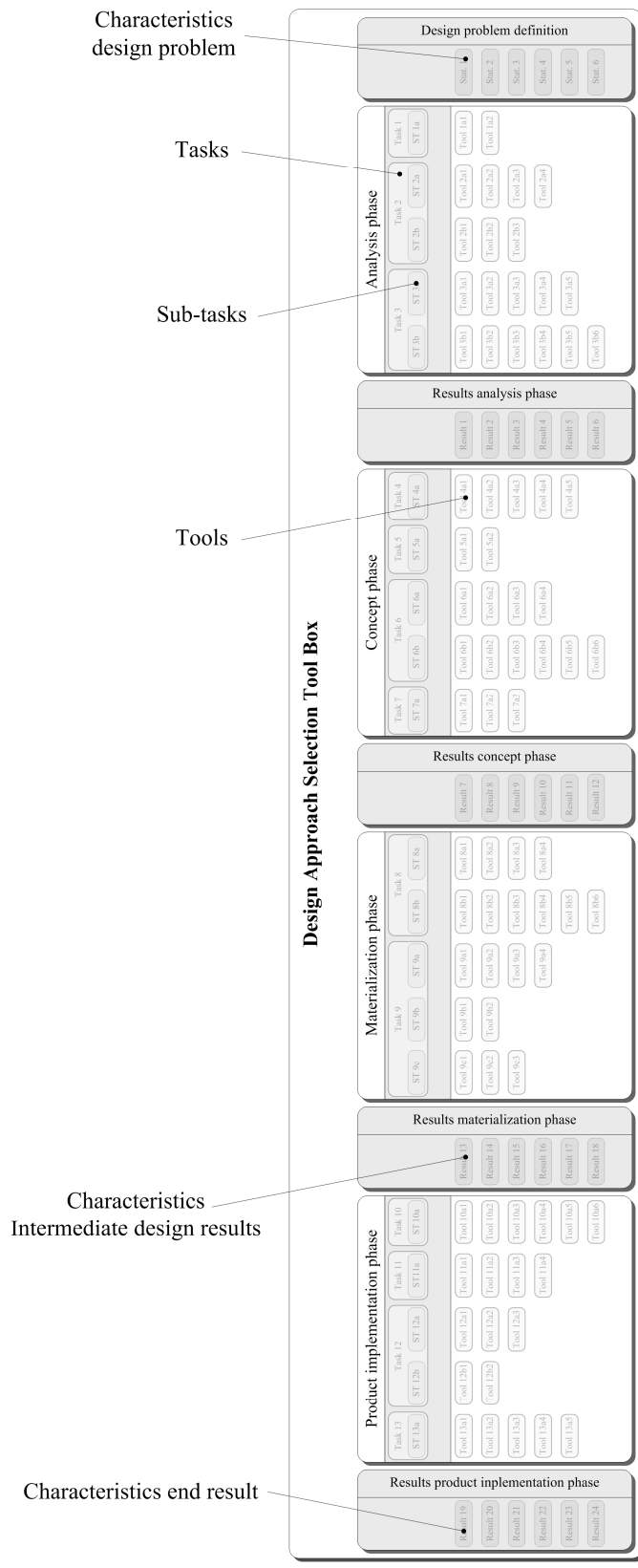


Figure. 2 Concept of the road map

4. Discussion

The previous chapter discusses a concept for a new UCDM. Compared with most existing UCDM, this concept is expected to lead to a UCDM which is better applicable to the design practice. Here applicability does not refer to the scope of kinds of design problems which can be solved by using this UCDM. However, it refers to the rate to which the UCDM is understandable for designers. A better understandable UCDM might increase the efficiency and effectiveness of the design process. There are two reasons to assume the UCDM's concept is expected to lead to a more understandable UCDM.

Firstly, most existing UCDM ambiguously prescribe, regardless of the design problem's characteristics or the design context' characteristics, which steps to take within each design phase or discuss which (intermediate) results to expect during the design process. Inexperienced designers in particular may become confused because of this. Therefore they might interpret the UCDM wrong. The discussed UCDM's concept does not focus on prescribing an ideal design process. However it enables designers to define a specific design approach that fits best to the design problems characteristics, design context's characteristics and their personal preferences. Secondly, the UCDM should lead to a more understandable design approach since it does not only discuss what a designer should do during the design process. It also discusses how to perform design tasks, how design tasks interrelate and what to expect as a result after performing the design task. So designers have a better idea of what they are expected to do during the design process and why they are doing it.

It is necessary to develop the discussed UCDM's concept towards a full UCDM to be applicable in daily design practice. Developing the UCDM's concept towards such a full UCDM exists out of several steps. The first development step will focus on specifying the road map. The road map should give designers an overview of all possible:

- Design tasks that they can do during a design project;
- Design tools that they can use to do a particular design task;
- Achievable intermediate design results in a design process.

The survey will be based on literature research as well as observations of the design practice. The second development step will focus on specifying the UCDM itself. The UCDM itself should give designers insight into how they should use the road map. Firstly, it should support designers in specifying the characteristics of the user-centered design problem as well as the characteristics of the design context. Secondly the UCDM should support designers in specifying the characteristics of the expected (intermediate) user-centered design results as well as the user-centered design tasks which need to be done to achieve these design results. Furthermore, the UCDM should support designers in selecting the design tools which they will use to perform the specified user-centered design tasks. Finally the UCDM should support designers in managing the design context. Developing the support for using the road map will be based on verified observations of the design practice. In here, research will focus on how designers define and manage user-centered design approaches in design practice at this moment. The final development step focuses verification of the UCDM. The UCDM is complete after specifying both the road map as well as the UCDM itself. However, assessing this UCDM in daily design practice will give insight into its actual applicability.

5. Acknowledgements

The authors gratefully acknowledge the support of the Innovation-Oriented Research Program 'Integrated Product Creation and Realisation (IOP IPCR)' of the Netherlands Ministry of Economic Affairs.

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