Identifying and Selecting Users for User-Centered Design

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ABSTRACT

It is critical to the success of a system that appropriate and representative users are involved in the development work. However, the process of identifying and selecting users has not been a focus of research. In this paper, we describe a process of identifying and selecting relevant users specifically for field studies. Characterization and sampling of users are discussed. In addition, a way of describing user groups is suggested. Finally, we summarize results from seven case studies in six different companies. The case studies show that developers tend to underestimate the diversity of users and that a systematic process helps to identify the different user groups, select representative users and identify representative user needs. It was found that identification of users' characteristics and groups is an iterative process, and user descriptions evolve when real data are gathered from users.

Author Keywords

Users, user characteristics, personas, user profiles, field studies, usability, user-centered design.

ACM Classification Keywords

H5.2. User Interfaces: User-centered design.

INTRODUCTION

User involvement is a widely accepted principle in the development of usable and useful systems [1, 9, 20]. However, in practice it is possible to involve only a limited number of users. Thus, participating users must be selected for field studies, usability tests, user acceptance tests and other kinds of collaboration.

Furthermore, the involved users should represent the intended users of the system as closely as possible [cf. 7]. For example, we can argue that if unsuitable users are selected for a usability test, the qualitative results can be flawed. In field studies in which users, their tasks and environments are studied in their actual context using qualitative methods [21], the goal is to understand user needs. Therefore, it is also important to reach representative users in order to understand representative needs.

For example, Wilson et al. [20] describe a case in which designers selected users under the guidance of the manager-user. Later, it was found that the needs of other users had been neglected. Most strikingly, the needs of junior, part-time or temporary staff had been disregarded, but so had those of the more senior managers. This resulted in the situation whereby some of these part-time staff did not see any good reason to use the resulting system. Therefore, Wilson et al. recommend selecting a truly representative cross-section of users.

As Dillon and Watson [5] point out, the ever-widening user population resulting from the diffusion of technology means that it is no longer sufficient to base design work on generic models of the users. Similarly, as they claim, we cannot assume that training on computerized tasks can be standardized across user populations.

However, the identification of users is not trivial [6]. It is particularly demanding if there are large numbers of heterogeneous users. Moreover, if the product is new, the type and number of potential users are unclear. As Grudin [6] describes the situation, developers may have a market in mind, but the actual users of a product are not known until the product is bought.

In such situations, developers often have a vague or contradictory sense of their intended users and may base scenarios on people similar to themselves [4, 12]. Cooper [4] suggests the use of user archetypes called personas that would help define the product by replacing the notion of the abstract, elastic user. The persona is a precise description of a hypothetical user and his or her goals, and it represents a group of users throughout the entire design process. As Sinha [19] points out, persona development emphasizes building detailed descriptions of a typical user, but not identifying representative users.

Marketing has traditionally provided information about market segmentation. However, Poltrock and Grudin's [15] findings of their participant-observer studies in two large software product development organizations are that the

focus of marketing is focus on competitive products and on the buyers or customers, and its' primary goal is marketability rather than usability. Thus, marketing may provide overly high-level information to be useful in development work.

In the Human-Computer Interaction literature, one is usually advised to identify users based on certain user characteristics [e.g. 13, 17, 18, 22]. For example, Schneiderman [18] states that all design should begin with an understanding of the intended users, including population profiles that reflect age, gender, physical abilities, education, cultural or ethnic background, training, motivation, goals, and personality. In addition, he cites user communities, different countries, and location (urban vs. rural), economic profile, disabilities, and attitudes toward using technology. While this list of user characteristics is long, other authors mention even more characteristics.

In addition, Dillon and Watson [5] review cognitive and other human abilities identified in cognitive and differential psychology, and suggest that the validity of user and task analyses could be improved on the basis of this research work. However, they do not present a method of identifying essential abilities or categorizing users into groups during design process.

Cooper's [4] perception is that it is impossible to satisfy a broad audience of users, and that the facilities that please some users will interfere with the needs of others. His solution is to narrow the design target to a single group of users (persona or user archetype) even if it represents a minority of users. This approach may be successful, as Cooper [4] shows, in the automotive or another industry in which the number of customers and users is very large. For example, Cooper reports that the Dodge Ram pick up was a best seller even if 80% of people in a focus group hated it.

However, a large number of users is sometimes not achievable, and often the success of system depends on a large number of user groups. In particular, varied user groups need to be considered in cases where the system is designed for organizations and not for individuals. Furthermore, the nature of software makes it possible easily to provide variations of products for different user groups, for example through platforms and product families.

Another kind of selection approach is the lead user method developed by von Hippel [23]. The idea is to contact and interview the most advanced users in the field of interest. The lead user method has been used in uncovering innovative product ideas. The idea is that lead users face needs years before the other users encounter them, and have already found solutions to their problems. Olson and Bakke [14] review experiences of using the lead user method in three published cases. Their general conclusion from the cases was that the method improved teamwork and was significantly faster and cheaper at developing new product concepts than more conventional marketing research

methods. In this paper, we report some experiences of using the lead user method in field studies.

As above described, identifying users particularly for user-centered design of mass-market products is a challenge. The identification of users is usually based on broad classifications, but how these classifications emerge and represent relevant user groups is not discussed. In this paper, we describe a process for identifying and selecting relevant users specifically for field studies and user needs gathering. In addition, a way of describing user groups is presented. The process is based on the literature and seven case studies in which users were identified and selected for field studies. The field studies involved a variety of products developed in different companies. Finally, we summarize the lessons learned from these cases.

THE PROCESS OF IDENTIFYING AND SELECTING USERS

In order to reach representative users, the most important user groups need to be identified and described. Noyes and Baber [13] propose simple steps for this task:

1. define the characteristics of the user population, and

2. work with a representative sample of the user group.

Hackos and Redish [8] suggest brainstorming a preliminary list of users and creating a matrix. In order both to identify and select representative users, we complement these steps based on our case studies:

1. Brainstorm a preliminary list of users.

2. Describe the main user characteristics (including market size).

3. Describe main user groups and prioritize them.

4. Select typical and representative users from the groups.

5. Gather information from the users and redesign the user group descriptions according to the new information gathered.

This process of identifying and selecting users is iterative and the work is supposed to happen in special user identifications sessions. The steps in this process are described in the following four subsections.

Brainstorming a preliminary list of users

Hackos and Redish [8] recommend assembling team members or contacting them individually to brainstorm a list of potential users. In assembling the team, they consider for example salespeople, sales engineering people, marketing professionals, trainers, and support personnel as important information sources. User differences provide a starting point for identifying the preliminary list of users,

User group	Task	Number of users
Admission clerks	Collect patient data	25
Nurses	View medical data	490
Administrators	Install and maintain software	12

Table 1. User group table for a hospital system.

the idea is that the assumptions about users are tested in field studies.

In addition to brainstorming and gathering information inside the company, statistics and market studies may provide useful information for listing user groups. Occasionally, user and customer roles can be separate, and in such cases the roles of both need to be identified. Users are individuals who will be interacting with the system while customers are persons who pay for the system.

Describing the Main User Characteristics
After brainstorming a list of users, it is useful to identify their main characteristics, as Schneiderman [18] and others suggest. These characteristics help to identify the diversity of users and the groups they form.

A large number of user characteristics are mentioned in the literature [e.g. 13, 17, 18, 22]. In practice, it is not possible to use all these characteristics in selecting users, but those relevant to the product need to be identified. Often the differences in tasks and goals are the most essential user characteristics. However, which kinds of user characteristics are relevant depends on the product or system type.

In the first instance, the relevant characteristics can be identified by brainstorming and gathering information from appropriate sources. However, the assumptions should be tested by gathering real data from users using field studies or other methods. We have gathered main user characteristics from the literature [13, 17, 18, 22] and categorized them as below. These categories can be used as a checklist when the main user characteristics are identified:

- Personal characteristics:
  - o Age, sex, education, job type, socio-economic status, role in organization.
  - o Lifestyle, personality, emotions and attitudes (e.g. toward using a technology).
  - o Skills.
  - o Physical abilities and constraints, e.g. poor eyesight, color blindness, etc.

- Task related characteristics:
  - o Goals and motivation.
  - o Tasks.
  - o Usage (heavy vs. light, frequency, indirect or remote).
  - o Training and experience (from novice to expert).

- Geographic and social characteristics:
  - o Location: regions, countries, continents, market areas.
  - o Cultures and other circumstances.
  - o Social connections and societies.

These categories are partly overlapping. For example, the personal and task related goals and skills may be difficult to separate from each other. Thus, even if a system is designed for an organization, the personal motivations of users need to be considered. However, the personal characteristics are most relevant in consumer products, which are used during leisure time. On the other hand, task related characteristics are important in work related systems, but these characteristics may also be meaningful during leisure time.

From the usability point of view, it is important to ensure that the less advanced users are also selected and that the most essential tasks are represented. When the most essential characteristics have been selected, it is useful to create a preliminary description of customer and user groups.

Describing and Prioritizing Main User Groups
Many kinds of tables, figures and personas can be used for describing user groups representing main characteristics. For example, Hackos and Redish [8] describe several. In those cases, where several user groups are using the same system, we have found their user/task matrix useful. This simple matrix describes the user groups and the main tasks that are likely to be performed using the future system. Table 1 provides an example of the user/task matrix.

In addition to user groups and tasks, the number of users or frequency of use etc. may be relevant and this information can be added to the user/task matrix. The number of users may help in prioritizing the groups and considering the solutions as shown in Table 1. For example, the 25 admission clerks may be trained more easily than the 490 nurses and the functions provided for nurses should be easy enough to be used without the need for training.

Furthermore, marketing research provides several ways of describing customer segments. These diagrams show, for example, how groups of customers differ in their purchase and pricing wants and needs [16]. These facts are needed in marketing products and considering sales strategies.
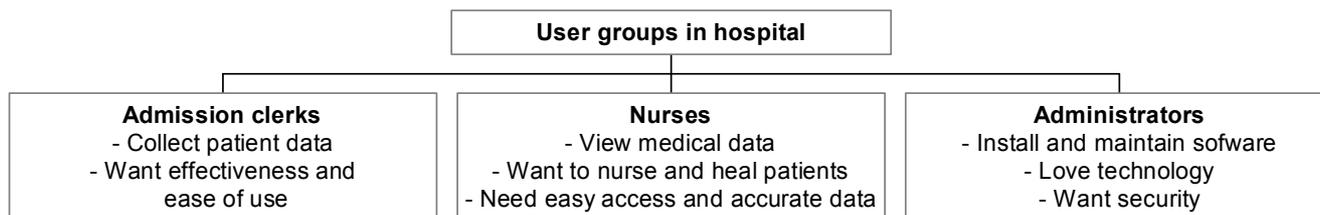
User groups in hospital		
Admission clerks - Collect patient data - Want effectiveness and ease of use	**Nurses** - View medical data - Want to nurse and heal patients - Need easy access and accurate data	**Administrators** - Install and maintain sofware - Love technology - Want security

Figure 1. User groups for a hospital system.

However, these kinds of diagrams can be utilized in user-centered design, as shown in Figure 1. We adapted a marketing figure from Proctor [16] for user-centered purposes.

In user-centered design, the focus is more on users, and the essential user characteristics are their goals and tasks. Thus, this information is shown in the diagram instead of purchase and pricing needs.

Selecting Representative Users
Obtaining a representative sample involves selecting individual users from a potentially huge number of users. In order to do this, a sampling strategy is needed.

Sometimes, it is possible to list all the individual users or the target is clearly defined e.g. in a database of special users or an area map of housing. Then, it is possible to take a probability sample and simply randomly select users from the list. However, the elements or subgroups being included should have a known chance of being selected, and the sample size needs to be large enough [See 16, p. 91].

Another strategy is to try to reach a cross-section of the users being sampled. In marketing, it is usual that certain percentages of the sample are required to be women or men or other subgroups. When users are selected for design purposes for usability tests or field studies, stratified sampling is usually most practical. In stratified sampling, the population is divided into mutually exclusive groups, and random samples are drawn from each group [16, p. 92]. In user-centered design, sampling can be based on the user groups identified by the main user characteristics. In qualitative research, it is enough to pick up representative users from each group based on the main user characteristics. This makes it possible for all necessary types of customers and users to be represented. In addition, after the groups and their size or significance is described, it is possible to identify the most important groups.

Qualitative studies can be complemented with quantitative studies; for example, the number of users in subgroups can be studied using other methods such as market studies or questionnaires [cf. 19].

Number of users
As always in statistics, the larger the sample the better. However, in design, the amount of available resources is usually restricted. Beyer and Holtzblatt [2] recommend that between six and twenty users should be visited depending on the scope of the study. Hackos and Redish [8] recommend striving for breadth of representation, but they believe that even with five to ten participants, it is possible to achieve a degree of breadth among the participant users.

The precise number of necessary users is difficult to define, and it depends on the case. For example, the number of users depends on how much variability there is among users and how many user roles are represented. However, the results of Kujala and Mäntylä [12] show that as few as six users may provide extremely useful information for product development.

CASE STUDIES
The process of identifying and selecting the relevant users was gradually developed based on the HCI-literature and experience gained from seven case studies. The seven case studies were performed as a part of two research projects carried out between 1998 and 2002. The studies were based on real product development cases in six companies in Finland. The goal of the case studies was to pilot field studies in real product development contexts, and in six cases to evaluate the costs and benefits of the field study approach. The used field study approach and the results of evaluating the approach are described in [10, 11, 12].

Case 1
The case study was conducted for TeamWare Group, a Finnish subsidiary of Fujitsu Corporation that is mainly active in CSCW, office automation, Internet solutions, and knowledge management products.

The aim of the study was to test field studies in the realistic setting of designing a personal digital assistant (PDA) application. The project team worked in close co-operation with a usability team and was developing a new product. The designers had already created their first interface prototype of PDA software, and they were interested in gathering more information about target users to support their design work.

Marketing had defined the target user group, and they recruited three users for the field study. The users did not use a PDA at that time, and they had different occupations. The researcher then visited the users in their work place and

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used semi-structured interviewing, interactive feature conceptualization and a think-aloud method for gathering information from users. The total time spent on the field study was 27 person hours.

Case 2
The second field study was conducted for a large Finnish company. The study was focused on a set of functions of a portable communications device aimed at supporting mobile users.

The product was already in use and the aim of the study was compare field study approach to a baseline design process. In addition, the designers were interested to learn more about user needs concerning the specific functions of the product. The users were randomly selected from a customer database together with the designers. The six users who participated in the study had different occupations, which nevertheless shared similar characteristics with regard to their product usage as they all had mobile jobs. The characteristics of the participating users were described in tables after the field study, but any user descriptions were not available in planning the study. The researcher performed the field studies using semi-structured interviewing and think-aloud method. Overall, 46 person hours were spent in the field study.

Cases 3 to 7
The rest of the case studies followed similar kind of method. The aim of the work was to help our industrial partners to improve their product development practices and support developers to gather user and customer needs by direct contact, and use user point of view in developing usable and useful products. The practitioners performed the rest of the five field studies. The role of the researcher was that of an expert or a consultant who provided information, instructions, training, and support for the practitioners.

All the studies started with a brainstorming session in which the stakeholders (particularly customers and users) were identified and described. The field study methods were semi-structured interviewing and observing.

Cases 3 and 4
The field study approach was introduced to KONE, a corporation developing elevators and escalators. A team including three product development engineers, a designer, and a marketing manager, was formed to improve user needs gathering practices. The group decided to pilot the field studies and they planned and performed one study. KONE has a long experience of developing products and has market specialists, and a sound understanding of market needs has evolved over the years. However, this existing information did not provide deep understanding of different user groups and more specific user groups were identified in a brainstorming session.

First, the team performed a field study, in which three users were interviewed. The results were carefully analyzed,

reported and presented. Overall, 111.5 person hours were spent in the study.

Second, the results encouraged more people to join the team and perform a new, larger field study. This study was a one day study in one customer location. Eight user groups were identified and described and several users representing seven of the groups were selected for interviews and observations. The team of eight persons spent 277 person hours in the field study.

Case 5
The fifth case study was performed in Vaisala, a company producing weather measurement systems and instruments. There was no team to perform a field study, but one developer performed it together with the researcher. The aim was to gather user needs for a variant of an existing product. The product manager had already made good descriptions of potential user groups and six users were sampled from the most important groups.

Case 6
The sixth study was performed for Tekla, a company producing software products for managing infrastructures. One developer performed the field study for a project, which were designing a new product. Three users were interviewed in order to recognize user needs for the product and to gather feedback from paper prototypes.

Case 7
In a large Finnish company, we were supporting the usability team to develop a field study process and the appropriate guidelines. As a part of this work, a pilot field study was performed to test the process. The study was done for a real product development project developing an information network tool. User groups were brainstormed and two users representing the most essential user group were selected and interviewed.

Results
The lesson learned from these seven case studies was that the identification of user characteristics and groups is an iterative process. For example, in Case 1 marketing personnel had defined the potential user group and recruited three users for field studies. However, when the actual users were interviewed, it was found that each user represented a different subgroup of users. These subgroups had their own needs and tasks in addition to the general ones. Only one of the subgroups was actually target group of the intended product. When more information was gained, also the user characteristics and groups elaborated.

Another clear observation was that developers underestimated the diversity of users. The role of some user groups such as infrequent and indirect users, summer help and other special groups were neglected. Organizing special user identification sessions helped developers to orient towards different user groups as different user characteristics were brainstormed.
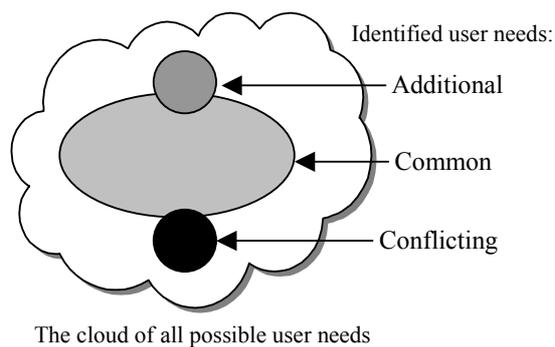
Identified user needs:
— Additional
— Common
— Conflicting

The cloud of all possible user needs

Figure 2. Type of user needs identified by the field studies.

In cases 3 and 4, a multi-disciplinary team helped identifying user groups as varied persons had information about users. In addition, understanding the customers' needs was found to complement the user point of view. In elevators and escalators, the customer, who is paying for the product, is different from the actual users. Even though the goal of the customer is to support users in their tasks, they had their own high level view that complemented the needs of the users. Thus identifying also customer roles is important.

The lead user method was a useful way of selecting users for field studies. For example, in Case 2, one lead user provided as much information and ideas as five ordinary users did. However, some of the lead users' needs were too advanced to concern the ordinary users. Thus, a combination of lead and ordinary users were found to be most beneficial. The ideas gathered from lead users could be reality checked with the ordinary users and their needs.

Overall, the field studies revealed that different user groups had different needs as Cooper [4] suggests. However, in any of the seven field studies the users representing different user groups did not have an entirely different set of needs. The amount of common user needs varied depending on how different the represented user groups were. In most of the cases, the identified user needs were largely common for different users as illustrated in Figure 2. Some groups of users had additional needs that others did not have. These additional needs implied product features that were not disturbing others. In addition, a small number of conflicting needs were identified. These needs implied conflicting product features that would help some users and disturb others.

One of our case companies designed their products in co-operation with their key customers. A product manager complained in an interview that this leads to extra work later when the system is sold to other customers. In some projects, the features required by a key customer had to be removed because these features were disturbing other customers. Thus, also in these cases, most of the needs were common for the different customers even if there were some conflicting needs, too. Identifying these conflicting

needs before implementing the product would have saved money for the company.

CONCLUSIONS

We have proposed a process of identifying and selecting relevant users for field studies. This process complements the existing approaches such as [2, 8, 10, 17] for gathering user needs by field studies. The seven field studies reported here provide preliminary empirical evidence that support the iterative process. Our experiences of selecting users for seven field studies show that this kind of process helps identify the diversity of users, select representative users and identify their needs. Describing user characteristics is an effective way of identifying user groups and making user sampling more representative.

The developed process of selecting users could be also appropriate for selecting users for usability testing. We should select relevant and representative users for usability tests similarly as for field studies. However, we need more research on that subject. In addition, the experience shows that the process of identifying user groups is iterative and practitioners tend to underestimate the diversity of user groups in the beginning. Thus, it may not be trustworthy to brainstorm and describe user groups, but the assumptions made about users should be tested and the preliminary descriptions of user groups should be verified by field studies or other ways.

At its best, user identification is based on both quantitative and qualitative information including market segmentation studies and field studies etc. As experiences with personas show the user descriptions should be based on real data, otherwise they are not perceived as credible and are not used [3, 7].

On the other hand, developers often complain that users have too variable and conflicting needs. Also Cooper [4] argued that designing for just one person will have far greater success than designing for a broad audience of users. Cooper is probably right in saying that trying to please too many different points of view can kill an otherwise good product.

However, our studies show that focusing on just one person or user group is not reasonable in all cases. Systems and products usually have a variety of users and user roles. In order to make the comprehensive use of the system possible, the different user roles need to be satisfied. Furthermore, it is necessary to identify the diversity of users in order to select rationally the target group.

The number of participating users in the field studies was relatively small. However, the field studies were replicated several times in varied kinds of product development contexts and the results have a similar kind of pattern. In systematically identifying different user groups, we could gain broader information about user needs and make the products more usable. In case 2, we explicitly evaluated the results and found that in this way the developed product

was more usable than a product developed through the baseline development process with mere iterative usability testing [12].

Thus, the findings support the view of several authors that varied kinds of users should be selected for user-centered design [2, 8, 20]. Our studies show that in most cases, user needs do not vary a great deal; in fact, a core set of common needs can be identified. This implies that it is possible to design a product that satisfies the needs of a broader set of users even if a consumer product is concerned. However, the additional and conflicting needs should be identified and considered in the early phase of development. How the variance of user needs is described for user-centered design and product family design purposes is a subject for future research.

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