EVASERVE

Module:
"USER NEEDS AND REQUIREMENTS, USER CENTERED DESIGN OF ITS"

Change history:

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BACKGROUND

The "historical" view to traffic information

In the past and even currently, drivers and travelers are used to get traffic related information on several media: on radio, newspapers, text-television, and even television. During the last 20 years traffic related internet services have become very popular and are among the most used web pages in many countries. Most of the existing information sources have been provided to the users without direct costs often by governmental bodies such as road authorities.

Taking the background into account, it may be challenging to convince the users to pay for new traffic related services, no matter sophisticated, real time or personalized those are. It has been said (e.g. Wahlberg, 2002), that the consumers, at least their majority, will not buy telematics just to get the latest technology. They want to get services that provide them with real value. Especially, when there might already be a "cheaper" substitute, such as paper map compared to the map in the navigator. Majority of the users is still quite critically cost-benefit oriented, and if they don't find the new information service or device to bring them more value than the "traditional" one, they might not be willing to obtain it.

In addition to costs – another characteristic in the process of getting traffic related information is in transition. Almost all of the "original" traffic information sources have been not just free of charge but also "free of effort", meaning that users have been provided with information as a broadcast or "push"-service in mass media. They haven't had actively to search for it – or select required settings to get the information. In the internet, there are already both types of services, those that are provided for everyone in the same format and without charge – but also newer ones which require registration, personalization and are no more free for the end user. The needed contribution – both monetary and manual effort – is to be compared with the gained benefits by the users.

Due to the fact that traffic information services typically need quite huge infrastructure investments for e.g. data collection and processing, it is quite easy to come into the conclusion that the amount of future users (consumers, buyers, payers) should be quite large to get the service or product to be economically profitable. The chasm (e.g. Moore, 1999) should be crossed to achieve the business economical profitability. In most of the cases, it is not enough that a limited number or lead users (aka early adaptors) will adopt the new technology. On the other hand, one might also raise the question of the need for business economical profitability, but overall benefits for the society How should the increased traffic safety been taking into account in this calculation. It is often stated in the media, that for instance red light cameras are not "paying themselves" back since the implementation and maintenance costs are so high. Maybe this holds true in business economical model, but how about the increased safety? The less "serious" examples for the benefits not so easy to calculate are increased travel comfort as a result of better information and also savings in travel time, pollution etc.

Challenges for the future services

In addition to the previously mentioned transitions in the area of traffic information services, there are many other challenges the new services are facing before becoming successful One of the most important issue is the one common for all so called intelligent products. When interacting with a new telematic system or service, users are actually interacting with one kind of computer. It has been even said:" To err is human, to really screw up, you need a computer!". Driver – vehicle – environment –interaction is getting even more complicated in the situations, where driver is not only "traditionally" interacting with other traffic and car controls but also in-vehicle technologies, including both information providing systems and advanced systems aiding driver in critical situations (ADAS).

Usefulness of many of these products clearly depends on the easy-of-use or usability on the product. In addition to this, when ever we consider traffic related products, especially those indented to be used by a driver when driving, we come into the even more critical field of driver technology interaction, meaning

here not only interaction with the product itself, but other controls of the car and as outmost critical, "the world around the own vehicle", other drivers, road environment, pedestrians etc. Which makes this even more challenging than just doing two things at the same time in the environment that stays constant (like kitchen while cooking) – is that there is nothing constant in the road environment while moving there: the road infrastructure is changing while you are moving, the other road users are moving, and may do something unexpected – and the driver (and user of new technology) should always be on top of this situation – ready to react when needed to avoid conflicts (called situation awareness).

Situation awareness is affecting the drivers many ways. On one hand, one might become distracted while using any driving related or non driving related device while driving, and therefore the situation awareness might not be as good as without using the device (e.g. conducting the secondary task). On the other hand, it has also been found that the drivers may also rely on the so called advanced driver assistance systems (ADAS) so much that it is hard for them to take over the control when needed.

Ease-of-use is not only an issue that just new technology products are facing. In the very well known usability book by Nielsen, the author describes a study of 2 000 adults in Oregon in which it was found that only 18% could use a bus schedule to find the time of departure. This finding did not indicate that the remaining 82% of Oregonians are less intelligent and should never be allowed onto a bus. Instead, the likely explanation is that the bus schedule was designed by people with extensive knowledge of buses and local transportation, who just knew the meaning of every element on the schedule, and therefore never considered that parts of it might be difficult to understand for people who rarely take a bus.

Challenges in investigating the user needs and requirements towards future technology in general

There are several challenges to overcome when investigating user needs towards new technology. Overall, the users may have problems when picturing the future and what they would use, pay for etc. In addition, there is a challenge of how to explain the service or device that does not exist yet. One particular example about the difficulty to forecast the popularity of new services, is the popularity of short text messages (SMS). Who could have told 15 years ago that there would be send millions of SMS 's in Finland every year. Think about asking people: "You will have 10 buttons in your mobile phone to use. You can write in total 160 characters with those and send it to the person you want to. This will cost you 20 cents. Would you use the service?"

This is one, and quite illustrative example of the difficulties in forecasting the development and popularity of new devices and services. How much can be planned and foreseen and how much is just a result of coincidence and 'happy accidents'? What are the characteristics that make some innovation to become a useful commodity, something people want to purchase and use, even an object of fashion.

Theoretical background

There are still several questions unanswered after quite a many user need studies at the area of transport telematics and traffic/traveler information. One basic problem is the one with the existing – or truly said: non-existing theories. There are quite several theories, on which the studies can lean partly, e.g. marketing, driver behavior, research methodology, sociology, social psychology, micro-economics, to mention a few. However, there is not such a theory as user needs to transport telematics!

User population and service levels

In general, the aim of transport politics in Finland is to provide all the citizens with equal possibilities to travel as they need to do to achieve their normal daily routines. In that sense, there must also exist equal (basic) traffic and traveler information available for all the citizens regardless of e.g. age, gender, physical ability/disability, residential area or economic and other resources. Therefore, a wide variety of users need to be taken into account when planning and implementing the services. In the past few years, traffic information services have been started to segment into "basic" services that are available for everyone, and are free of charge to the end user. The more sophisticated and personalized "additional" services are therefore no more provided by road authorities and free of charge for the end user. Different user groups

and specific target users needs to be basis for the user centered design of those services. In addition, it is good to keep in mind, that often a service or a device that can be used by more challenged users (e.g. elderly, …) is most of the time also easier to use for everyone (design for all principles).

Context
To achieve the representativeness, telephone interviews are one of the most cost-effective methods. However, there is a "question of context" to overcome. The respondent is normally interviewed in the middle of his/her daily home routines. At the same time he or she should be able to think about his/her traveling or driving, and to answer to the questions concerning that. Different kind of reflexive methods, e.g. diaries, have been tested to make the context clearer for the respondent. Still, those are useful, if all the respondents have those on hand. The problem of context can be further divided into two sub problems:

Context of the interview as interaction: Many researchers conceive of the context as being the sum of total physical, social, and psychological stimuli that exist at the time of an interaction. The definition conveniently allows the analyst to decide what counts as the context on the basis of his/her own assessment of the situation. Some researchers argue that the context is a phenomenological construct that is created jointly by the participants. (Briggs, 1995).

Context of the studied phenomena: In addition to the context of the interview as interaction, there is the context of studied phenomena to take into account and to be aware of. Especially, in case of quantitative studies where people are interviewed e.g. by telephone, the researcher must be very careful while planning the questionnaire/questions. The respondent does not answer direct in the situation, which is under interest of the study. On the contrary, he or she might be in the middle of his/her daily home routines with children etc. and the researcher is interested about his/her travelling, his/her willingness to pay for some services or devices in the future. To overcome this problem, the respondent should be given as comprehensive introduction as possible to get him/her to think about the phenomena under interest. In addition, the interviewer needs to remind the interviewee often to keep him thinking about the correct context. On the other hand, one must keep in mind, that the total length of an interview is very limited, especially in case of telephone interviews.

Problems to overcome in interview studies in general: reliability and validity of the studies
The two concepts – reliability and validity – are discussed in most works on methodology, because they provide the benchmarks by which data analysis and collection are measured. In short, reliability refers to the probability that the repetition of the same procedures, either by the same researcher or by another investigator, will produce the same results. Validity refers to the accuracy of a given technique, that is, the extent to which the results conform to the characteristics of the phenomena in question. (Briggs, 1995.)

It has been pointed out earlier (under 1950's) that very few studies in the methodological literature were concerned with validity. Emphasis was rather placed on decreasing inter-interviewer variation, that is, in reducing the extent to which inter-interviewer differences affect the reliability of data. The interviewer's attempts to increase reliability by standardizing the presentation of the questions thwarts her or his ability to achieve ecological validity (Briggs, 1995).

OBJECTIVES

Main goals of user needs –module are as follows:

1) to emphasize the importance of user centred approach in any development process, especially the ones including new technology with HCI (human computer interaction)
2) to give an overview of the methods to ensure user centred approach in the development process,
3) to give overview of the complexity of the area of HCI in traffic and
4) to list some examples of the user centered studies conducted at VTT during the past 15 years.

METHODS

User centered design process in general

Knowledge and understanding of the user needs and requirements are crucial to ensure the new product to achieve its goals, no matter if social or economical. If the users don't need, or don't think that they need a product they will not pay for it. On the other hand, if the products aimed to be used while driving are too complicated, demanding too much attention from the user or otherwise crucially affecting the driving task, the consequences of the introduction of such devices can only be imagined..

Since traffic related services and products are becoming more and more complicated, including mobile usage, use of different software and hardware, even while driving, it is outmost important that users and user centered design is part of the whole design process (*figure 1*).

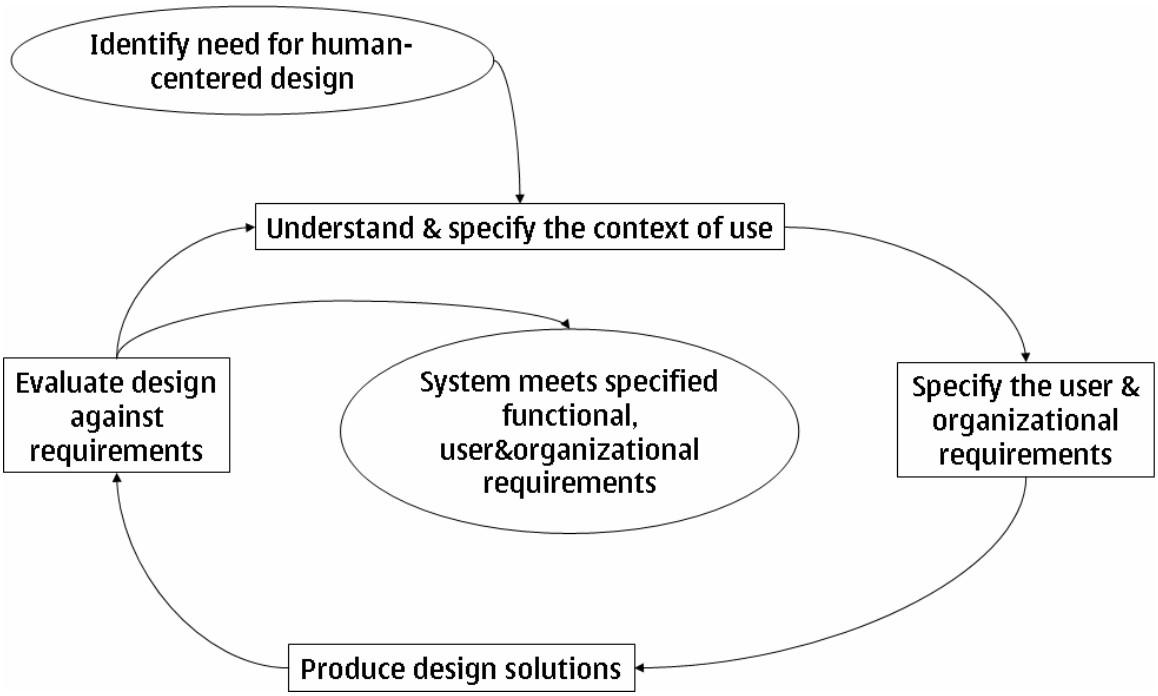

Figure 1. User centered design process (ISO, 1999).

The first task can, and actually should always lead to the next phase in traffic related systems or services. Human user is always a part traffic – and therefore at least some type of user centered approach should be included into the designing process.

Understanding and specifying the context of use is very important in traffic related designing processes. Users decisions – either correct or wrong ones – do not only affect themselves but also the other people in traffic – and therefore, traffic system and safety. In understanding the context of use, also the variation should be taken into account. Traffic environment is anything but constant, weather, incidents, mixture of traffic etc. are changing continuously.

When specifying the user needs and requirements, one must keep in mind, that there is no such thing as an average driver. Neither can the services be planned and addressed for such a driver, or traveler. The users of the traffic system are as diverse as humans in general. There are different users (by age, driving experience, physical capabilities etc), and even one user have many different needs and requirements depending on the situation (mode of transportation, purpose of trip, even motivation and emotion). Therefore, the user centered design process must take these different users and different use cases into account while reaching for optimal – or at least best possible solutions.

Based on the diversity in the context and users and their requirements, the first set of produce design solution is introduced. It can in the beginning include several options that can be tested with the users to find out if they fit into the requirements. If they don't, the iteration should be redone. One must also note

that the solutions tested in the first testing round don't have to be final or "fancy", and actually they should not. The whole process should be very iterative in its nature, to enable the user needs and requirements taken into account before introducing the final product – to which, one cannot affect that much anymore.

User-centered design-process in traffic related information services

User-centered design process and related user centered methodologies can be categorized for instance based on the product's degree or readiness. By this categorization, the four different approach "families" can be listed for instance as follows:

1. User needs evaluation or strategic design,
2. User involvement in design process,
3. Usability and in traffic: SAFETY evaluation, and
4. Marketing research.

All the above listed approaches serve the same main goal: to enhance the products' user centered characteristics, to make sure that the product is going to be used as planned and it is not going to have non-planned negative side effects while used in traffic

What is then a difference between the distinct techniques or approaches. The main characteristics of the different approaches ca be listed as follows:

1. *User needs evaluation (VTT): or strategic design*
    - Context: traffic and transportation
    - Wide problem area: needs in the different situations (hurry, familiar/not familiar route, mode of transport, weather etc.) and different users: (individual differences, constant/variable differences)
    - Services vs. devices: already existing services vs. telematics enabled future services, added value of telematics.
    - Social point of view: the basic service level for all the citizens
    - Information of the service vs. marketing?
    - Governmental services, public-private partnership, private (market-driven) services.
    - No all the products are interactive, some can only be one-way information from the producer to the user, and some interactive, even intervening (taking e.g. part of the driving task away from the driver, as advanced driving assistance systems).
2. *User involvement in the product design*
    - The users are taken into the product development process
    - There is already a idea of a product to be manufactured,
    - The specific product is designed with the real users: the different approaches are used in the design process. The final product is the sum of compromises: time schedule, aims of the engineers, user needs and requirements.
    - The product is quite often interactive in some extent.
3. *Usability/user testing/safety evaluation*
    - There is a product or a prototype of it to be tested by the real users
    - "The extent to which a product can be used by specific users to achieve specific goals effectiveness, efficiency and satisfaction in a specific context of use" (ISO 9241-11)
    - Interaction research

- How are the users using the product? How they were thought to use the product? How fast can they learn? What kind of mistakes are they doing? How could the product be developed further?
- Quite demanding task to report the findings; the main aim is to find bugs and failures…
- How does the product affect the user? Does it have negative effects; does it have negative effects to e.g. traffic safety?

4. *Marketing research*
   - Usually products which are on the market already: which of the alternatives, why, what influences the choices and how much, market segmentation
   - Can be concentrated in the specific market segments and/or customers
   - Usually it is possible to compare the study results with the real market data – at least in some extent.
   - The instrument in marketing: the needs cannot be created (Engel et. al., 1995) but at least stimulated.

In a way, the level of interactivity seems also to have effect on the methodology to create and achieve a needed, wanted, usable product that has also positive effects. The more interactive the product is, the more difficult it could be to achieve the usability goals just by interviewing people without any prototype to test. This must be kept in mind while considering devices and services just giving traffic information and the devices that really interact with the user as advanced driver assistance systems (ADAS).

The modern, "intelligent" (the products are not intelligent in a way people are – the just have a few features of data processing) products are typically such, that the user is interacting with them or even interacting with other users and traffic environment while using them. The products are combinations of mechanics and programs, hardware and software (Keinonen, 2000). For the user's point of view, the distinction between soft- and hardware is not necessary very clear or even interesting. However, the designer must take the usability into account in designing both separately and – last but not least – in designing the whole product to be used in specific context (especially if to be used in traffic).

Interviews and questionnaires

Interviews and questionnaires cover quite a wide area in the user-centered research and design methodology. They can be used as quantitative – to find out for instance how many users are interested in a new service, how much they would be willing to pay for it, and also, how do different user groups differentiate from each others. Interviews and questionnaires are can be, and are used in all the above mentioned phases. Before there is even a product, a goal of a user needs study may be to find out, how important users consider real-time information of the arriving buses to be. When involving the users directly into the design process, several variations of the interviews and questionnaires can be used. They can be either very strictly formulated (table 1) or just about "chatting" of the investigated phenomenon. Interviews are also used in connection to user tests and also widely in marketing research.

The two methods are often considered to be just one, and the terminology is sometimes mixed. To cut the long story short: interview always included interaction between the interviewer and the subject of the study, whereas questionnaire is filled in by the participant without interacting with interviewer. The main characteristics, advantages (+) and disadvantages (-) of interviews and questionnaires are listed as follows (Jyrinki, 1977; Penttinen, 1997):

Interview:
- it is in general flexible method and therefore the non-answering is almost negotiable (+)
- the questions can be asked in the specific order (+)
- the researcher can create different paths to follow according to the respondent's earlier answers (+)
- the respondent cannot consider his/her responses beforehand (+/–)

- in case of personal interview the researcher can control the situation (who answered) and make observations (+)
- the interviewer/researcher can affect on the responses (–)
- in case of semi- or non structured interviews the interviewer/researcher can interpret the answers incorrectly according to his/her own expectations (–)

The interview situation itself is an interaction between the respondent and the interviewer. Therefore physical, social and communication related aspects must be taken into account carefully, especially when there is any kind of risk of social favorable answers (typically: users state that safety is outmost important even if they want to have a fast car).

Questionnaires:

- economically affordable (+)
- accessibility better than in case of interviews (the mailed questionnaire reaches the respondent better than the interviewer) (+)
- the possible effect of the researcher/interviewer vanishes (+)
- the questions are exactly similar for all the respondents (+)
- the respondent have time to consider and specify the answers (+)
- the respondent can consult e.g. family members and use source material (+/–)
- the researcher/interviewer does not have a possibility to help with complicated/unclear questions (–),
- the number of questions is limited: the longer the questionnaire, the smaller the response rate (–),
- there is typically similar kind of people, who do answer the questions (e.g. elderly, people who have time) and respectively a group of people who do not answer the questionnaires (busy people, typically young and middle-aged men). Therefore the sample may not longer be representative but biased. (–)
- it is hard to know which of the family members has really answered the questions (–),
- the questionnaires may be filled only partly (–)
- additionally for the internet-questionnaires: the group of respondents is not representative of the whole population: not everyone uses internet, and not everyone using internet is participating the study. However, one can also argue, that when it comes to the developing of e.g. internet services, internet interview is quite a good choice of the methodology in the early phase of planning or even when evaluating the service. (+/-).

As mentioned above, an interview can also be classified as structured or loose. In the structured interview, the questions and question order is very strictly structured and the questions are not modified by the previous answers. Of course, if the form includes questions that are not relevant to the interviewed persn, those can be “jumped” over. One example could be: if the person never uses bus transportation and doesn’t even have access to it, it is not very good idea to include his answers to the set in which the goal is to find out how users like the current but information service. In the loose interview, the interviewer can just have listed the themes, of which he or she is going to discuss with the subject of the study. The advantages and disadvantages of loose and structured interview techniques can be listed e.g. as follows (*table 1*)

Table 1. The advantages and disadvantages of loose and structured interview techniques (Coolican, 1999).

Method	*Advantages*	*Disadvantages*
Loose	Relative natural conversation: produces richer, fuller more genuine and more realistic information on interviewee's own terms. Enables capture of respondent's construction or unique perspective. Interview questions can be adapted to: context, interviewee's style and thoughts and the general flow of answers. Relaxed, more informed and involved respondent.	Differences in procedure could make data comparison less fair and reliable. Difficulties in analysis of wide variety of qualitative information. Important topics could be missed. Length and depth of process may limit numbers it is possible to interview. Some people may not want to commit the time and energy. Requires thoroughly trained interviewers.
Structured	Ease of data comparison and analysis Can be replicated and data reviewed by other researchers. Reduction of interpersonal bias factors. High reliability from "positivistic" view. Results more generalisable. Interviewers need not have all the skills and experience required for loosely structured procedures. Speedy administration: • Respondents may feel more ready to participate given low time/effort commitment.	Data obtained may be trivial. Narrow range and quality of information gathered. Respondent constrained and cannot express complexities and subtleties of an issue or experience. Questions wordings cannot be adapted to levels of understanding of the respondent. Suffers general questionnaire weaknesses.

In case of both interviews and questionnaires, there is always a risk that one might not fnd out what he was looking for – meaning that the subjects of the study don't understand th questions correctly, and as a result, the data obtained, is befinitely not valid. There are at least the following things to avoid when planning the questions and statements. The supreme ideal would be that all the respondents will interpret an item in the same way. This is unrealistic, but there are several aspects to consider in the statement design (Coolican, 1999):

- *Complexity*: avoid complex statements. Break those up into logical components.
- *Technical terms*: There are many technical terms that are clear to the researcher but not to the rest of the population. Try to explain with popular/common sense terms.
- *Ambiguity*: make it clear, which is the "object" to assess
- *Double-barreled items*: do not ask two questions at once
- *Negatives*: in principle there should be half of the statements positive towards the object and half negative. Be careful with combination of reject/not, ignored etc. Make the statement negative in the beginning, not only negating a positive statement.
- *Emotive language*: Emotive items should not be in the beginning of the test

- *Leading questions*: do not give the respondent statements, which are hard to disagree. Otherwise you can get answers like yes, but… that should be actually counted as disagreement but will be recorded as agreement because of the beginning "Yes,…".
- *Invasion of privacy*: do not be intrusive: do you have a criminal record?
- *Balance of scaled items*: as many scale items for positive and negative opinions
- *Balance again*: the positive and negative items must also be the same issue (not e.g. helpful vs. enjoyable)
- *Sensitivity of scaled items*: for instance a dichotomy yes/no is usually too insensitive.

Organization of items
There are several principles to organize the items to get more reliable and valid results.
Response set or bias: An effect called *response acquiescence set* (myöntyväisyys) often occurs when responding to questionnaires. This is a tendency to agree rather than disagree ("Yeah –saying"). To avoid a constant error from this effect, items need to be an unpredictable mixture of positive and negative statements about the attitude object. There is also some evidence of a smaller bias towards disagreeing with items. (Coolican, 1999).
Respondent's interpretation: With any questionnaire or scale, it is a good ides to make it clear that both positive and negative items will appear as mentioned above.
Social desirability: This factor involves respondents guessing at what is counted as a socially acceptable or favorable answer and giving it in order to "look good". A further reason for guessing might be to "please the researcher" by giving the results it is assumed are required.

Other user centered design methods

Focus groups and user panels
Group discussions help to summarize the ideas and information that a group of informants may come to old as a group, rather than the information held by the individual members. The general idea is that each participant can act to stimulate ideas in the other people present, and that by a process of discussion the collective view becomes greater than the sum of the individual parts. (Poulson, 1996).
Group discussions can be used to serve a variety of purposes, and may be used to assist in problem identification, in clarifying the issues relevant to a particular topic, and in the evaluation of products. Group discussions form a part of such techniques as Brainstorming and Focus groups. Group discussions are very common in the "user requirement" stage of product development. (Poulson, 1996).
Focus groups bring together participants to discuss a particular topic, and differ from brainstorming sessions in that the objective of the meeting is not necessarily to be creative, but rather to come to some agreement regarding a particular topic or issue. A variation of the use of focus groups is to combine the characteristics of individual interviews with group based techniques. A researcher might first interview a number of participants on a particular topic, to then summarize those personal interviews, and then use the results as a basis for further interviews or a group discussion with the original participants. The idea behind this is that the individual interviews allow each participants to contribute to the ensuing discussion, where the collective opinions can be explored in more detail. (Poulson, 1996).
Very often it is the users that are the most relevant participants in discussion groups, as they are the experts in dealing with their own situations, and needs. However, if a new product is being developed it can be very difficult for potential users to express their needs, or to visualize how the new idea might help them. This is less of a problem when non innovative developments are being considered, and if an existing product is being improved, user's opinions are very valuable. (Poulson, 1996).
In user need studies, focus groups can be used either in the beginning – to gather ideas to be later tested with e.g. quantitative interviews, or after the quantitative interviews to get the meanings and insight to the results.

User trials

In user trials a product is tested by ”real users” trying out the product in a relatively controlled or experimental setting, where they are given a standardized set of tasks to perform. The result can be a ”problem list” which contains valuable information for designers regarding the potential for improving that usability of the product. Time spent completing a task or the number and types of errors made in use, is information that can be used to compare two different products or two versions of the same user interface. Subjective statements about acceptance are normally part of the results of such trial. (Poulson, 1996).

The testing procedure originates from experimental psychology, and may be performed in a very formal way, performing controlled experiments and using statistical analysis techniques. It is, however, most often used in a more qualitative manner. (Poulson, 1996).

User trials are normally applied when a prototype product is running, or when a complete product is to be evaluated. Low-tech mock-ups and prototypes may also be used. They are often used before a final product design has been agreed, and are commonly used on pre-production prototypes. They are often used as a simpler way of evaluating products compared to more extensive field trials, which commonly take place when a more completed product is to be evaluated prior to market release. (Poulson, 1996).

In transport related studies this is most often the testing of e.g. comprehensibility of e.g. pictograms, phrases etc. in laboratories. The use of driving simulator is quite common as well (e.g. in VTI in Sweden).

Field trials

In field trials a product is tested by users in a real life settings. Both the product and the field trial setting are designed to be as close as possible to actual usage. This often involves installing a particular piece of equipment and then monitoring its performance over a period of time. It is common to allow users to operate equipment as they would in actual usage, and it is usual to monitor that usage using objective and subjective measures. (e.g. Poulson, 1996; Coolican, 1999)

One common method is to conduct regular interviews with users in order to plot their experiences in using a product. In addition the technique can be used in conjunction with other data capture tools e.g. diary keeping methods. Usage and non usage of equipment can also be recorded in such trials, and in some cases the product itself can keep automatic records of its usage i.e. where the product is computerized and has automatic logging facilities. (Poulson, 1996).

The result of such an investigation can be a problem list, which contains valuable information for designers regarding the potential for improving the usability of a product. The use of field trials is very common for the testing of new products prior to their commercial launch. Field trials are normally applied when a final prototype is available, or a complete product is to be evaluated. Because of the relative time and expense of running a field trials it is not common to use them in the early stages of product development, but rather to use them for evaluation purposes. (Poulson, 1996).

In transport related studies the fied trials can be used e.g. to test the effetcs of a device (in-vehicle or traffic sign) on e.g. traffic safety.

Direct observation

The term non-intrusive is often used to characterized this technique: users do what they normally do without being disturbed by the observes. One of the advantages of this method is that users can be observed in the environment where the system is normally used. This is why direct observation is said to have high face validity, also referred to as external validity or ecological validity. However, one must always be aware of the so called ”Hawthorne effect”; the fact that people usually perform better under observation because of the attention paid to them. (Poulson, 1996).

The data captured during direct observation can include objective as well as subjective information; countable data as well as feelings etc. Direct observation does not allow observers to interfere in the users normal interaction with the products, which is of advantage for ensuring that realistic usage is observed, but also disadvantage in that the observer has to interpret what they observe without the active clarification of the person being observed, and that in addition they cannot control the experiences the person faces. (Poulson, 1996).

Direct observation may also be useful in user need studies when planning/considering different services and travelers/potential users in different situations where they could use the services.

Task analysis

Task analysis can be defined as the study of what a user is required to do, in terms of actions and/or cognitive processes, to achieve a task objective. Task analysis is particularly useful when considering the design of interfaces to products, and how users interact with them. (Poulson, 1996).
Task analysis can be applied to studying how users use existing products, and such an analysis will assist in the process of understanding the difficulties they face in using existing products, and improvements that might be needed. The technique can also be used in a predictive fashion to represent how users may operate products that are just being developed. Task analysis can also assist in the development of training manuals for products. (Poulson, 1996).
Thinking through the sequences of activities that a person would need to go through to use a product can assist in identifying whether these are organized logically or not, and can assist in designing and redesigning the operations needed to use a product. Two processes are usually followed when a task analysis is conducted. The first of these is some understanding of sequence or dependency between different activities. The second process is one of representing how activities or tasks fit together. (Poulson, 1996).
The technique should be used during the analysis phase of design to ensure proper description of user activities. It can be used to analyze interactions with an existing system or as means to structure discussions about a hypothetical product. Task analysis data can be used as input to the detailed design of interfaces to products, and can also be used in planning evaluation studies. (Poulson, 1996).
In user need studies the task could be “daily travelling”. By thinking through all the situations different individuals face during the daily travelling may also give ideas for further studies.

Brainstorming

Brainstorming is one of several techniques to facilitate group creativity. The idea is to let people to come together and inspire each other in the creative, idea generation phase of the problem solving. Brainstorming is used to generate new ideas , allowing freedom for creativity. The tool has widely been used in design. (Poulson, 1996).
Brainstorming is usually applied in the very early stages of design. Especially when there are people with different backgrounds that can give different input to the design process, brainstorming may be a good start. The human resources are the most important in this method. In brainstorming, the session starts with pre-defined question, e.g. ”How to improve x?”. Next step is to give the participants (5–12 people) to sit quiet and think, at least 5 minutes. During that period, they write down (e.g. post-it notes) all the ideas that come into their minds concerning that problem. Even the wild ideas are to be written down. (Poulson, 1996).
Next step of the procedure is to present all the written ideas to the group. At the same time, it is allowed (and actually desirable) that the participants, when getting a new idea, will continue writing those down. After the idea-collecting session, all the ideas are categorized based on for example subjective idea. (Poulson, 1996).
In user need studies brainstorming could be useful in the planning phase of the project. The ideas gathered can give a good starting point into design of the questionnaire.

Usability laboratories

One approach o evaluation, which has become popular human computer interaction in recent years has been the specialized usability laboratory. The principle behind such laboratories is that they provide a place where new equipment or prototypes of equipment can be tested in laboratory settings. Commonly, users are given specific tasks to perform which are designed to be representative of the tasks that users are likely to need to perform with the equipment, and aspects of their performance on those tasks are then measured. This can include times taken to perform tasks and the errors made. Users may also be given questionnaires to fill in after performing their tasks to determine their perceptions as to how easy or difficult the equipment was to use. (Poulson, 1996).
In user need studies, the usability testing could be used if the study is aimed to be a part of the product development throughout the whole process. This is, however, seldom possible.

Different types of data

There are two main types of data obtained in the studies in general, also in user needs and requirements related data. The **quantitative** methods are most often used when modeling the present state or future by asking questions "How much or Who?". The problems to be solved by the quantitative methods concern normally the appearance of familiar characteristics, diffusion/distribution, and variation between different groups and dependencies between the attributes. (Tekes, 2001).
Quantitative methods, therefore, apply best for studying the subjects that are already somehow organized. The results, however, are quite often generalized but non-specific. If one wants to understand the phenomena better, the use of **qualitative** methods is then reasonable. In qualitative research, one is searching also the associations between the cases as in quantitative research. The search is, however, not to find statistical associations but to find sense or explanations between e.g. two variables. (Tekes, 2001).
The target group of a qualitative research ("sample") is not for making statistical inferences to the population as whole but rather to achieve cultural representativeness. In qualitative research one is making inferences in the theories or as essence. In this case, the interpretations of the results are the most important part. (Tekes, 2001).
Quite often the researcher makes the choice between the quantitative and qualitative research. Those two approaches should, however, not be seen as mutually exclusive but rather complementary approaches. One rule of thumb is, that the less the demographic characteristics explain the consumer behavior and the more the psychographic dimensions (such as lifestyle, personality) emphasize, the more one should consider using qualitative methods to deepen the statistical findings. (Tekes, 2001).

Using multiple methods: triangulation
There is a distinct tradition in the literature on social science research methods that advocates the use of multiple methods. This form of research strategy is usually described as one of convergent methodology, multimethod/multitrait convergent validation or, what has been called "triangulation". It should be noticed, that the quantitative and qualitative methods should be viewed as complementary rather than mutually exclusive. (Jick, 1979).

Triangulation is broadly defined as "the combination of methodologies in the study of the same phenomenon". E.g. in organizational research this would involve the use of multiple methods to examine the same dimension of a research problem. For example, the effectiveness of a leader may be studied by interviewing the leader, observing his or her behavior, and evaluating performance records. In this case, the triangulation is made between (or across) methods. (Jick, 1979).

Triangulation can have other meanings and uses as well. There is the within-method kind, which uses multiple techniques within a given method to collect and interpret data. For quantitative methods such as survey research, this can be e.g. the use of multiple scales or indices focused on the same construct. For qualitative methods such as participant observation, this can be reflected in multiple comparison groups to develop more confidence in the emergent theory. (Jick, 1979).

In user need studies, the use of multiple methods is also considered to be an important tool to improve both reliability and validity of the studies. If we want to find out, what kind of services and devices people want to use and buy to help their everyday traveling, we can use several methods. We can, for example, start with qualitative methods (observation, diaries etc.) to gather ideas in general. The second phase could be then quantitative interview (telephone or personal) to measure, how widely accepted are our qualitative ideas. After we have found out, what are the most interesting services or devices to study and which are the most interesting user groups (market segments), we can come back to the qualitative approaches and use e.g. focus groups interviews, interactive computer simulation, scenarios, observation etc. to get more insight of the earlier found opinions. In addition, the final part should then be – if possible – to gather the real market/use data from registers. However, that is quite seldom possible in case of ITS products or services.

Measurement
To begin with, there is a need to make a distinction between categorical and measured variables. A category system can be defined as follows: people fall into one category or another and they cannot be placed in between (men–women). All the other variables can be called measured variables. In many experimental studies the independent (*riippumaton, selittävä*) variable is categorical and the dependent (*selitettävä, riippuva*) variable is a measured variable.
The data can also be divided into several categories based on the measurement level (For more detailed information: see Coolican, 1999) i.e.

- *nominal* (*luokka-asteikko*; men vs. women),
- *ordinal* (*järjestysasteikko*; totally agree, agree,…),
- *interval* (*välimatka-asteikko*; scale 1 to 5, temperature measured in celcius-scale) and
- *ratio* (*suhdelukuasteikko*; as interval, but there is in addition absolute zero-point, e.g. Kelvin-scale to measure temperature, age),

When selecting the statictical analysis method, one needs to be aware of the characteristics of the measured variable. For instance, one should not conduct a analysis of variance to the variable that is measured in lower than interval level. One can, however, quite often see, that ordinal scales are treated with analysis such as variance analysis. More information of the measurements and allowed statistical analysis in Coolican (1999).

CONCLUSION

To ensure that an aimed product will be taken into use, used and will have planned effects on e.g. traffic safety and fluency, users should be taken into the development process already in the beginning. In addition to that, they should also be involved in different phases, and the development should be improved iterative based on users' reactions, feedback and actual measured effects of the use of the product.

In addition, if feasible, the real consumer and user behaviour could be

This short description and presentation of user needs and user centered methods is not by any means detailed enough to be used as such when planning a user study. This can be, however, used as a checklist when selecting the methods, comparing the most used methods and their pros and cons…

In addition, I hope that this short presentation gives motivation and some understanding of the importance of user involvement – especially in the early phase of the development process – the time when the most critical and most expensive decisions are made. In the area of traffic telematics, we should finally proceed from product oriented evaluation to the user centered design!

CONNECTION TO THE OTHER MODULES

This module "User needs" is closely related to the modules of: User interfaces, Market and foresight, Social and political aspects as well as Revenue and finance.

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