

USER PARTICIPATION IS NOT ALWAYS AN EASY THING WHEN DEVELOPING AN INNOVATION

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1. Introduction

User centered design (UCD)/Design for Usability (DfU) and user participation is in the development process seen as important for the creation of useful new products and their transformation into innovations meaning products that have been taken in use. As a part of UCD the product developers can e.g. interview users and watch them using the product. They can also, as a more advanced step, get them aboard on the development project as team members.

This paper is about experiences from two development projects ending up in innovations for which qualified users were invited to be parts of the development teams and some experiences from that. The first project was the development of an ambulance simulator in Norway. The second was the development of a web based administrative system for occupational therapists in Sweden.

The studies were done to find out some other important factors influencing the development of technical products and solutions except form the pure technical disciplines to create functional solutions.

1.1 Treatment in ambulances

In the Nordic countries of Europe there are few people per square km and the distances between the hospitals are often large. Therefore the ambulances must be well equipped so that the initial treatments after an accident or sudden severe illness of a patient must be done in the ambulances by specially trained nurses and doctors. Ambulance drivers should also be trained to drive in a way that does not make the situation worse for the treating staff and patients – not to drive as fast as possible. Thus the ambulances are real work places for the medical staff meaning a tight area to work in and an environment that is moving/shaking when the transport to a hospital takes place. In the Winters also the roads are slippery, which adds to the difficult situations for the treating staff.

As a rule, no treatment shall be done when the ambulance is moving, but when a sudden life dangerous situation occurs, in practice treatment must be done although the rules say something else. Also monitoring of the patient and adjusting sensor connectors and medication drip to the body has to be done by the ambulance nurces and doctors during the transport.

To be able to train the medical ambulance staff Mr. Jo Sterten suggested to take one real ambulance out of use and to place it on a hydraulic regulated table so that ambulance nurses and doctors should be able to work on patient replicas in the ambulance simulator to be developed. To make the development efficient and the simulator training realistic, an ambition was to bring together nurses, doctors and engineers to set up project demands for the ambulance simulator before it was developed.

1.2 Patient administration

In the Nordic countries people since 15 years are used to use different web applications for different topics. However, still the hospital sector is behind the common use levels of the population and in the industry. In an attempt to benefit from the ICT development in the society a female manager of a post hospital treatment department consisting of five occupational therapists decided to ask Dr. Stig Ottosson, who she knew and who was the managing director of Tervix ICT AB, about what could be done to make the administration of the work and the following up of the work more efficient. She also wanted to get better statistics of the work done to show the politicians and municipality administrators that the resources financed by them were used in an efficient way and that no possibilities were at hand reducing the occupational therapist force if the demands were to be serviced in a proper and safe way. With the demographic changes - meaning more elderly to take care of - she also saw a possibility to get good backing with such a system to motivate increased fundings.

2. Research method

The research method used for the two projects was Participation Action Research, which is a powerful strategy to advance both science and practice ([Björk 2003] and [Holmdahl 2006]). It involves practitioners in the research process from the initial design of the project through data gathering and analysis to final conclusions and actions arising out of the research. As Action Research (AR) in general is a qualitative research method that means that often only one single case is studied at time – and that as a longitudinal studie - from which information can be drawn and compared with other studies (e.g. [Ottosson 1996], [Ottosson 2003], [Björk and Ottosson 2007]). The more single AR studies presented the better the PD theory will be. Participation Action Research, which is a specific method within the AR family, means that the researcher acts simultaneously as a researcher and project leader of the ongoing project studied.

For both cases shortly presented in this paper reflections have been made during and after the work was completed. Documentation especially from the development of the ambulance simulator is drawings and notes (e.g. [Sterten 2010]).

3. Theory

3.1 User focus

Design for Usability (DfU) for hardware products and User Centered Design (UCD) for software products share a design philosophy that places the person (as opposed to the ‘thing’) at the center; it is a process that focuses on cognitive factors (such as perception, memory, learning, problem-solving, etc.) as they come into play during peoples’ interactions with things.

DfU/UCD are multidisciplinary design approaches based on the active involvement of users to improve the understanding of user and task requirements, and the iteration of design and evaluation. UCD is widely considered the key to product usefulness and usability—an effective approach to overcoming the limitations of traditional system-centered design [Mao et al. 2005].

DfU/UCD can be characterized as multi-stage problem solving processes that not only requires designers to analyze and foresee how users are likely to use an interface or a product, but also to test the validity of their assumptions with regards to user behavior in real world tests with actual users [Ottosson 2009]. Such testing is necessary as it is often very difficult for the designers to understand intuitively what a first-time user of their design experiences, and what each user’s learning curve may look like.

While most designers are conscious of the need to design for ”end-users”, they often base their understanding of users only on their own experience or on findings from market research. In contrast, user-centered designers also engage with potential users directly, believing that understanding the details of individuals’ experience give greater insight than the aggregated reports of market research, and that what people tell market researchers doesn’t always tell what they actually do when observed in their own context.

A factor necessary to consider is conflicting requirements as end users can be primary users, secondary users, and co-users/side users [Björk 2003]. Often the three user categories have different requirements. A primary user is a person who employs the product or service in the intended way [Hansen 1991]. Secondary users are those who use or handle the product or service in some way e.g. a service engineer. Side users are those who assist or take part in the usage without taking personal responsibility for the outcome of the usage. The three user groups need to be identified in product development work to obtain product usability for all categories. To note is that users and customers often are different bodies [Ottosson 2009]. Figure 1 shows an example of different user situations.

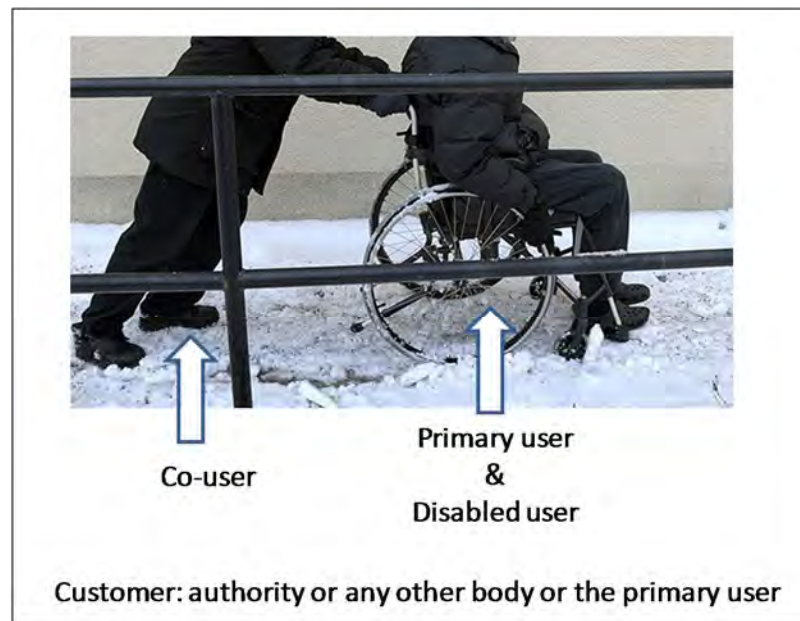


Figure 1. Users and customers can simultaneously appear in different shapes [Ottosson 2013]

Many standard design models involve customer and/or user feedback especially in the latter stages of the product development. But the user-centered designers need to start engaging with users during the early, formative stages to set the agenda for their projects, rather than waiting until it is too late to make significant changes. Then, during the whole development process to a commercial product and the selling of it, one will never lose sight of the customer's and user's view.

3.2 What is innovation?

Innovations are created and developed in the private sector, the public sector and the idealistic (non-commercial) sector although the aim of the work differs [Ottosson 2013] (see Figure 2). For the private sector the aim mainly is to create a sustainable profit. For the public sector the main aim is to give better service to the people in the society – the users. For the non-commercial sector often a better world – on the local or global scale – is the aim with the innovative activities.

“For the private sector the aim mainly is to create a sustainable profit [Baldwin et al. 2006].

There is no commonly accepted definition of innovation. A short definition of innovation covering all the three sectors and situations is:

Innovations are implemented new solutions that have led to economic societal and/or cultural development. [Ottosson 201]:

This short definition can be extended e.g. as it is defined at Gjøvik University College (GUC):

At GUC innovation is defined as a new idea, process or service, a concept or product has been realized and which creates economics, cultural and/ or social value, and which contributes to greater sustainability. At GUC the innovation process is seen in a broad socio-technical perspective. This means that the process of economic and/ or social value created, must be done through new technological innovations (technology and equipment) and also through new social innovation (culture and structure).

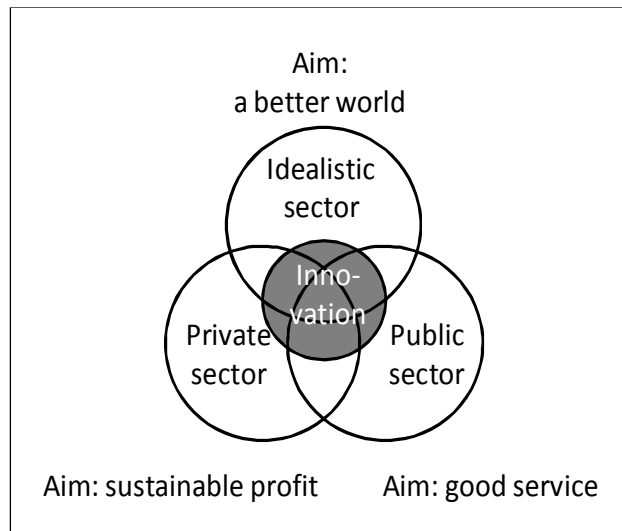


Figure 2. Innovations appear in more than the private sector [Ottooson 2013]

3.3 Product development principles

The reason to develop a new solution that after further work also can be transformed into an innovation is often based on the desire to take care either of new knowledge - called technology push in the private sectors - or a challenge - called market pull in the private sector [Ottooson 2013] (see Figure 3).

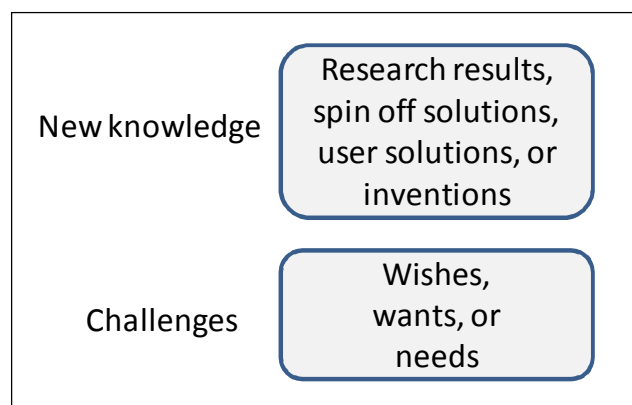


Figure 3. Different starting conditions for new product development [Ottooson 2013]

User innovations are done by so called end users [Henkel and von Hippel 2012] and lead users [von Hippel 2005]. End users develop solutions to their own needs without having in mind to sell them. Often the solutions can - after refinements e.g. by a producer or service provider - be innovations. Lead users are experts in their fields who also develop solutions for their own use but who think their solutions can be of use for others. One example is when a sportsman develops new equipment which results in her/his better performance. Another is when a surgeon develops a new instrument to be better able to do her/his work. A third is programmers making new software when they feel the commercial products are not good enough. Generally, if lead users develop new solutions, the solutions reached are often of high quality and usability compared to when the solutions are developed in a traditional industrial way.

End/lead users have the advantages not having to ask others or watch them before they can start the development as they develop for themselves. The new product development (NPD) success rate will therefore be high (see Figure 4). New product developers have to get information to be able to develop the product and there is a risk that they have not got enough information or have misinterpreted the information. When project planners investigate needs, wants or wishes before they handle over the

information to product developers the success rate will often be low what regards NPD or at least will the development process be slow and costly.

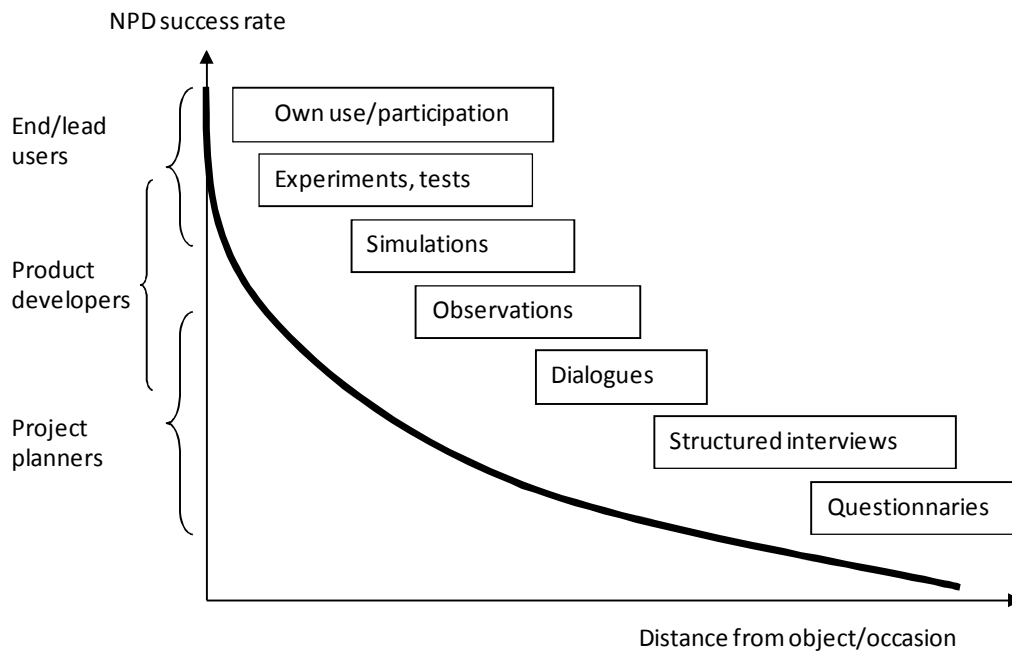


Figure 4. Depending on who starts the NPD process the result will be different (based on [Ottosson 2009])

The development of new products can, as two extremes, be made according to dynamic theories [Ottosson 2009] or classical theories – such as the Stage-gate method [Cooper 2001]. Figure 5 shows in principle the execution for the two methods.

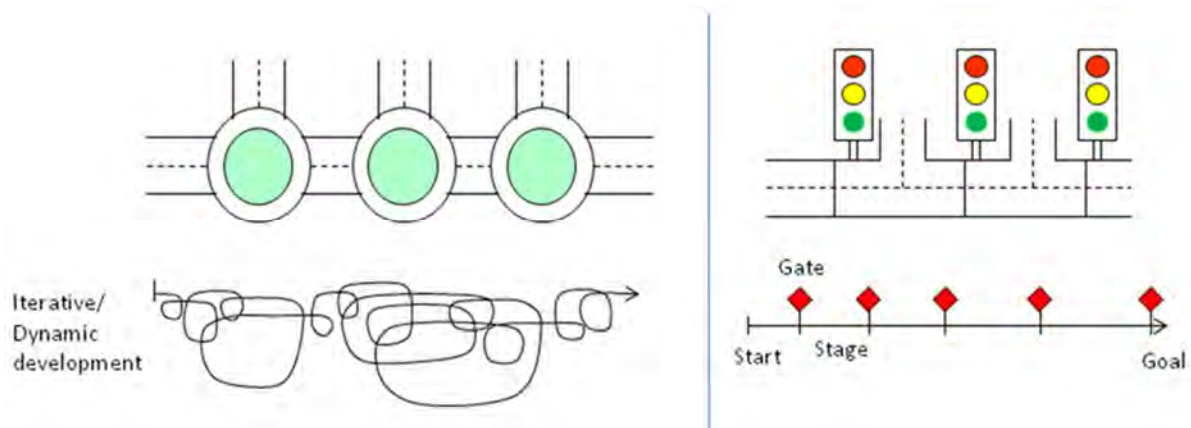


Figure 5. New product development can be done based dynamic or classical philosophies here seen as traveling on a road with traffic islands or a road with traffic lights [Ottosson 2009]

4. The development processes

4.1 The ambulance simulator project

At Gjøvik University College experiences had been gained from the development of a sub-marine simulator (see Figure 6) for which Mr. Jo Sterten was responsible. Of different reasons that simulator never came in use meaning a new product but not an innovation. Mr. Jo Sterten wanted to make use of that knowledge by forming a technology spin off project. He had noticed a want to make a simulator

to train nurses and doctors making their job in an ambulances. Also training of the important communication between the ambulance driver and the ambulance nurse/doctor was to be taken care of as well as the recording of the tests leading to discussions and reflections after each test.

The start of the project was to find an ambulance that could be used as the training environment. The management of Gjøvik Hospital was kind to supply with an ambulance at no costs as it saw the need for such a simulator to be able to train and license staff working in ambulances.

The development of the shaking table was rather straight forward based on the knowledge that was gained from the sub-marine simulator development project [Sterten 2013]. Figures 6 and 7 show the ambulance on the shaking table and how it is equipped.

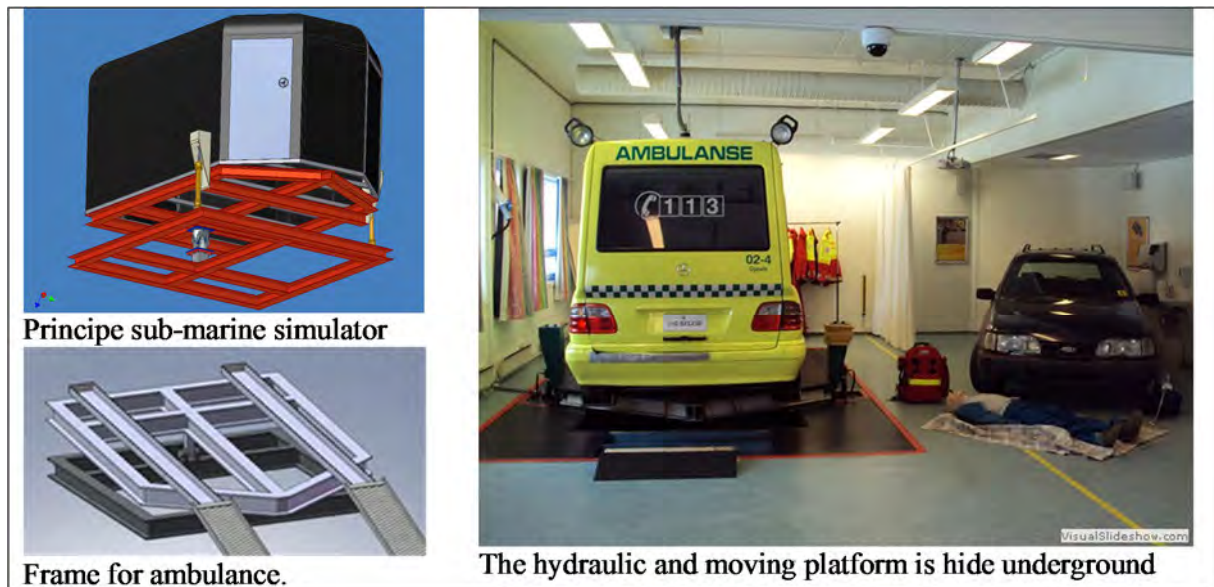


Figure 6. The ambulance placed on the shaking table



Figure 7. The interior of the ambulance (the former prime minister of Norway Jens Stoltenberg inspects the ambulance simulator)



Figure 8. shows an example of the virtual road the ambulance driver had to maneuver the ambulance on

The project was firmly rooted in the strategy of Gjøvik University College where both interdisciplinary work and welfare technology is highlighted as key priorities. Therefore the Dean of the Health Department allocated money and time resources for employees to actively take part in the development project. Based on that management support a desire was to set up a group of 4 nurses, 2 doctors and 6 engineers for the development of the regulating and recording system.

Normally it can be challenging to cooperate in various engineering disciplines, but here the project leader was facing a much greater challenge: nurses with care as the main perspective/background simply did not want to participate in the project. An expressed reason for the unwillingness to participate was that the nurses did not see any role in a technology project. Also it was not possible to manage to find interested doctors for the development project. The only participation interest was from the male head of the clinic laboratory, and an emergency nurse who had a significant motivation and technical insights from his experience in the area. The development project therefore was done mainly with a staff of engineers. Especially the driving on virtual roads to get a “real” feeling, was a point of much discussion.

When the development was finished some technical problems occurred causing the testing nurses to be skeptical towards the simulator. When the technical problems had been solved other ambulance nurses and nursing students showed to be more interested taking part in the project. Today the simulator is used in the training of students and ambulance staffs. An international interest has recently been shown making more ambulance simulators based on the GUC simulator experiences and solutions.

4.2 The software project for occupational therapists

At Ale municipality in the County of Västra Götaland in Sweden there was a want to get a software web based system to follow up the work done by a team of five occupational therapists as well as getting different statistics on hours used on different activities, cost, etc. Tervix ICT AB, a web consultancy in Göteborg, was engaged to develop such a system.

As the occupational therapists were not used to develop software or to specify demands or wishes on such a system the product developers had to ask and try to understand what the therapists needed. When the developers showed drafts/models of such a system the therapists had many comments and were rather critical. Based on that new attempts were done in an iterative way until well functioning solutions had been achieved.

The system was used for four years until it was exchanged with a system used in the whole of County Västra Götaland. The reason for change was a decision by the county politicians and not the municipality politicians. Experiences gained from the project has been used in other commercial products by Tervix ICT AB.

5. Reflections

Some of the research findings were that cultural conditions affected the design processes in the interdisciplinary projects consisting of nurses/occupational therapists and engineers. The communication showed not to work well enough for the process to flow as planned. One can agree and

achieve consensus on user requirements and specifications of the product but the specification of design targets and details showed to be difficult to agree upon. When solutions had been developed by the engineers, the nurses and therapists reacted and were critical about the solutions causing re-engineering. Thus the process was not linear but went on in loops that caused budget cracks and delays compared to plans.

Examples of words that blocked or destroyed the cooperation in the ambulance simulator developing project because of that they was felt as attacks on subculture values are seen in Table 1.

Table 1. Problematic words

<i>Problematic Words</i>	<i>Engineer</i>	<i>Nurse prefer</i>
	Technology	Supporting equipment
	Customer	Patient, user
	Production	Creating
	Efficiency	Good structure nursing, but do not run faster
	Robot	Human care
	Lean	Good working routine
	Waste	waste
	Deviation	Variance
	Resource scarcity	Lack of time with the patient
	Procedures	Procedures
	Usability	Usability

6. Conclusions

The development of the ambulance simulator and the software for occupational therapists had been impossible to do following the traffic light method (see Figure 5). The best way to describe the two development projects is that they were in accordance with the dynamic theories (see Figure 5).

The development of the ambulance simulations showed that engineers and nurses had different expectations of the product development process although the aim of the project was clearly stated before the project start. Different subcultures and different subjects' terminology hampered the cooperation. The engineers were not fully able to understand the user's needs and had an eagerness to deliver more than what the users actually needed. There were a number of cultural barriers and lack of expertise and knowledge that blocked effective communication. Had e.g. the doctors and nurses that were invited to participate in the project been trained in the design process and how to innovate, their participation had been natural.

As the occupational therapists could not make demand lists or tell what they wanted the solution became to make models which they could comment and be critical about causing iterations in a way perceived less efficient, cost- and time consuming.

Despite the cooperation and communication problems, an innovation from the public sector arose based on a unique welfare technological product arose. The same counts for the software system for the occupational therapists.

The wishes from the hospital management getting an ambulance simulator for the training and licensing of ambulance staffs was satisfied although the time it took exceeded targets as well as what was budgeted. Similar findings were done in the software development project.

As the engineers and the nurses/therapists had different backgrounds and training in developing products as well as that they used different occupational languages the development process showed to be inefficient, costly and long lasting although the result became useful for what the ambition was with the development projects.

Seen from an industrial point of view the studies showed that pure technical disciplines to create functional solutions are not enough to develop products in a cost efficient way. An implication is that the education of product developers should have a broader perspective than what maybe is common

today. At GUC we therefore have implemented cross faculty project work to be done by every student the first study year and the second study year.

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