INNOVATIONS FOR LIFE: DESIGN FOR WELLBEING

T Larsson[1], A Larsson[1] and E Kassfeldt[2]

[1] Polhem Laboratory,
Division of Computer Aided Design,
Luleå University of Technology, Sweden
Email: tobias.c.larsson@ltu.se, andreas.c.larsson@ltu.se

[2] Division of Machine Elements,
Luleå University of Technology, Sweden
Email: elisabet.kassfeldt@ltu.se

Abstract
Design for Wellbeing (DfW) will enable persons with disabilities to influence their everyday living conditions through active participation in the design of the assistive devices they use in their daily lives. One objective is to enhance the wellbeing of persons with disabilities by using their descriptions of needs in relation to assistive devices as a starting point for product development. We aim to give users an active role in developing their own assistive devices by allowing people from various disciplines to work with them in a product development team, to improve the wellbeing of persons with disabilities, and to develop product development methodology with respect to a more empowered user role in product innovation processes. This paper reports on the fundamental concept of DfW, but also on two nine-month student projects, CRE[ATIVO]^2 and INTELiCare, that have been carried out as joint efforts between Luleå University of Technology, the Royal Institute of Technology and Stanford University.

Key words: Wellbeing, product innovation, collaborative design

Introduction
The constant ongoing efficiency race in the manufacturing industry with cost awareness and lead time as main business drivers together with, for example, environmental issues and mass customization as factors adding complexity makes the industrial development climate hard. It can be said that the only constant in business is change itself. Product development and production facilities must be tailored to fit global markets where products are produced and sold on global, rather than local, markets.

Design for Wellbeing (DfW) is a global, multidisciplinary project with research, user centered product development, and education as primary ingredients. The project aims to create new processes for global product development with focus on increased wellbeing for people with disabilities, including the additional goal of making a wider societal impact. DfW is a multidisciplinary initiative, with participants from mechanical engineering, health science and human work science. In engineering, end-user participation in the development process is often restricted to needfinding (Patnaik and Becker, 1999) and needs analysis and the occasional testing of prototypes, after which the user receives a finished product. In the context of assistive devices, this may be one reason why the degree of functionality and

user-friendliness is so low that some assistive-device users are even afraid of injuring themselves with their own assistive devices. By adopting an interdisciplinary approach, we will be able to manage the entire development cycle from an initial understanding of users' needs to studies of finished products in everyday use. In the health sciences and human work sciences fields, there is a vast knowledge of what it is like to live with a disability. By bringing people from these areas of expertise (and persons with disabilities) onto the product development team, we intend to give product users a more active role in developing their own assistive devices. We thereby aim to improve the wellbeing of persons with disabilities, and to develop product development methodology with respect to a more empowered user role in the process.

DfW redirects the focus of product development from technology-based development to participatory product development, both in terms of design practice and design education. In addition, it focuses on those people who are deviations off the *normal* or *average* consumer, along many different dimensions, not only physical ability. The framework also suggests a way to approach the rising industry demand for product designers with experience from multidisciplinary collaboration in globally distributed teams (Larsson et al, 2003).

DfW centers on three main goals:

1. *Designing innovative products for increased wellbeing*
2. *Educating the product innovators of tomorrow*
3. *Shaping the future of globally distributed collaboration*

Objectives

The paper reports on experiences from two nine-month global student design projects carried out jointly between Luleå University of Technology and the Royal Institute of Technology in Sweden, and Stanford University, USA, with strong multidisciplinary and distance-spanning constituents. The student design projects were generally situated within the Design for Wellbeing theme, but specifically organized into two different tracks: *Mobility devices* and *Social Health Monitoring and Support.* The objectives of the student groups were to, with user needs as a start; develop innovative solutions to meet the user and market needs.

Some important research questions are:

- How can persons with disabilities be given a more active role in the product development of assistive devices for use in day-to-day living?
- How can DfW be applied so that, for persons with disabilities, *daily living* does not only entail the satisfaction of fundamental personal needs, but also the enhancement of wellbeing enabled by greater opportunities for participating in society on the same terms as people without disabilities?

Methods

Design for Wellbeing comprises two parallel paths of inquiry: a demonstration project and a process development project.

1. Demonstration project

Within the framework of a final-year course entitled *SIRIUS - Creative Product Development*, in the MSc degree program in mechanical engineering at Luleå University of Technology,

several product development projects are conducted each year in close collaboration with industry. This form of cooperation has proven very successful and has led to the development of a number of so-called Greenhouses (Andersson et al. 2002) at Luleå University of Technology. During the academic year of 2003-2004, we introduced Design for Wellbeing as one of the projects in the above-mentioned course, which involved the participation of students, assistive-device users and other interested parties in a joint development project that assessed the entire development cycle – from understanding of user needs to studies of the use of newly developed assistive devices.

2. Process development
The process development project involves researchers who investigate how the product development process can be adapted to address user needs more effectively, and how we can integrate the engineering, business, and human work science disciplines in education, product development, and research. The aim is to develop product development methods that makes cross-disciplinary teams be able to work confidently in heterogeneous knowledge-creation environments. In connection with this the target is to investigate how we can adapt the product development process to address user needs more effectively. The interplay between users' wishes and the formulation of quantifiable product specifications is a key aspect. It is also important to observe the bridges between quantitative and qualitative analyses that are necessary for assuring the success of an interdisciplinary project.

Interdisciplinary/cross-sectoral profile & theoretical starting points
Design for wellbeing represents not only a multi-science approach; it also brings people from various groups – assistive-device users and developers and interest groups – into the process.

The point of departure is in cross-functional knowledge creation, whereby people from academia and the surrounding society interact as partners and equals at both the organizational and individual levels. By allowing people from different knowledge and interest areas to meet in a concrete project in which nothing can be taken for granted, intrascientific perspectives must be reconsidered, and innovative new ideas can emerge and become the basis of entirely new products (i.e., not merely upgrading of existing products) in the field of assistive devices.

CRE[ATIVO]^2
The team started out with only one set of keywords to frame the scope of the project: *active, winter, leisure time*. From these words the team started to focus on mobility devices. Through rigorous needs analysis and benchmarking of current solutions the group discovered the need for winter-adaptable manual wheelchairs. Thus, the mission statement for the CRE[ATIVO]^2 project was formulated:

> *To develop a safe mobility device that is easy to maneuver on varied terrains and in multiple weather conditions. The device should also improve user access to facilities and transportation, while being easily transportable*

Through numerous concept generations and evaluations, a light-weight composite wheelchair and a tire cleaning system was developed. By using composites instead of metal, the weight of the wheelchair was reduced, thus allowing for the addition of extra features

while still keeping the chair lighter than the most popular chairs on the market today. A center of gravity adjustment feature was added, whereby the user can adjust the center of gravity position while in the chair. This allowed for the backrest to be adjustable in different positions, giving the user added comfort. Traction in winter was improved by the addition of clip-ons with a unique tread pattern. Finally, a wheel cleaning device was created to help the user to clean the chair before entering the house during late winter and early spring, when pavements are wet and dirty.

INTELiCare

The goal of Intel's Proactive Health project, INTELiCare, was to explore, demonstrate and test a variety of home health technologies aimed at prolonging elders' independence and enhancing their quality of life. The initial focus of the Proactive Health project is on addressing the needs of elders coping with various stages of cognitive decline. The mission for the team was:

> *To develop a system that could help elderly people to prolong their independence at home and that could help relatives know the state of the elders.*

The idea was to cut time losses, expenses and the work load for the caregiver. It was also the goal to help elders remain socially active and to encourage them to initiate contact with other elders. The communication device for the elders, designed by the student team at Luleå University of Technology, gives the elders the possibility to see what their friends' availability is at the moment. If they browse through the names of their friends they can see if they want to socialize or not. Another possibility with this unit is that they can counteract cognitive decline by viewing images and explanatory text of relatives and friends by projecting these images and texts with the unit on, for instance, a table or a wall.

Figure 1. Left: Exhibition of the light-weight composite wheelchair. Right: Visualization of the INTELiCare elder device concept.

Results

The findings from the research and education projects performed within the DfW agenda indicate that it provides a framework for project-based, team-structured learning in global teams. The wellbeing theme, with an emphasis on the design of products and services that

increase the wellbeing of individuals, seems to act as an appropriate conceptual *umbrella*, under which key challenges in industry can be approached while the educational contents can be continuously redesigned to better prepare engineering design students for a future work environment characterized by multidisciplinary collaboration in global teams, focused on innovation. DfW meshes well with the basic concept of a new educational framework called the Stanford Design School (d.school), currently under development at Stanford University. The d.school framework brings together business, human issues, and technology in a comprehensive approach to support the creation of tomorrow's innovations (Feland et al, 2003).

Discussion and Conclusion

DfW seems well suited to a comprehensive approach to design and engineering that brings together business, human issues, and technology in a comprehensive approach. Such an inclusive framework, carefully tuned to meet the industry's demands on the *engineer of tomorrow*, also needs student and research projects that are thematically inclusive, meaning that many different disciplines can contribute and that the actual collaboration across disciplines is what spurs innovation (Dym et al. 2005).

> *Design for Wellbeing is a perspective on life quality that goes beyond the traditional scope of assistive technology in the sense that it aims to help people make a transformation from an actual state of being to a desired state of being – regardless of ability level.*

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