Should Assistive Technology Centers be involved in User-Centered R&D?
Example of the TOBI-Project – Tools for Brain-Computer Interaction

Evert-Jan Hoogerwerf
hoogerwerf@ausilioteca.org

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Opportunities

AT centers are places where needs and resources to respond to those needs meet.

Needs: Unexpressed or not met yet

Resources

- Teams of qualified professionals
- Overview of needs
- Favourable setting and infrastructure aimed at identifying solutions.

Research in AT should always include AT centers with "hands on" experience
Our work in key words

Supporting people of all ages in identifying appropriate technological solutions for increasing autonomy and independence in all areas of life.

No commercial interests

AT Resource centres operated by AIAS staff:

• Emilia Romagna’s Regional Centre for Assistive Technology
• Centre for Technological Aids
• Centre for the adaptation of the home environment

Involvement in research projects as AT professionals
Independent AT centres

• Support people in identifying appropriate technology that suit their needs in different areas of independence, participation and inclusion: supporting informed choices
• Provide independent advise (no binding ties with industry)
• Work with Multidisciplinary teams
• Intervene in different settings (centre, home, work, etc.)
• Establish a long term relationships with clients
• Have a wide range of solutions available in the Centre
• Provide personalisation, loaning, training and support (following assessment)

...are the result of an evolving perspective on disability!

Ref.

GLIC Association. The Italian Association of Independent ICT-AT Centres: www.centriausili.it
Dimensions to be considered in designing AT solutions for and with people with disabilities

This requires:

- Multidisciplinary team work
- Participative design
- Communication and a shared language between actors
- A holistic approach: more than solutions, we are supporting life projects

Interesting prerequisites for UCD
User Centred Design

The ultimate goal of any User-Centered Design process is to ensure that the final product or service fulfills the users' wishes and needs.

UCD is fully integrated with knowledge translation and technology transfer models, where researchers and developers collaborate with end-users, industry and other stakeholders to evolve from problem identification to solution validation.

Ref. Lane, J.P. (2010). Delivering on the ‘D’ in R&D: Recommendations for Increasing Transfer Outcomes from Development Projects. SEAT Center and ATIA.

The lack of user involvement or incomplete user requirements are the main reasons for the failure of ICT system development.


In AT:

the real-world needs of users

the capabilities and opportunities afforded by the technologies

### Parallels between good practice in AT assessment and UCD practice

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TOBI Project

The TOBI project aims at developing non invasive brain computer interface (BCI) controlled applications in the fields of Assistive Technology (AT) and Rehabilitation Technology.

- Short time-to-market perspective
- Evaluated by end users (people with disabilities and patients in rehabilitation
- Functional - Usable
- Reliable - Safe

Application areas
Communication and control (text entry, web and document browser)
Entertainment - leisure (fast and slow games, photo browser, music player)
Motor substitution (Tele presence robot)
Motor substitution (orthosis - upper limbs)
Motor restoration (medical device for post stroke rehabilitation)

www.tobi-project.org

Project period: 1/11/2008 – 31/01/2013

Funded by the EU in the framework of the 7th Framework Programme FP7-224631.

Budget: approx. 14.000.000 USD
Type of technology

Non-invasive BCI are based on electroencephalogram (EEG) signals. The EEG is recorded through electrodes placed on the user's head. Signals are used to drive applications.

HMI based on
- evoked potentials
- motor imaginary

Click Here

BCI does not
Read your mind
Write your thoughts
Heals parts of your brains

No muscular movement required
Our concern

• The involvement of all stakeholders in the technology transfer and product innovation process in order to make these more efficient and effective.

• Establish reciprocal learning between researchers, end user and AT practitioners.

• Explore the role and contribution of AT practitioners in AT research projects.
Framework of reference for UCD in TOBI

ISO 9241-210 human centred design processes for interactive systems

- This is a technical revision of ISO 13407 - “Human” stands for user + significant others
- For ex. 6.5.2 Conducting user-centred evaluation + 6.5.4. User based testing

User centred evaluation metrics

Methods and tools able to capture the user experience: www.usabilitynet.org
methods tables and guidelines

Living labs for open innovation

- “Living Labs is an approach to develop and evaluate products together with end-users. Key characteristics are the involvement of end-users in every stage of the design process, and observing and testing in the user’s own environment with as little disturbance as possible.” http://knowledgecentre.livinglabs.eu
- Ref. Jens Schumacher/Veli-Pekka Niitamo (Ed.: European Living Labs a New Approach for Human C
ISO 9241-210 human centred design processes for interactive systems

Principles of HCD

(1) Include a clear understanding of user’s tasks and environmental requirements.
(2) Encourage an early and active involvement of users.
(3) Be driven and refined by user centred evaluation.
(4) Iterate developmental stages for identification of optimal design solutions.
(5) Incorporate the whole user experience.
(6) Encourage multi-disciplinary design.

Activities involved in system development lifecycle

(1) Understand and specify the context of use.
(2) Specify the user requirements.
(3) Produce design solutions to meet user requirements.
(4) Evaluate the designs against requirements.
Feedback that feeds the development cycle

Interface

Testing of prototype with end users

User feedback:
- f.i. Not “natural”
- Lack of feedback
- Not sufficiently personalisable

Discussion and development of improved prototype:
Evaluation Metrics and User Involvement

- BCI operability evaluation metrics
  - Signal acquisition and processing, control, speed, reliability, accuracy, etc.
- Application specific metrics to measure functionality
- General Metrics: Impact on users and environment
  - Evaluation by end-users and AT-experts
    - Assessment of data through questionnaires (developed for assessing AT related outcomes) and structured interviews:
      - User’s characteristics and Quality of Life (ICF checklist, SEIQoL-DW, ACSA)
      - Subjective workload (NASA TLX)
      - Device satisfaction (“TUEBS” based on QUEST 2.0)
  - Satisfaction with TOBI application as AT-solution (Assistive Technology Device Predisposition Assessment, ATD-PA)
Establishment of user forums

- Involvement of experienced end-users with disabilities
- Agreement on treatment, trials and feedback methods
- Interview and discussion about TOBI applications and their impact on the life of end-users with disabilities, possible application fields, acceptability, etc.

www.usabilitynet.org
suggesting tools and methods
Examples

Survey user requirements and preferences based on real life scenario’s

Focus groups with end users concerning their expectations and possible other application fields.

Example User scenarios with sketches for photo browsing/music/games
[For researchers/interviewers to help explanation and/or discussion of some of the features mentioned above and does not necessarily need to be translated. It should be emphasized that these are not the only possibilities but merely to stimulate ideas and help users to think about what they want.]

Music

11. (User control) Although nobody else is around in the room, you can change the music that is being played.
12. (Expressing feelings or thoughts)

You are feeling frustrated today and set the mood on the music player to ‘angry’. The music player starts to play ‘angry’ music. A friend walks in and notices the music and starts a discussion about why you are not feeling happy. (Other ideas: could also be feeling happy and wanting to express joy!)

13. (Creating atmospheres or moods)

You are feeling frustrated today and create a playlist of happy music to cheer yourself up. (Other ideas: could also be for creating a good atmosphere for a caregiver, friend or family member while they go about doing housework, relaxing music as someone comes in the house, calm down if feeling

Acknowledgement: Melissa Queck, University of Glasgow.
Living Lab - objectives

An user-driven open innovation ecosystem which enables users to take an active part in the research, development and innovation process:

• bringing the users early into the creative process in order to benefit from their views

• bridging the innovation gap between technology development and the uptake of new products and services involving all relevant players in the value network

• allowing for early assessment of the implications of new solutions.

Ref:

• Design as a driver of user-centred innovation. European Commission, 2009 (Commission staff working document)

• The European Network of Living Labs http://www.openlivinglabs.eu/
Living Labs – features

A “permanent” community of users who are iteratively asked to become integrated in some stages of the design/development/validation and marketing process and who’s feedback is collected by means of various socio-ethnographic research methods (focus groups, surveys, testing, polls, etc.)

- Different stakeholders working together for innovation
- Open innovation concept: sharing and spreading
- Real life testing environment: seamless and spontaneous interaction between people and technologies (+ environments)
- User centric approach to innovation: people’s feedback is put at the core, especially at the beginning

“MIT Living Labs brings together interdisciplinary experts to develop, deploy, and test - in actual living environments - new technologies and strategies for design that respond to this changing world. Our work spans in scale from the personal to the urban, and addresses challenges related to health, energy, and creativity.”

Source: http://livinglabs.mit.edu/

Can AT Centres be considered permanent Living Labs?

**Conditions**

- The Service delivery reflects a client centred model
- User centred outcome measurement tools are in use
- There are mechanisms in place to capture the knowledge that is developed or that emerges spontaneously
- Not only products, but also outcome measurement tools, procedures, policies are subject to the attention of the Living Lab.
- There are Dissemination strategies towards other stakeholders in the AT value chain: research, industry, policy makers

Handouts are available at: www.atia.org/orlandohandouts
Roles and relationships in UCD

In UCD Users are key to the process but it can be difficult for target users and system designers to **effectively communicate** their ideas given their diverse aims, backgrounds and perspectives.

This challenge can be exacerbated when working with **users with impairments**.

**Domain experts**, involved in research projects, can help to reduce challenges in UCD, such as those related to communication and to help modify the UCD process so that users with disabilities can participate.

Ref: Allen et al. (2008), *Univ Access Inf Soc*
Roles of AT (domain) experts

**Researcher**: They can both inform the design of the research and assist in executing the research; they can also help in planning and carrying out the research.

**Liaisons**: can facilitate subject recruitment, act as communication intermediaries, establish trust with the target population, and assist participants in understanding and completing consent forms.

**Representative**: the involvement of the target/end users is not always practical or feasible. In these cases, domain experts can take part in the design process as representatives of the target users. F.i. early prototypes for severely impaired.

**Team\Collaboration**: AT Experts and Target Users collaborate in the product development process...

Adapted from Allen et al. (2008), *Univ Access Inf Soc*
Methodological choices of the AT centers

• Testing with AT users as early as possible in the project:
  • Capture AT know how
  • Impact on outcomes and increase market potential.

• Users testing prototypes in different stages of development.

• Involvement of people with disabilities in less severe conditions
  • Stress – fatigue - motivation – mood
  • Not 100% fulfilled conditions: reliability of technology, understanding of all factors, collaborative context
  • Ethical implications – responsibility for success
  • Unfair power balance
  • Conditions for full involvement in all stages of the project
Contribution of hands on multidisciplinary AT teams to research project

A psycho-social approach integrates the medical or technological approach.

To promote a different view on persons with disabilities – clients, consumers of new technology

To implement a Collaborative design model:
  increasing the usability of solutions
  identifying new areas of application

To introduce a holistic approach that addresses:
  entire user experience
  different settings of use
  development of needs over time
Cost and benefits for UCD in AT centres

- Professional development of the team
- Improved contact with clients
- Orientation on scientific methods and tools
- Contribute to development at AT

- Time consuming
- Expensive
- Potentially conflicting work strategies in organisation
- Training required
- Requires different mind set
Conclusions

• An AT Center (as described) seems to be appropriate setting/resource centre for the implementation of user centred design processes in AT.

• AT Centres can *benefit from* and *contribute to* the understanding and further development of User Centred Design principles and practices.

• AT experts can be considered both professional users and domain experts near to potential end users of AT applications.

• Research activities and service delivery could coexist, creating the conditions for permanent living labs that contribute to ongoing innovation in AT.

• Nevertheless there is a need for user training and empowerment.
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