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Challenges in communicating user requirements: Lessons learned from a multi-national AAL project

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Abstract. A user-centred-design approach has become essential when developing devices and systems to satisfy users' needs and to raise acceptance and user experience. Within the eWALL project, which contributes to the prolongation of independent living of older people with and without chronic diseases through technology, iterative evaluations with users in four different countries were conducted to adapt the prototypes with users' feedback. After each evaluation, the feedback was rephrased in form of specific recommendations and summarized in a spreadsheet. Before communicating those to technical and design partners, all recommendations were prioritized and categorized. This paper describes the methodology for the user involvement and communication within the project team to successfully integrate users' feedback. Furthermore, it highlights important steps of this process and outlines lessons learned related to the prioritization, categorization, phrasing and communication of recommendations. Derived implications embrace adapted strategies to thoroughly involve users' feedback in the prototype development.

1 Introduction

Over the past years, it became more and more apparent that the development of technology for supporting older people needs users to be involved in the design process (Wilkinson & de Angeli, 2014). This was mainly caused by the insight that 70 to 80 % of new product developments fail because users' needs were not addressed accordingly (Von Hippel, 2007). In the past, development was mainly driven by technology and new innovations, whereas nowadays the needs of the real users are the starting point and the reoccurring source of feedback during the development process of support technology for older people (Lindgaard et al., 2006; Wilkinson & de Angeli, 2014).

The benefits of this user-centred design approach, such as increased confidence of the end-users and improved usability, are well-known. However, many support technologies for older people still lack user's acceptance since proper involvement of user's feedback in the development cycle is not always ensured (Brett et al., 2014). Older adults tend to have low technology literacy, diverse views about technology support and maybe health problems that affect their user experience and accessibility (Crabb, 2013; Malinowsky et al., 2010). Those circumstances further increase the importance of users' involvement to understand their needs for specific new technologies and to ensure usability, acceptance and accessibility. A prerequisite for thorough user centred design is good communication within the research and development team. As nowadays mostly required for European research grants, user evaluations are often done in at least two different sites. The more partners involved, the more important is it to use efficient communication strategies for securing the implementation of users' feedback.

This paper demonstrates the user involvement in the eWALL project. This EC-funded project contributes to the prolongation of independent living of three different user groups: i) older adults who face a risk of loss of function in the physical, cognitive or psychological domain, ii) people with mild cognitive impairment (MCI) iii) people with chronic obstructive pulmonary disease (COPD) (Kyriazakos et al., 2014). The system is composed of a large, wall-mounted touchscreen, which serves as interaction tool for the users. Additionally, environmental sensors (temperature, humidity, gas, movement) in the rooms provide support and safety to the users e.g. to detect that the oven was not turned off. Measurement devices track the activity level and health values which are pulse, blood pressure and oxygen saturation in the blood. The following functionalities are provided by eWALL: individual video exercise training programs based on the user's preferences and activity levels; cognitive training games with difficulty levels; daily, weekly and monthly overviews of users' activity level, sleep and health values; overviews of air condition in the living

room, kitchen, bathroom and toilet; smart calendar application. eWALL recognizes the needs of users and detects behavioural changes as well as decline of cognitive functions. According to users' conditions, eWALL encourages users for a healthier lifestyle. It would, for example, suggest to do some physical or cognitive training, to measure health values, to go outside for a walk if the weather is nice or to have a healthy breakfast etc.

Thorough user involvement for optimizing the final product to the users' requirements is the main focus of the project, supported by four different evaluation sites in Austria, Denmark, Italy and the Netherlands. Besides the primary user group, also experts for MCI and COPD as well as usability were inquired.

User involvement was mandatory during all phases of the project. Users' requirements, which were evaluated at the beginning of the project, served to derive *personas*, *user scenarios*, *concept sketches* and finally *system requirements* for the specific user groups. *Personas*, which are fictional characters that represent typical persons of the specific user groups, were based on previous user-centred design projects, literature and workshops (Van Velsen et al., 2012). It is a common user-centred design method that is useful in considering the goals, desires, and limitations of users and therefore helped to guide decisions about the product as the services, the interaction or the visual design (LeRouge et al., 2013). By using the personas, requirements engineers created *scenarios* to describe the way in which care is currently provided. Further, *future scenarios* created a vision of the future in which eWALL would satisfy the needs and wishes of the personas in their specific context of use. From these scenarios, *requirements* (describing functionality and technical demands) and *use cases* (describing the interaction between the user and eWALL) were derived. *Concept sketches* illustrated the system with all the sensors inside user's home in order to achieve common understanding between the user and technical partners. Based on that information, *system requirements* for the eWALL device were defined. The system requirements were an important tool for developing the first prototype, which was iteratively tested with users.

The following section describes the methodology of user involvement for testing and elaborating the prototype. In section 3, we reflect the used methodology and describe lessons learned.

2 Methodology

To allow the proper integration of users' feedback in the prototype, we evaluated the prototypes of month 19, 22 and 25 through an iterative evaluation cycle. These lab trials, summarized by the term *Small Scale Evaluations* (SSE), cover the first evaluation stage of the DeChant framework, which was developed

to systematically evaluate telemedicine technology (DeChant, 1996). This stage aims to evaluate the usability of a low fidelity prototype (Jansen-Kosterink, 2014). The main objective of the SSE was to evaluate the usability based on the level of user satisfaction and their intention to use the eWALL prototype, and to adapt the prototype with users' feedback. The first prototype, developed upon the basic *system requirements*, was tested in the lab setting in the four different test sites of the project.

Figure 1: Main screen of the eWALL touchscreen

In first stages, we tested the interface with mock-ups as the prototype was not operationally working at that point of time. In particular, we used PowerPoint mock-ups on the touchscreen to simulate the user the interface of a fully working system, so users could click on the buttons as if it would work (see Figure 1). In later stages, we already used the operational prototype displaying data from simulated users. Thus, sensors were not used for SSE, the only interaction between users and eWALL was the eWALL touchscreen. The evaluation was divided into 11 tasks e.g. main screen, personal data, daily functioning monitoring, etc. During the tests, a task-based approach was used as well as the thinking aloud technique to know which difficulties users faced during the tasks. For example, we asked them „Please open the video trainer and start a new physical training session." The users were asked to comment on the different interfaces of eWALL and related services and functions.

Thereafter, all evaluation partners of the test sites summarized users' feedback and rephrased it in form of specific recommendations to communicate them effectively to evaluation and design partners of the project (see Table 1).

	UI	Recommendation	A	B	C	D	mean
Rec.1.1	Weather	Future weather prediction would be very useful. Add this information.	4	4	5	3	4
Rec. 2.1	Daily Functioning Monitoring	The daily information displayed should be reduced to only meaningful events. Not show if person is moving between kitchen and dining room with a high frequency.	5	5	5	5	5
Rec. 3.1.	Clock	Add display of date to clock display	4	5	3	3	3,8

Table 1: Example of recommendations from first round of SSE for technical partners (0=low priority; 5 = high priority; A/B/C/D = Rating of the four evaluation partners)

If, for example, it was not obvious for users which elements of the main screen were interactive, the specific recommendation was to highlight interactive elements. All those recommendations were summarized in a spreadsheet, separated into more design or technical recommendations and prioritized by the four evaluation partners, based on the users' feedback of their test site. All problems or emerging needs for changes were addressed in the subsequent prototype optimization, followed by an additional iteration of user tests as described above (see Figure 2).

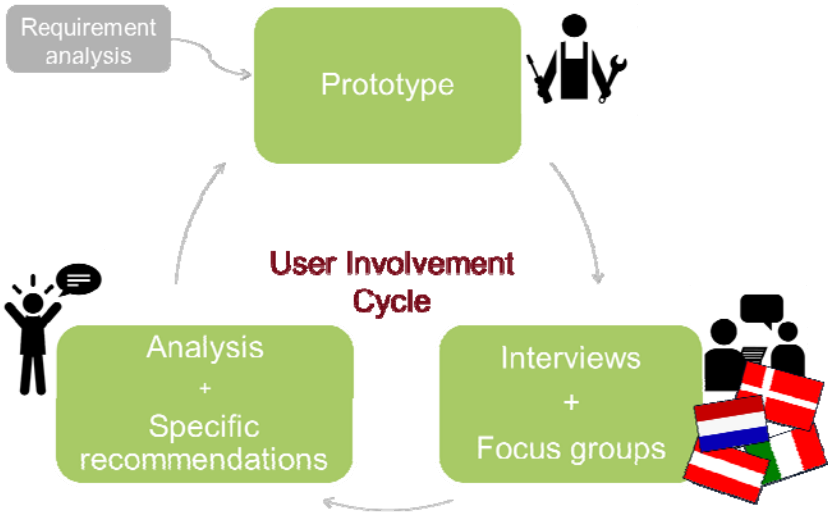

Figure 2: User Involvement Cycle

We used weekly teleconference calls to discuss adaptations. The attendance of both technical and evaluation partners in these calls was an important prerequisite to discuss the results on an interdisciplinary level.

A final evaluation of the integrated eWALL system will be given in the field tests, where the final prototypes will be installed in users' homes for six weeks.

3 Results and Lessons Learned

The approach of using spreadsheets to summarize users' feedback in form of specific recommendations was a very helpful communication bridge from users to all evaluation partners and finally to technical and design partners. However, some important steps have to be considered when conducting a user involvement cycle in a multi-national project. This section critically reflects the described methodology and shows up the lessons learned. It does not describe the results of the lab tests related to the user's perception of the system, as this is not within the scope of this article.

After summarizing the recommendations, their *prioritization* was an important step. On the one hand, this was reasoned by the large number of recommendations that had to be ordered to implement the most important ones first. Also, some recommendations prohibited the implementation of other recommendations. At first, we didn't prioritize them but soon found out that the evaluation partners of the four countries experienced in their lab trials different priorities with some recommendations which made it difficult for the technical partners to decide which ones to implement. Prioritization helped to find a consensus on all important design decisions within the entire project team.

Additionally to prioritization, *categorization* of recommendations, e.g. into "new functions", "data sharing", helped us to get a structured overview of the users' feedback, since some recommendations occurred manifold from the four evaluation sites. The categories were an important basis for following discussions.

Moreover, the importance of *clear recommendation phrasing* became apparent when passing them to technical and design partners. Those recommendations have to be as specific as possible. For example, a recommendation like "change the size of the button" is not specific enough. The desired size of the button must be described. It seems obvious, but it is important to keep in mind to write the recommendations for persons who did not experience users' interaction with the system. Specification also allowed us to have clear and measurable steps in the development of the next prototype.

This leads to the next point for a good implementation of users' feedback. Keeping a good *communication* between partners was an important part throughout the whole SSE. At the beginning, the main collaboration happened between the evaluation partners, who defined the methodology for the four test sites but also summarized their results and rated them. In the second place, the recommendations were communicated from the evaluation partners to technical and design partners. Since we recognised some recommendations not being clear

enough, close communication between technical, design and evaluation partners turned out to be important to discuss the feedback between those who collect the feedback with those who adapt the prototype. This allows clarifying the gap between the questions: *What do users want? What must be adapted to satisfy users' needs?* versus *What is possible to achieve from a technical point?* In our case, weekly telephone conferences were held to discuss unclear recommendations. The main discussions occurred around the details to cover the identified needs (e.g. What is the minimal duration to log the user in a specific room? – see Rec. 2.1 in Table 1) but also around new insights from evaluations that had not been addressed so far (e.g. including weather forecast – see Rec.1.1 in Table 1). The attendance of both technical and evaluation partners in these calls allowed us to discuss the results on an interdisciplinary level. The developed personas and use cases helped to guide the discussions by considering the needs of the user group on vivid examples.

4 Conclusion

For thorough involvement of user feedback in the development of the eWALL prototypes, we collected users' requirements and developed personas, scenarios, concept sketches and use cases as well as system requirements, which served as the basis to develop the first prototype. To test and advance the prototypes, we conducted iterative lab evaluations in four test sites with potential end users as well as MCI, COPD and usability experts. This user involvement cycle consisted of the evaluations and was followed by the reprocessing of the feedback, which was finally communicated from the evaluation to technical and design partners of the project. This article presents challenges and lessons learned of this methodology, concerning clear phrasing of recommendations, prioritization and categorization of recommendations as well as communication between partners. The presented methodology and lessons learned may help other projects to be aware of possible pitfalls that can occur in the user centred design process and outlines the importance of specific measures to avoid them.

5 References

Brett, J., Staniszewska, S., Mockford, C., Herron-Marx, S., Hughes, J., Tysall, C. and Suleman, R. (2014): A Systematic Review of the Impact of Patient and Public Involvement on Service Users, Researchers and Communities. The Patient -Patient-Centered Outcomes Research 7 (4):387-395.

Crabb M. (2013): Human cognitive measurement as a metric within usability studies. In CHI '13 Extended Abstracts on Human Factors in Computing System.

DeChant, H.K., Tohme, W.G., Mun, S.K., Hayes, W.S., Schulman, K.A. (1996): Health systems evaluation of telemedicine: a staged approach. Telemed J. 2(4):303-12.

Jansen-Kosterink, S.M. (2014): The added value of telemedicine services for physical rehabilitation. Enschede.

LeRouge, C., Ma, J., Sneha, S. and Tolle, K. (2013): User profiles and personas in the design and development of consumer health technologies. International journal of medical informatics, 82(11), 215-268.

Lindgaard, G., Dillon, R., Trbovich, P., White, R., Fernandes, G. and Lundah, S. (2006): User Needs Analysis and requirements engineering: Theory and practice. Interacting with Computers, 18(1), 47-70.

Malinowsky, C., Almkvist, O., Kottorp, A., and Nygård, L. (2010): Ability to manage everyday technology: a comparison of persons with dementia or mild cognitive impairment and older adults without cognitive impairment. Disability and rehabilitation: Assistive technology, 5(6), 462-469.

Kyriazakos, S., Mihovska, A. and Prasad R. (2014): eWall for Active Long Living: Assistive ICT Services for Chronically Ill and Elderly Citizens. IEEE SMC 5-8, October, IEEE 2014 Proceedings 2014.

Van Velsen, L., van Gemert-pijnen, L., Nijland, N., Beaujean, D., and van Steenbergen, J. (2012): Personas: The Linking Pin in Holistic Design for eHealth. In Proceedings of the 4th International Conference on eHealth, Telemedicine, and Social Medicine (eTELEMED2012) (pp. 128–133). Valencia, Spain.

Von Hippel, E. (2007): An emerging hotbed of user-centered innovation, Breakthrough ideas for 2007'. Harvard Business Review, Article R0702A.

Wilkinson, C.R. and De Angeli, A. (2014): Applying user centred and participatory design approaches to commercial product development, Design Studies 35, 614-631.