Living Lab 65+ – Participatory testing of technical assistance systems in the natural home environment of senior citizens

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Category: Research in-progress

Abstract

Older adults want to live independently as long as possible in their own homes. At the same time, they need to feel safe and secure. Technical assistance systems can be used to achieve these goals. However, technological innovations are not always developed in correspondence with specific needs and aims of their end-users, in our case older adults. To meet the needs of the end-users and to ascertain that end-users fully accept products, it is essential to adapt the products to older adults' requirements and to reduce elderly people's fears of using technology. To ensure this we suggest long-term testing of innovations in real-world experimental environments called Living Labs (usually the older adults' homes).

Keywords: *Living Lab; AAL; real life testing; seniors; technical assistance systems*

1 The Living Lab approach

The Living Lab concept was developed in the beginning of the 21st century (Bergvall-Kareborn & Stahlbröst, 2009; Karaseva, Seffah, & Porras, 2015). As the concept is quite new there is not yet a standard concept (Kviselius & Andersson, 2009; Tang, Wu, Hamalainen, & Ji, 2012). Two basic approaches currently exist:

i) The Living Labs concept was originally introduced by William Mitchell of the Massachusetts Institute of Technology (MIT) (Open Living Labs, 2016). Mitchell understood a living lab as a laboratory that could be inhabited. He created a laboratory environment in which everyday life could be observed and manipulated. In addition, new technologies could be tested and adapted. This temporary living environment could be used as a space for test persons to experiment with new technologies (Markopoulos & Rauterberg, 2000; Open Living Labs, 2016).
ii) Over time the concept has been further developed and can now also be seen as a natural test environment for technical assistance systems. The real, domestic, everyday environment of the users is called a Living Lab (Folstad, 2008; Franz, 2014; Open Living Labs, 2016). This is where the Living Labs 65+ concept comes in.

2 Aging society – the situation in Switzerland

In Switzerland, as in most industrialized societies, the proportion of the population over 65 is growing steadily (Federal Statistical Office[FSO], 2017). Especially the number of very old people (85+) is increasing. At the same time, the percentage of skilled workers and care personnel is constantly shrinking. This will result in a lack of personnel to cover the care needs of older adults in the following decades. The large amount of elderly people wanting to stay in their own home instead of living in retirement homes is making the lack in personnel even more apparent.

The use of technical assistance based on new ICT technologies or support systems offers promising solutions to face these challenges of our greying society. Although Active and Assisted Living (AAL) technology holds great potential, scepticism among the elderly towards these innovations is common. Main reasons for distrust include lacking knowledge about the benefits of these technologies, the risk of being stigmatized, the fear of required high technology expertise or perceived high costs (Meyer & Schulze, 2008; Mollenkopf & Kaspar, 2004; Mollenkopf, Oswald & Wahl 2007). Living Labs allow direct testing and validation of innovative services and products by the end-users under real life conditions and are thus a promising approach to meet the market barriers and bridge the gap between the abstract and the concrete.
For this purpose, and as part of the “Age and Ageing in Society" (AGE-NT) project, we have created Living Labs 65+ which provide a frame for understanding older adults needs

regarding (technical) assistance and a platform for the testing and validation of new technologies.

3 Definition of the Living Lab 65+

Traditionally AAL technologies are tested short-term and in laboratories under artificial test conditions. We believe that in such settings valid and reliable data cannot be obtained. Instead, the testing of technical assistance systems should take place in a real-life setting, in so-called Living Labs (LL). Kusiak (2007) and Stahlbröst (2013) among others demonstrate Living Labs potential for successful innovation development of assistive technologies. We define a Living Lab as a network of households (natural living environments) of older adults where needs for a technical assistance system are investigated (with regard to a specific system that will be tested) and technical assistance systems or services are tested directly by end-users. Older adults test AAL technologies in their everyday life and in "natural" living environments: these include private households, assisted living apartments, nursing homes etc. The Living Lab approach thus opposes classic short-term testing under laboratory conditions and relies on long-term tests and "real life testing". Another important factor is participation: the end-user becomes a key factor in the process of developing assistive technologies. Participating older adults are closely and regularly accompanied and supported by our project team.

4 Objectives of the Living Lab 65+

The Living Lab 65+ is part of the largest national innovation network "Age and Ageing in Society" (AGE-NT) and a joint project of the University of Applied Sciences St. Gallen and the University of Geneva. An objective of the Living Lab 65+ is to understand the real needs of older adults regarding assistive technologies and to test technical assistance systems directly with target groups. Thanks to the participatory involvement, end-users can give direct feedback as early as possible in the innovation process. Therefore, products and services can be tested and improved in an iterative process.
Based on the field tests, concrete data concerning needs, accessibility, usability and technology acceptance can be obtained. Those robust findings enrich research as well as marketing strategies and allow different stakeholders to adjust their products. Against this background social challenges can be met proactively and socially acceptable and sustainable solutions for people 65 years and older can be developed. The long-term aim of the project is to enable older adults to stay autonomously and safely in their familiar environment as long as possible.

5 Research methods used in the Living Lab 65+

The project team consists of sociologists, ethnologists, gerontologists, psychologists and information and communication technology experts. Their research focusses (1) on the active participation of end-users and (2) on the practical relevance of the research. Quantitative and qualitative methods are used for data collection. The data collection takes place at several points in time (before, during and after the testing), and incorporates standardized questionnaire batteries, diary entries and guideline-based interviews. In addition, community events are organized. Community events are a good opportunity for participants and stakeholders to share and exchange experiences and to evaluate results in a participatory manner. Moreover, the events may increase the participants commitment and can also be considered as an act of showing gratitude and appreciation.

To ensure the quality of the tests within the Living Lab 65+, validated tests and questionnaires are used to gather quantitative data. The quality criteria: objectivity, reliability and validity are observed (Lienert & Raatz, 1998). As the subject has a special role to play in qualitative research the usual quality criteria must be adapted or supplemented (Misoch, 2015). Thus, in addition to reliability (Mayring, 2002; Misoch, 2015) and validity, controlled subjectivity and intersubjective comprehensibility (Misoch, 2015) must be considered.

6 Study population of the Living Lab 65+

Qualitative research runs the risk of selection bias (Collier & Mahoney, 1996). Research on elderly technology users feature a specific pattern of participation: Participants are usually well-educated and show a high affinity towards technology (Classen, Oswald, Doh, Kleinemas, & Wahl, 2014), while social groups such as migrants or lower educated people are underrepresented. Although the prime aim of the Living Lab 65+ is not to generate representative results, we strive for a heterogeneous sample. A broad range in participants' technological affinity, socio-economic and cultural background allows us to consider as many points of view as possible.

The study population of Living Labs 65+ consists of housing units including both private households in the sense of system-independent housing units without service connection, and housing forms such as nursing homes or assisted living, in which at least one person is 65+ years old. The households are selected according to the requirement profile of the assistance system to be tested.

7 AGE-Lab

The AGE-Lab is part of the Living Lab 65+. It serves as (1) test lab (in the sense of a classical,

artificial lab) for the preparation of assistance systems to be tested in the field (hardware and software setup), (2) room for idea finding, (3) demonstration room for the presentation of possible fields of application and practical solutions to potential end-users and (4) research room for data analysis from the Living Labs 65+. During a series of tests, the protocol data from the residential units are recorded and stored centrally in anonymized form on the AGE-Lab AAL-laboratory server. The selection of data and data evaluation method depends on the specific tested AAL-system and the defined research questions. For each field test adequate research questions and an investigation design is defined. All collected data is anonymized, stored on the AAL-laboratory server and can be used for subsequent big data analyses.

8 Challenges of the Living Lab approach

Some challenges need to be considered when implementing the Living Lab approach. Since the living lab projects are conceived over a longer period of time, the careful recruitment of the participants is indispensable (Ogonowski, Ley, Hess, Wan & Wulf, 2013). Nevertheless, changing circumstances and mortality rate often lead to a higher dropout rate in research among older adults. Moreover, it is important to maintain the motivation of the participants throughout a longer period of time to avoid dropouts (Smith, 2013). An important factor for facilitating long-term cooperation is the contact person. This person must be familiar to the participants, must be available by phone during office hours and should remain the same throughout the research process (Georges, Schuurman, Baccarne, & Coorevits, 2015, Hess & Ogonowski, 2010). Organizing joint face-to-face meetings is also recommended. Furthermore, research within a Living Lab may affect the sense of privacy of the participants as research questions may require personal and private information.

A sensitive and empathic interaction strengthens the ties between researcher and participant and creates a relationship of trust. In this regard reciprocity is a key element (Smith, 2013). Participants must feel taken seriously and all processes and decisions must be transparent. All this enhances the commitment and willingness to give honest and essential feedback.
Although heterogeneity of participants is a key aspect in AAL research it can also cause some challenges. Participants may have varying levels of experience, different expectations (improved product, knowledge gain, marketable product) and needs regarding AAL-systems (Ogonowski et al., 2013). Heterogeneity is also a challenge to investigate needs regarding (technical) assistance in everyday life-situations, since they vary considerably between individuals for example with different health conditions.

Investigation of needs with regard to the technology to be tested is essential referring to adequacy – technical systems have to solve the right problems – but is also a methodological challenge. To ask for them with face-ot-face interviewing techniques gives only access to conscious needs. But needs are sometimes latent. A possible research method to explore needs is observation. But this is very intrusive in the context of dwelling, costly and complex to organize. For future assessment of demands we consider a mix of methods to attain more

detailed results.
Time and financial resources are important factors in running a Living Lab (Schuurman, Evens, & De Marez, 2009). Time resources must be available to researchers on the one hand, but also to participating households on the other. Financial support is usually more difficult to obtain especially in Europe, as more conventional test environments are cheaper and usually better known.

Finally, it can be stated that the establishment and the operation of a Living Lab requires considerable competence from all stakeholders involved. For researchers, these go beyond purely scientific skills and refer for example to social skills, especially to ensure the commitment of participants and by this the sustainability of a Living Lab structure.

9 Advantages of the Living Lab approach

The Living lab approach allows the development of assistance systems that meet the real needs of their targeted users (Liedtke, Welfens, Rohn, & Nordmann, 2012). Older adults are involved in decisions while developing assistance systems that enable them to live longer independently in their familiar living environment. Indirectly relatives of older adults also benefit, as they are relieved and reassured when they know that their beloved are well cared for and supported. Due to the current pressure to save money experts and service organizations are interested in avoiding home visits provided that the quality of care won't be affected. This saving in maintenance costs is also a considerable advantage for politicians.
By focusing on the actual needs of end-users, business or industry representatives can assume that these assistance systems are more likely to be successful on the market and thus reduce their development costs (Liedtke et al., 2012). The results should also be transferable to real everyday life situations and to other people than the test persons (Pierson & Lievens, 2005).

10 Preliminary findings

Several assistance systems have already been tested successfully in the Living Lab 65+ and further product and service tests are planned within the next two years. There are first findings concerning ideal user context, the need for support and service when using a new technical product, the process of adoption and acceptance of technology, recommendations for industrial partners and an initial conclusion on the Living Lab approach.

An ideal user context means that older adults have access to information on assistive products, they have support in their decision-making process if or not they should use an unknown product, they have support when installing/setting-up a product, they have access to instruction and service. Older adults are interested in trying out new technologies if usage

is mediated by trusted persons like family members or friends or by trusted organizations or companies. Beyond user context personality factors (for example curiosity) and properties of a technical device/service have impact on acceptance of technology. Following table illustrates properties with positive respective negative impact on technology acceptance:

positive	**negative**
clear defined function	lack of need
easy to handle	bad usability
added value	stigmatization
aesthetics	malfunctions
trust	"to many" devices
access to service	
reasonable price	

The discussion with the first participating households of Living Lab 65+ clarified that older people decide very pragmatically what could be useful for them in everyday life and what not. It is not the variety of technical possibilities offered on the market, but the individual needs and usability of a system that ultimately lead to acceptance of a product.

Our Living Lab method is constantly being further developed and refined. We learned that the research questions or research hypotheses must be defined clearly within the project team before the start of field testing. Furthermore, the three levels of data collection (qualitative, quantitative and mechanical data collection) must be well coordinated to achieve optimal results. It became apparent that a technical product should first be pre-tested in a classical lab environment before being installed in households (for example initial functional tests to eliminate major malfunctions). For this reason, the AGE-Lab has now been set up. Subsequently, the knowledge gained in this way should lead to an improvement loop. After adjustments field tests can be carried out in a larger number of households.

11 Conclusion

In the last 10 years a lot of money has been invested in the research and development of AAL technologies on a European level (AAL Joint Programme). Despite high investments these innovations have so far hardly been successful on the market. We can only speculate about the reasons for the low demand for such solutions. Certainly, there are a variety of reasons that stand in the way of spreading these solutions, such as insufficient usability of the technical solutions, stigmatization through inappropriate design, no obvious personal benefit for the elderly person, high acquisition and operating costs, lack of coordination and cooperation between the various stakeholders involved (Spitex, Pro Senectute, manufacturers of AAL

technologies, etc.). This is exactly where the Living Lab 65+ approach provides a decisive advantage. Direct involvement of older adults (end-users) and other stakeholders in the development process of AAL solutions can prevent such problems by developing solutions for the real needs of older people and adapting them to their wishes, thereby also increasing market success. For the manufacturers of AAL technologies and for the service providers of AAL solutions, the Living Lab 65+ offers an opportunity to bring useful solutions to the market to support a self-determined life of older people adults.

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