Developing a Health and Wellbeing Platform in a Living Lab Setting: An Action Design Research Study

W.J.W. Keijzer-Broers, G.A. de Reuver, L. Florez Atehuortua, N.A. Guldemond

Delft University of Technology, w.j.w.keijzer-broers@tudelft.nl, g.a.dereuver@tudelft.nl, l.florezatehortua@student.tudelft.nl; UMC Utrecht, n.a.guldemond@umcutrecht.nl

Abstract. The world's population is rapidly aging, which affects healthcare budgets, resources, pensions and social security systems. Although most older adults prefer to live independently in their own home as long as possible, smart living solutions to support elderly people at home did not reach mass adoption, yet. To support people age-in-place a Living Lab is established in one of the metropolitan areas in the Netherlands. The main goal of the Living Lab is to develop an online health and wellbeing platform that matches service providers, caretakers and users and to implement that platform in one particular city district. In this paper we describe the narrative of the action design research process that will give researchers insight how to deal with complex multi-stakeholder design projects as well as cooperation issues to develop an artifact in a real-life setting.

Keywords: aging-in-place, platform, action design research, smart living

1 Introduction

An aging population can be explained by the increasing life expectancy due to improved public health and a declining fertility rate. Both trends are expected to continue the coming decades. Life expectancy at birth will increase globally with ten years, to reach an average of 76 years by 2045 – 2050. In the same timespan the average global fertility rate will drop to the replacement level. Next to that, the United Nations predict that within thirty years the older adults will even outnumber children under the age of 15 [1]. One policy to reduce healthcare expenditures is to encourage people to live longer at home (i.e., aging-in-place) [2]. While, most elderly prefer aging-in-place instead of living in an institution [3], to maintain a certain quality of life [4], it is a challenge to make this happen. Declines in cognitive and functional abilities, social exclusion, digital divide as well as time pressure on the caregivers, are typical hurdles. Besides these general difficulties end-users are not aware of what products and services are available to fulfill their needs at a certain point of time. To assist the elderly, considerations need to be given to housing, transportation, social interaction, cultural engagement and activities [5]. Aging-in-place also implies that elderly maintain social connections to the neighborhood and the community, as well as in socio-cultural contexts [6].

The focus of this paper is on how aging-in-place can be supported by ICT-enabled solutions. For instance solutions related to smart living involve connecting our daily activities at home, along the way, or anywhere else, through integrated ICT. Although smart living has been on the agenda of policymakers for quite a long time, smart-living services have not reached the diffusion phase and did not make it into the mass market, yet [7]. Creating awareness among end-users about existing solutions to support them age-in-place is challenging. We propose that such awareness may be increased, by offering an online service platform to find all relevant applications within the smart living domain [8, 9]. How to design, implement and roll-out such platforms is unclear as existing literature on digitals platforms is merely based on ex-post studies of successful platforms [10]. Therefore, the objective of this paper is to describe a narrative how to develop, a health and wellbeing platform within a real-life setting, in an agile iterative way.

Designing such a health and wellbeing platform is highly complex as many stakeholders are involved. We draw on Action Design Research (ADR), which has been suggested by Sein, Henfridsson [11]. ADR is particularly appropriate because 1) it combines action research (AR) and design research (DR) to generate prescriptive knowledge 2) it is problem-driven and 3) it aims to build design principles based on iterative cycles. Action Design Research should generate knowledge that can be applied to a class of problems that the specific problem exemplifies. Next to that, ADR is based on an artifact and emphasizes the interdependence of building, intervention and evaluation. As a result, the research activity is problem-inspired and combines thinking with doing [12, 13]. To use ADR in practice, we develop an artifact in a real-life context while constantly reflecting on the process. To track the iterative design steps, the action design researcher kept a logbook on a daily basis over the period 2013 – 2015 amounting up to 650 pages.

2 Earlier work on designing the artifact

In earlier research [14] we elicited three main features of an online platform for health and wellbeing based on 59 interviews with stakeholders 1) an **online community** for contact, social wellbeing and interaction with the neighborhood (consumer to consumer) driven by the need for social cohesion; and 2) a **portal** for bundled smart living services and solutions (business to consumer), driven by the one-stop-shop philosophy for 'aging in place' and 3) an **intervention instrument** for the municipality (government to consumer) to interact with citizens about needs for services and questions about the different health care arrangements. Ultimately, such a platform should enable end-users to enhance self-management (i.e., independency) by the provision of relevant information and support in matchmaking between different stakeholder groups (i.e., consumers, providers and government). Eventually the platform has to enhance the quality of life of end-users. While the initial phase sets the generic scope and functional requirements for the platform, the next step is to instantiate the design in a municipal setting.

To elaborate on the main features we arranged four focus group sessions and introduced personas as vivid descriptions of the potential platform user [15]. The aim of the focus group sessions was to assess whether using personas, as a user-centered design tool, would lead to a better understanding of the end-user [16]. During two expert meetings these personas were further improved and applied as an input for scenario descriptions. For instance, frail elderly people like Annie (See fig. 1), who have no kids and are not *tech-savvy*, need an intermediary that can guide them through the complexities of the Dutch health and social care system. The goal of the personas and their associated task scenarios is to describe what the current customer journey looks like from different perspectives and, next to that, if and how a platform could help to support people age-in-place.



Fig. 1. One of the scenarios, according to Persona 2: elderly person called Annie. (The WMO helpdesk is the Dutch Social Support Act).

Both tools (i.e., personas and scenarios) are used to focus attention on problems and opportunities of a specific target audience.

3 Action Design Research Project

In a Living Lab, research and development moves from a pure academic environment into a real-life setting, with a multi-disciplinary network of people and organizations. We argue that designing a multi-sided platform can only done by addressing end-users' as well as external stakeholder needs in concert. It demands collaboration of stakeholders from multiple sectors to contribute to the required resources. Since the municipality is our launching customer, it was important to assemble the Living Lab according to a local community setting. To acquire commitment from stakeholders establishing a Living Lab required a lot of effort and resilience of the research team. After several attempts and initial failures, we managed to assemble a consortium with multiple stakeholders from different disciplines (i.e., municipality, multinationals, SMEs and end-users). Based on a short questionnaire and additional interviews, the functions, roles and expected gains were elicited from the stakeholders. See table 1.

Table 1. Description of functions, roles and value propositions from a stakeholder perspective.

Stakeholder	**Core function**	**Role in the project**	**Expected gains from the project**
Municipality	Launching customer	Problem owner	Interaction with citizens Lower transaction costs
Multinational 1	ICT firm	System integrator	Market access Health domain Competitive advantage
Multinational 2	Telecom operator/Cable company	Hosting and infrastructure	Market access Health domain Competitive advantage
SME 1	eHealth solutions	Owner platform building blocks	Business opportunity Competitive advantage
SME 2	ICT developing firm	Platform developer/ project leader	Business opportunity Competitive advantage
Governmental Foundation	Intermediary digital process	Architecture	Governmental pilot project Use case Project Architecture
Non-profit Foundation	Intermediary process/ finance	Platform owner	Exploit platform idea Capture the long-tail
Elderly society	Intermediary end-users	Elderly connection	Elderly engagement Support elderly to age-in-place
PhD researcher	ADR	Overall project leader	Research and valorize platform idea

Important drivers for the stakeholders to invest in the Living Lab are related to 1) market access to the health and care domain 2) competitive advantage and 3) business

opportunities. Importantly, the stakeholders in the Living Lab do not receive subsidies or other monetary compensation for their efforts.

3.1 Design workshops

The project draws on a set of reference platforms for inspiration and practical guidance. Next to that, the architecture is based on existing, successful online platforms, recognizing their value, the tensions and dilemmas around trust, privacy and security, that users encounter every day. In order to track real-time problems during the design process we are using the agile scrum method based on flexibility, adaptability and productivity [17]. To do so, we arranged three workshops with the Living Lab stakeholders to elaborate on efforts prepared in different scrum teams in parallel.
In a first workshop a list of main features were set to specify the critical design issues (CDIs) of the platform that were already gathered during previous research iterations [14, 16] See table 2. Table 2 illustrates the multiplicity of requirements for platform functions, ranging from basic information exchange towards active recommendations for services and matchmaking, and from pure focus on transactions towards interactive communication with end-users. Based on the aforementioned features, the platform would be a first mover in the Netherlands to combine and offer 1) matchmaking between smart living products and services 2) finding local activities 3) connecting with others (e.g., family, caretakers) 4) information about aging-in-place and 5) integration of successful, existing platforms in the health and wellbeing domain.

Table 2. List of main features for the platform.

	Domestic	**Health**	**Wellbeing**
Products	Security Home automation	Nursing aids	Entertainment Comfort products
Services	Renovation (i.e., installer) Maintenance (i.e., gardner)	Personal care Health care	Comfort services (i.e., grocery, cooking, housekeeping)
Local activities	Every day activities Education	Daycare Care related activities	Sports and entertainment Cultural In/outdoor activities
Contacts	Family Friends	Patient bonds Health care	Elderly bonds Municipality
Information aging in place	Advisors Renovators	Municipality	Advisors Caretakers
Integration existing platforms	Radio and broadcasting Restaurants and takeaway	Governmental	Caregivers Volunteers

In a second workshop, the technical architecture was further specified, by designing a Project Start Architecture (PSA) based on NORA, which is an acronym for the Dutch government reference architecture [18]. The reason to use this framework is to embark on a growth curve in maturity and to take the scalability potential of the platform into account. The PSA contains ten basic principles that relate to the provision

of public services, and includes all activities by or through which service-providers carry out public tasks. The PSA is meant to ensure an adequate and sustainable solution for services that comply with 40 architecting principles, regarding technologies, service orientation and roles and responsibilities for providing digital services from the Dutch government.

3.2 Critical design issues

In a third workshop the Living Lab stakeholders elaborated on the critical design issues. Next to that two new CDIs were identified as the discussion moved towards ensuring adoption of the platform by end-users. The first CDI is *trust*; it aims to ensure that the users believe in the reliability of the online platform, the accuracy of the information displayed, and the delivery fulfillment and service between consumers and providers of products. In further discussion during the workshop the participants translated this CDI into two requirements for the platform. The first requirement is a *rating/review* mechanism for products and services offered in the platform; reviewers are end-users who provide a rating and/or review after a transaction (e.g., the act of consuming a product or service or attending an activity offered in the platform) to present the feedback to other users in order to reduce the customer's perception of risk. The second requirement is a *moderator* who oversees the transactions and performs actions to enforce the rules set and quality of the products and services offered; this requirement also enhances confidence in the platform by supporting dispute resolution and mediation services between consumers and providers. The second CDI is *user data privacy*; there should be a clear separation between 'social' data in the context of the platform and the data (e.g., medical) that must remain private to the user or those who are authorized (i.e., care takers, relatives). Next to that, the data privacy policy of the platform should be concise and transparent to create trust related to the platform. The proposed platform is a multi-sided platform offering services to individuals and to providers who offer services to the individuals. Such platforms require special attention to privacy because each transaction within the platform is somehow related to personal data of the individual. The platform will be compliant with privacy-by-design principles throughout all the development phases and the entire lifecycle. Consideration of appropriate use of existing Privacy Enhancing Technologies (PETs), as well as the EU Data Protection Directive (Directive 95/46/EC) will be made. In a multi-sided platform, one user contract for all the different types of services offered by all the different service providers will not be enough. In fact, one has to decide to implement a system based on approval for each single transaction within a general overall contract. Systems based on this design scheme like OpenPDS take care of the technical implementation, but the legal aspects should be taken in consideration in the design as well. For instance, approval for the delivery of personal data for each transaction, between a service provider and an individual, requires special software comparable with banking software for financial transaction (which can be considered as a subset of personal data).

To make sure the ADR team was on the right track with the proposed artifact, eight potential end-users were involved in the development phase of the mock-up and the first clickable model. Based on their recommendations, a mock-up of the design could

be included in a widespread survey (i.e., elderly and informal caretakers) for further data gathering on the subject. In parallel with the data-analysis of the survey, field tests of the clickable model of the platform are foreseen with different groups of informal caretakers, district nurses and potential end-users (age group 55 – 75). These evaluation moments are part of the iterative design steps of the overall ADR project.

In the same workshop, we developed a first template to get an initial idea of the platform architecture. The proposed platform should contain an Application Programming Interface (API) as well as an Application (APP) store, and the emphasis is on a web-based application as the main interaction point with the users. Because compliance with rules on data protection and security is vital for healthcare applications, the platform will be compliant with the highest available Dutch standards for data security on a database level (i.e., NEN 7510) to share medical information. All authenticated pages must be exclusively accessed secured HTTP (i.e., HTTPS). Therefore all data throughout the platform send via the Internet will have Transport Layer Protection through the Transport Layer Security (TLS).

4 Reflection of the design process

Most of the theoretical and empirical research on multi-sided platforms has focused on mature platforms and less attention has been given to issues starting up a new platform. Therefore, the challenge is how to deal with the small iterative design steps, going back and forth in a rather complex design project. We formulate the following tentative propositions on the process of setting up and realizing a Living Lab setting, based on our smart living case experiences:

1. *Maintain a logbook on a daily basis to track actions of the design process.*
2. *Interview essential stakeholders from different disciplines related to your initial ideas about the artifact and include end-users as one of the stakeholder groups as well.*
3. *Use different methods of data collection (e.g., interviews, focus groups, survey) to get to the core of the design problem.*
4. *Include the goal of the user of the artifact: for example develop personas and scenarios to keep grip of the customer journey and use this during the whole project.*
5. *Select stakeholders from different disciplines with realization power and empower them to create a Living Lab or a similar case setting (e.g., multidisciplinary team with a launching customer, industry, end-user group and academy).*
6. *Develop a project plan to back up the artifact and the roles, functions and tasks of stakeholders.*
7. *Collect requirements for the artifact and prioritize the critical design issues.*
8. *Define the scope of the project and set up boundaries to develop a minimal viable product to test in real life.*
9. *Work in different groups in parallel, to get things done in small iterative design steps, according the agile scrum methodology.*
10. *Involve the end-user in the design process to validate and evaluate the artifact from the very beginning.*

5 Conclusion

Our design project contributes to current research on how ICT can support end-users aging-in-place. We are following an Action Design Research approach, with a focus on the understanding of the stakeholders and their needs in relation to a health and wellbeing platform. We are using the Living Lab setting to place the values of the stakeholders into a real-life context. This paper proposes a way of using ADR in design science to bridge the gap between theoretical propositions and successful adaptation of smart living platforms in daily practice. Accordingly, ADR gives us the opportunity to get a close look at the complexity of the design process when multiple stakeholders including end-users with different value propositions are involved. This understanding contributes to the design knowledge that is generalizable to other design projects. Based on our study, we propose a first practical guideline how to develop an artifact (i.e., an online platform) in a complex environment using ADR: in this specific case related to a highly sensitive health and wellbeing environment.

6 References

1. UN, *World Population Ageing 2013*, in *ST/ESA/SER.A/348*. 2013, United Nations, Department of Economic and Social Affairs, Population Division
2. Carstensen, L.L., et al., *Civic engagement in an older America*. The Gerontological Society of America, Washington, 2010.
3. Wiles, J.L., et al., *The meaning of "ageing in place" to older people.* The gerontologist, 2011. **52**(3): p. 357-366.
4. Chan, M., et al., *Smart homes - Current features and future perspectives.* Maturitas, 2009. **64**(2): p. 90-97.
5. Wahl, H.W. and G.D. Weisman, *Environmental gerontology at the beginning of the new millennium: Reflections on its historical, empirical, and theoretical development.* The Gerontologist, 2003. **43**(5): p. 616-627.
6. Peace, S., L. Kellaher, and C. Holland, *Environment and identity in later life*. 2005: McGraw-Hill International.
7. Peine, A., *Understanding the dynamics of technological configurations: A conceptual framework and the case of Smart Homes.* Technological Forecasting and Social Change, 2009. **76**(3): p. 396-409.
8. Sassen, E., A. Benz, and H. Österle. *Plattformen zur Dienstvermittlung für Independent Living: eine Frage der Betriebswirtschaft, nicht der Technologie*. in *Ambient Assisted Living-AAL*. 2010. Berlin: VDE Verlag.
9. Schenkel, P., P. Osl, and H. Österle. *Towards an electronic marketplace for bricks-and-mortar services*. in *In 24th Australasian Conference on Information Systems (ACIS)*. 2013. RMIT University.
10. Nikayin, F., *Common Platform Dilemmas: Collective Action and the Internet of Things*, in *Technology, Policy and Management - Engineering, Systems and Services* 2014, Delft University of Technology: The Netherlands.
11. Sein, M., et al., *Action Design Research.* MIS Quarterly, 2011. **35**(1): p. 37-56.

12. Markus, M.L., A. Majchrzak, and L. Gasser, *A Design Theory for Systems that Support Emergent Knowledge Processes.* MIS Quarterly, 2002. **26**(3): p. 179-212.
13. Kuechler, W. and V. Vaishnavi, *On Theory Development in Design Science Research: Anatomy of a Research Project.* European Journal of Information Systems 2008. **17**(5): p. 1-23.
14. Keijzer-Broers, W.J., N.A. De Reuver, and N.A. Guldemond, *Designing a multi-sided health and wellbeing platform: Results of a first design cycle*, in *ICOST 2014 - Denver*. 2014, Springer.
15. Long, F., *Real or imaginary: The effectiveness of using personas in product design*, in *Proceedings of the Irish Ergonomics Society Annual Conference* 2009. p. 1-10.
16. Keijzer-Broers, W., F. Nikayin, and M. De Reuver. *Main requirements of a Health and Wellbeing Platform: findings from four focus group discussions*. in *ACIS 2014*. 2014. Auckland: AUT Library.
17. Schwaber, K., *Agile project management with Scrum*. 2004: Microsoft Press.
18. NORA. 2010; NORA 3.0 Strategy Supplement accessed march 12 - 2015]. Available from: http://www.noraonline.nl/wiki/Documenten.