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Keijzer-Broers, Wally; de Reuver, Mark

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Applying Agile Design Sprint Methods in Action Design Research: Prototyping a Health and Wellbeing Platform

W.J.W. Keijzer-Broers, M. de Reuver

Delft University of Technology, w.j.w.keijzer-broers@tudelft.nl, g.a.dereuver@tudelft.nl

Abstract. In Action Design Research projects, researchers often face severe constraints in terms of budget and time within the practical setting. Therefore, we argue that ADR researchers may adopt efficient methods to guide their design strategy. While agile and sprint oriented design approaches are becoming common in the practitioner domain, they have not been integrated yet in Action Design research. In this paper we illustrate how a Design Sprint could jumpstart a design process in an ADR setting, fostering a low-fidelity prototype into a minimal viable product. We do so by describing an extensive case on a health and wellbeing platform for elderly people developed in a Living Lab setting. We extract lessons learned on how to apply design sprints in Action Design Research, which can be reused to guide other situated design projects with limited resources.

Keywords: Action Design Research, Agile, Smart living, Prototype, Health and Wellbeing platform, Age-in-Place, Design Sprint

1 Introduction

Action Design Research (ADR) has been proposed by Sein, Henfridsson [1] as an approach to design IT artefacts in a problem-inspired and action-oriented setting. ADR combines action research (AR) and design research (DR) to generate prescriptive knowledge, is problem-driven and aims to build design principles based on iterative cycles. In doing so, the starting point of ADR is the practical problem in an organization, or a network of organizations, rather than a theoretical design problem [cf.,2]. While ADR provides a useful positioning of situated design projects, the approach still leaves a lot of freedom to the researcher, which design methods to use. In this paper, we focus on the specific class of ADR projects where researchers face severe constraints in terms of budget and time available in the practical setting. Such situations might especially be common in real-life settings where stakeholders participate in design efforts without external subsidies or funding. Due to limited resources we argue that ADR researchers may adopt efficient methods to

guide their design strategy, without losing sight of the intended research goals. In order to track real-time problems during the design process and to allow rapid iterations, especially agile ways of working based on flexibility, adaptability and productivity [3] combined with User Experience (UX) design appear promising in the practitioner domain. Both methods traditionally use different approaches for resource allocation [4] but integration of Agile and UX design methods is increasing in practice as it seems to produce better-designed products than versions designed using waterfall approaches [5, 6]. While agile and sprint oriented design approaches are becoming common in the practitioner domain, they have not been integrated yet in ADR approaches. Therefore, the research objective of this paper is to illustrate how to combine a design sprint method with Action Design Research. This by describing a design case of a health and wellbeing platform to support people age-in-place, which is developed in a Living Lab setting. Our case uses requirements and specifications developed in previous iterations as a starting point. The case is appropriate as it concerns a Living Lab with multiple stakeholders without external funding, implying that budget and time resources were severely limited.

After the description of the Action Design Research method (section 2), a background on the case at hand is provided (section 3). In section 4 we enter the Building, Intervention and Evaluation phase. In section 5 the design framework is described, subsequently followed by insights from the design sprint (section 6). After the discussion in section 7, we conclude our paper with lessons learned and future work (section 8).

2 Action Design Research method

For the design of the platform, we apply Action Design Research (ADR) [1] as an overarching method. ADR is problem-inspired and combines thinking with doing [7, 8]. ADR is an appropriate method as: 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. Sein, Henfridsson [1] emphasized their model on the Design Science Research paradigm advanced by Venable [9]. The object of ADR is what Sein et al (2011) call an ensemble artifact, i.e., an artifact composed of technological and social elements. In our project, the artifact is an online matchmaking platform for health and wellbeing to support people age-in-place and the ADR team acts within a Living Lab setting. ADR differs from ethnography because the researchers intervene in the research context in situ. While ADR has received much attention since the breakthrough paper by Sein, Henfridsson [1], the method has not been fully explored in practice and there is a limited number of completed ADR cases in literature available [10].

Therefore, Iivari [2] explicitly encourages researchers to evaluate ADR in practice. To do so, our ADR case is based on primary data and comprises a cyclic process of design iterations (i.e., prototyping, testing, analyzing and refining) within a real-life setting. To reflect on the ADR process and to track the iterative design steps, the action design researcher kept an observation log on a daily basis (2013 – 2016) amounting up to 900 memos. Next to that, the logbook is used as a scientific record [11] establishing a chain of evidence, and therefore contains the decision steps and feedback loops related to the design process and the preliminary outcomes.

3 Case description

Our case is situated in the domain of health and wellbeing in the Netherlands. As many other countries in Europe, the Dutch government is aiming at a better integration of health and social care not only to support older adults but also patients with chronic conditions in the community [12]. Although people prefer to stay at home as long as possible and deinstitutionalization is also based on the assumption that homecare services are less costly than institutional services, it also represents a major challenge, as increased support for homecare has to be provided somehow [13]. From 2015 onwards the responsibility and the execution of health care in the Netherlands is shifted towards the municipalities and therefore local authorities (i.e., municipalities) are: 1) responsible for supporting citizens so that they can participate in society, 2) free to decide for themselves how they meet these targets, and 3) accountable at a local level for their performance. On the other hand municipalities receive non-earmarked budgets, giving them strong incentives to contain costs and to improve cost-efficiency [14]. However, local governments are searching for solutions to mitigate the transition phase. Together with the support of a Dutch metropolitan city the research team established a Living Lab setting to explore the practicality of an online health and wellbeing platform, which could support elderly people to age-in-place.

In 2013 the first set of requirements for the platform were identified and the main purpose of the platform was defined as 1) an online community for contact, solutions, social wellbeing, interaction with the neighborhood and a digital marketplace for applications, 2) an information exchange platform, between providers and end-users (business to consumer), driven by the need for matchmaking between service providers and end-users, 3) a portal for bundled, services and solutions (business to consumer), driven by the one-stop-shop, philosophy for aging-in-place, where end-users can find relevant applications related to health and wellbeing, but also can create a personal profile, and 4) an intervention instrument for the local government (government to consumer) to get in contact with citizens about needs for services and ques-

tions about health care and legislations. 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.

In 2014 an initial set of Critical Design Issues (CDIs) for the platform is extracted from 59 interviews (i.e., strategic level stakeholders, affiliate level stakeholders and end-users). To elaborate on the main features, eight personas were introduced as vivid descriptions of the potential platform user [15]. The personas described potential users related to four different archetypes (i.e., elderly, informal caretakers, providers and representatives of a local government). During two focus group sessions the action design researcher evaluated if the personas, as a user-centered design tool, would lead to a better understanding of the end-user. Followed by two expert meetings to improve these personas and applied them as input for user stories and scenario descriptions. These design tools (i.e., personas, user stories and scenarios) are used to focus attention on problems and opportunities of a specific target audience.

4 Building, Intervention and Evaluation phase

While the initial ADR phase (i.e., Problem Formulation) explored the generic scope and functional requirements for the platform, the next ADR phase (i.e., Building, Intervention and Evaluation) focused on the instantiation of the design in a municipal setting, and evaluated the platform in practice. To enter the stage of ‘Building, Intervention and Evaluation (BIE)’ we moved in 2015 from a pure academic environment to a Living Lab setting with a multi-disciplinary network of people and organizations. Our Living Lab can be described as a Quadruple Helix: an innovation co-operation between large and small-medium enterprises, the university, public organizations and end-users [16]. The focus of the Living Lab is to develop a service platform, which should not only create awareness among end-users about what services and technologies can help them, but also assist in matchmaking between (latent) needs and (yet unknown) services. Ultimately, such a platform should enable end-users to enhance self-management (i.e., independency) by the provision of relevant information and on the other hand support in matchmaking between different stakeholder groups (i.e., consumers, providers and government). Unfortunately, after a jumpstart executing the first two design iterations, we experienced a decreased energy level within the Living Lab setting. Because there is no subsidy or monetized compensation involved related to the stakeholders’ effort, it was core to keep the participants motivated. After careful considerations about our constraints (i.e., time, money and energy level) versus the research goal, we decided to use a Design Sprint method [17-

19] to speed up the prototype process, hoping that the design sprint workshop would give the Living Lab partners an energy boost.

5 Design framework

To shape the design iterations within the BIE phase, we followed a specific method for Living Lab settings from Ståhlbröst and Holst [20] who emphasize five design iterations within a Living Lab setting (i.e., planning, concept design, prototype design, innovation design and commercialization). To execute these iterations we extracted not just two, like suggested in the framework of Da Silva, Silveira [21], but even three teams from the Living Lab setting that worked in parallel on the design, development and evaluation of the platform. The Development team established a project plan, specified the critical design issues in a navigation plan and a high level architecture of the platform. The Design team designed mock-ups as basic input for the low-fidelity platform prototype and, translated the clickable model into a platform demo. The Research team identified related design issues by means of interviews, refined user stories and scenarios, facilitated workshops and evaluated the prototypes within multiple user tests. Although, agile development methods strive to deliver small sets of features with minimal design effort in short iterations, while UX design needs more time and considerable research effort, we adapted insights from both design methods [21, 22], and incorporated them in a design framework that was efficient for our project (See figure 1).

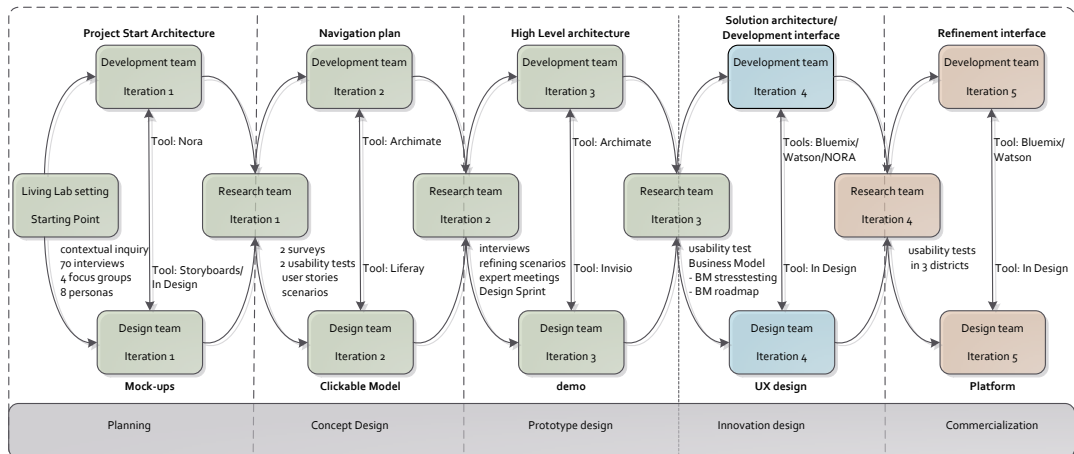


Fig. 1. Design cycle iterations: efforts from three ADR teams [21].

Meanwhile, input from potential end-users within the Living Lab (e.g., local government, service providers, informal caretakers and elderly) informed the research process. Having the end-user on-sight, made it possible to facilitate the user tests and allow the different teams to incorporate test results in subsequent design iterations.

As a starting point of the Living Lab setting previous research input (i.e., 70 interviews, contextual inquiry, results from four focus groups sessions and defined personas) [23] was already available to inspire the three ADR teams (i.e., Development, Design and Research team) at the same time. The preliminary research effort from the Research team could be regarded as **design iteration 0** [21]. In the **first design iteration** (i.e., the planning phase) the Development team focused on defining a project plan to guide the platform architecture, while the Design team worked on the first mock-ups of the platform (*NN*). In the meantime the Research team developed user stories and scenarios based on the eight early-defined personas and refined the requirements as a result from previous conducted interviews and end-user surveys [24, 25]. In the **second design iteration** (i.e., concept design phase) the Development team worked on the initial version of the platform architecture, while the Design team translated the mock-ups into a clickable model (i.e., alpha version of the platform). Subsequently, the Research team refined the user stories/scenarios and evaluated the clickable model in two usability tests with potential end-users [26]. Based on the main features the alpha version of the platform captures basically three core functionalities: 1) a social environment for local activities and contacts, 2) a marketplace for smart living products and services with reviews, and 3) a health and wellbeing profile which can be extended with a personal Care Plan. The rationale behind the Care Plan is that people themselves can be the center of action-taking related to health and wellbeing, such as measuring, tracking, experimenting and engaging in interventions, treatments and activities. In the **third design iteration** (i.e., prototype design phase) the Development and Design team respectively refined the architecture and the clickable model and, subsequently, representatives of each ADR team were included in a three day Design Sprint workshop. As an output of the workshop the Design team delivered a demo of the platform. The demo is subsequently used for a usability test with elderly end-users, informal and professional caretakers, service-providers and representatives from the local government. In parallel the Research team arranged two business model workshops to be prepared for up scaling of the platform initiative. The outcomes of the third design iteration are being used for the **fourth design iteration** (i.e., design innovation phase), which is currently work in progress and focuses on the development of the minimal viable product (i.e., interface). **The fifth design iteration** (i.e., commercialization phase) is part of the future research agenda within the Living Lab setting.


6 Design Sprint session

As mentioned before, the Design Sprint was part of the third design iteration (i.e., prototype design). Although there is no shortage of models, frameworks and methodologies to guide design thinking, limited resources challenged us to explore condensed design thinking methods like provided by IBM [17] and Google Venture [19] to shape our design sprint journey. Due to preliminary work in the first two design iterations the actual Design Sprint session could be limited to three days instead of the recommended five.

Before the design sprint was executed the workshop moderator (i.e., an experienced UX designer) formulated the design tasks and prepared six sprint stages (i.e., understand, define, diverge, decide, prototype and validate) as a guideline for the Design Sprint. In the meantime the workshop members (i.e., ADR researcher, UX designers and developers) reviewed related research input, which was stored at an online cloud tool.

The **first Design Sprint day** started with an overview of the workshop approach, followed by an in-depth interview with the problem owner (i.e., policy maker of the health and wellbeing domain of the metropolitan city). The rationale behind this interview was to verify if the initial idea about the platform was still valid, and if it fulfilled the basic needs of the local government to support people aging-in-place. Subsequently, the workshop participants compared these insights with the eight predefined personas before indicating persona Ria (See figure 2) as the key-user of the platform.

Persona 4 : Ria van Marrewijk



Age	55 year
Place of birth	Den Hoorn
Home environment	terraced house
Marital status	husband and 3 children at home
Profession	part time care giver at Buurtzorg
Social class	average income
Internet use	private

Ria is a caring mother. Next to her job as a caregiver, she takes care of her family and her parents who also live in Den Hoorn. Ria is a social person. She is dedicated to her family and she wants to support her parents (both 80) to let them stay in their home environment independently as long as possible.

Family members
Married to Sjaak (57) whose profession is a greenhouse builder. Three young children living at home (17, 19 and 23 years old)

Hobbies
She has no time for hobbies, because of the dedication to her family.

Special needs
Ria is looking for nursing solutions for her parents. She has little computer skills, but with a little help from her children she will manage.

Fig. 2. Caregiver Ria (one of eight predefined personas).

The rationale behind this is that persona Ria fits the user profile extracted from preliminary research efforts, because she is 1) an informal caretaker, 3) an intermediary for relatives, and 3) belongs to the young elderly group (age between 55 – 75 year). Persona Ria (55) is married, has a part time job as a caregiver, is devoting her time to take care of her parents and her children as well, and belongs to the so-called sandwich generation. According to Roots [27], adult children that are literally ‘sandwiched’ between their aging parents and their own maturing children (or even grandchildren) are, because of this burden, subjected to a great deal of stress. By defining what could unburden Ria, her persona description is extended with initial user stories (See table 1). User stories are written in the following format: As a <type of user> I want <some goal> so that <some reason>. This structure helps to really flesh out requirements and create a better understanding of the user [28]. Based on previous research insights the following refined user stories have been created for Persona Ria, categorized as either functional, user interaction or contextual requirements [29].

Table 1. User stories for Persona Ria.

Requirements	Must-haves	Nice to haves
	As Ria an informal caretaker...	As Ria an informal caretaker
Functional	<ul style="list-style-type: none"> ... I need to be able to support my parents so they can live independently as long as possible ... I need to find the right help at the right time to support my parents ... I need a monitor system to be notified when something is happening with my parents 	<ul style="list-style-type: none"> ... I want to post information in a diary and share this with my parents/relatives ... I want to stay in touch with my relatives about appointed and future tasks related to my parents ... I like to share a calendar with my relatives
User interaction	<ul style="list-style-type: none"> ... I need a simple to use interface that encourages me to use an online system ...I need a online system that is trustworthy 	<ul style="list-style-type: none"> ... I want a helpline to support me with an online system ... I want to consult a review system for products and services
Social context	<ul style="list-style-type: none"> I need to have peace of mind related to the (health) condition of my parents I need help from my kids as a backup related to the use of an online system 	<ul style="list-style-type: none"> I want to find likeminded people, to share ideas and problems

Next to that, we approached the needs from both Ria as her parents from a preventive, urgent and after-care perspective to encounter end-user needs experienced in different situations. See table 2.

Table 2. Needs from an end-user perspective.

Perspective	Needs elderly people	Needs informal caretaker
Preventive	What do we need to live in a comfortable way in our own home? Where can we find additional help if needed? Where can we find local activities which suit our interests?	How can I support/monitor my parents in a seamless way? How can I start a conversation with my parents about ‘aging-in-place’? Where can I find local activities to suggest to my parents that will fit their interests and daily schedule?
Urgent	Who can help us in case of emergency?	How can I arrange practical help to support my parents in case of an emergency?
After care	What kind of additional help is available to recover/stay at home after an incident	How can I find trustworthy products and services to support my parents so that they can stay at home?

Based on the user stories and end-user needs the workshop participants discussed multiple scenarios, whereas one was chosen to guide the platform design:

What if Ria’s mother Bep broke her hip? How can an online platform help Ria to make practical arrangements to ensure Bep can return home to her husband Jan instead of recovering in a rehabilitation center?

In the **second Design Sprint day** the scenario is extended with Ria’s personal customer journey related to the arrangements she has to make in a certain timeframe after her mothers’ fall incident. See table 3.

Table 3. Arrangements Ria has to make, after her mothers’ fall incident.

Timeframe	Arrangements after the fall incident
Directly	Collect insurance papers/medicines/identification/their doctor etc. Reassure Jan that everything will be all right with Bep Follow the ambulance to the hospital
Within 1 - 4 hours	Inform close relatives Pick up toiletries for Bep Prepare questions for the surgeon Organize practical arrangements for Jan: groceries, meal, walk the dog
Within 24 hours	Inform insurer/read insurance policy Contact helpdesk local government: demand for assistance Divide urgent tasks with close relatives: arrangements at home Schedule hospital visits Organize nursing aids: adjustable bed, walker/wheelchair etc.
Within one week	Find service provider for adjustments in the house: remove thresholds, renovate shower, install stair elevator etc. Divide daily tasks with close relatives/informal caretakers Think of a system to keep close relatives/informal caretakers informed about the situation (for instance a care plan). Find suitable activities for both parents that fit their interests and day schedule

After defining the customer journey the workshop participants made a competitive overview from existing health and wellbeing platforms to verify that ‘the wheel was not invented elsewhere’. Subsequently, the participants sketched as many possible solutions that could support Ria with her customer journey, using different brainstorm techniques and diverge methods like mind maps, storyboards and ‘crazy eights’ (i.e., 5 minutes to create 8 sketches). This idea-generation phase, without regards for constraints and criticism, resulted in dozens of plausible platform ideas, which were accordingly categorized and extensively discussed. See figure 3.



Fig. 3. Overview (fragment) of used diverging techniques (e.g., mind maps and storyboards).

At the end of the second day the participants voted for the three best ideas, and, at the start of the **Third Design Sprint day**, every participant had to pitch their most favorite idea. After the pitches the team discussed how to combine the most suitable ideas that could guide the platform design. Based on all input of the first two design sprint days the rest of the third day was used to shape and reshape the demo of the platform according to Bep’s fall scenario and taking into account the pre-defined user-stories of persona Ria. See figure 4 for the first platform sketches. The Dutch platform demo can be consulted via: Zo-Dichtbij (translation of the title: ‘as-close-as-possible’).

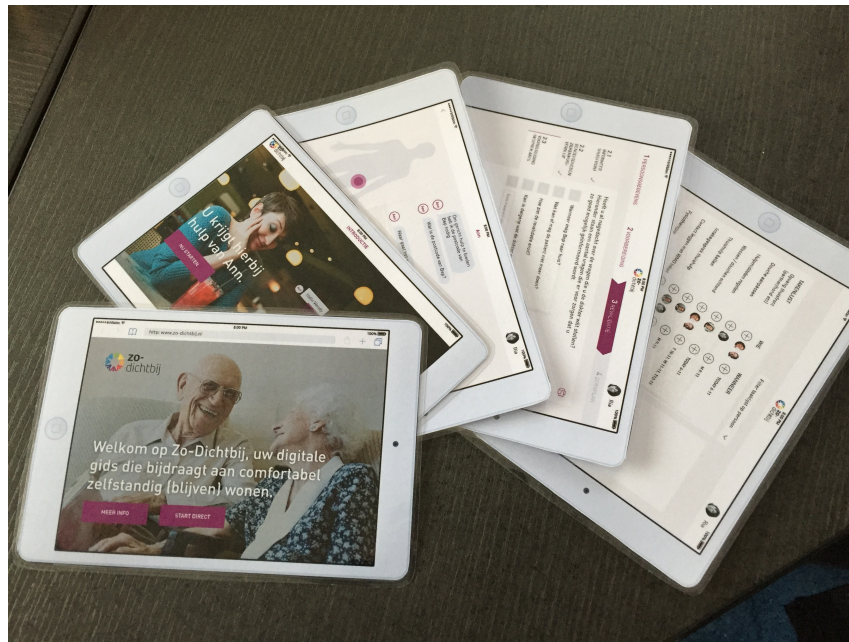


Fig. 4. First sketches of the platform demo Zo-Dichtbij (Dutch Market).

To ensure external validity in the third design iteration, the Research team used a couple of weeks to test the platform demo with 30 end-users (i.e., elderly, caretakers, providers and representatives of the local government). Our general motivation to include the end-user in the ADR process is the adaptability to new obstacles as soon as they pop up. Accordingly, the ADR research team adjusted the goal-setting procedures, confided to what the end-user states in the next design iteration. Furthermore, communication with our target groups is crucial to understand especially the abilities, morals and mindsets of elderly people. Overall the platform demo was positively evaluated and highly appreciated by the test group. Minor details were related to the use of colors, corps sizes, spelling mistakes and sequences of questions. Regarding extra functionalities interesting suggestions were made, like: anonymous use of the platform, chat possibilities with relatives, sharing diary with family, simultaneous use of the care plan, connection with social media for arranging local activities, frequent asked questions and adding checkboxes for social and medical arrangements. Next to that, some reviewers had additional questions about: the security of the care plan, privacy issues and if the 'guide' in the platform was intended to be a real person or a chat bot. Comments were gathered and the feedback was summarized in a revision table.

After internal discussions with the Living Lab participants, core adjustments

were made in the platform demo as input for the fourth design iteration (i.e., innovation design) developing the minimal viable product. All suggested extra functionalities are added to the wish list.

7 Discussion

For the execution of the Building, Intervention and Evaluation (BIE) phase of our ADR project, we used insights from Da Silva, Silveira [21] how to get ‘the best’ from two design worlds and integrate agile development with user experience practices. This is an initial attempt to combine UX and Agile design methods in a Living Lab setting and to foster collaboration between design teams (i.e., Development and UX Design) in an ongoing process. To guide the research process we incorporated the Research team in the design iteration cycles as well. During the whole research process we made sure the Research team kept one step ahead of the other teams by providing timely research input, so that the development and design team could focus on relatively small design tasks at the time, instead of designing the whole platform tool at once. However, improving an artifact does not come without risks or costs and in order to reduce this, the framework supports the idea that all the iterative design and evaluation steps are executed in a condensed form.

Therefore we consulted the Living Lab partners as efficient as possible, taking into account that we had to place the values of the stakeholders in the health and wellbeing domain into a real-life context. This context both stimulates and challenges research and development, as public authorities and end-users will not only participate in the Living Lab, but contribute to the whole innovation process as well.

In retrospect, combining UX design and the agile way of working within the Development team fitted well in the Living Lab setting, but it heavily relied on the ADR team members’ ability to properly collaborate and to have an ‘open mind’ in the first place. This open mind proved to be crucial in the Design Sprint session, as well. Despite of the participants’ background (i.e., development, UX design and research), we managed, within three days to develop a platform demo that justified previous research efforts. This could not have been done without the help of an experienced Design Sprint moderator. Nevertheless, the platform demo was a satisfying result from the Design Sprint, within a limited amount of time and restricted budget. Next to that, the sprint session generated also the predicted energy boost within the Living Lab. At least we had something tangible to show and discuss with the ‘world’, which was experienced as a valuable intermediate step to inspire the fourth design iteration.

Next to that, the demo made it easier for the ADR team to have thorough discussions about the platform idea in the market, not only with end-users (i.e.,

elderly, informal caretakers, providers and local governments) but also with potential (funding) partners. Since the Design Sprint session, the platform demo is successfully used as visual support during numerous ‘pitches’ with influential companies in the Netherlands to explore up scaling and valorization of the system.

8 Conclusion and future work

This paper provides an initial foray into integrating agile, sprint and user experience methods within an Action Design Research strategy. Based on an extensive and rich case of ADR we illustrated 1) how to combine agile and UX design approaches in a seamless way and, 2) how to apply design sprints as a condensed but sound design thinking method. The Design Sprint session is experienced as an enrichment of the third design iteration, because it forced the teams to refine earlier research outcomes and to make final decisions how to visualize the platform in a low-fidelity prototype, within a limited amount of time. Although, we only incorporated one scenario in the demo, extra scenarios from different perspectives are currently under review as part of the fourth design iteration: developing the interface. As a follow up, usability tests with different groups of informal caretakers, district nurses and potential end-users (age group 55 – 75) are foreseen, before implementing the minimal viable product in three districts of a Dutch metropolitan city.

The artefact can be seen as a groundbreaking concept for the smart living domain in the Netherlands, because it would be a first mover to combine and offer: 1) matchmaking between providers of smart living products and services and potential end-users 2) finding local activities 3) connecting with other people (e.g., family, caretakers) 4) information about aging-in-place and, 5) integration of successful, existing platforms in the health and wellbeing domain. Nevertheless, an important aspect for the success of the platform is the availability of resources within our Living Lab setting (i.e., intellectual, time and money). Limited resources required creativity and determination of the research team and this experience can guide other researchers dealing with similar design projects. The ADR method gave us the opportunity to get a close look at the complexity of the design process when multiple stakeholders with different value propositions are involved. Next to that, by maintaining a logbook the Action Design Researcher could track and trace the decision steps in the design process, to establish a chain of evidence and this improves transparency, validity and reliability of the research. Hence, researchers can use similar methods to create their own design science research studies.

References

1. Sein, M., et al., *Action Design Research*. MIS Quarterly, 2011. **35**(1): p. 37-56.
2. Iivari, J., *Distinguishing and contrasting two strategies for design science research*. European Journal of Information Systems, 2015. **24**(1): p. 107-115.
3. Schwaber, K., *Agile project management with Scrum*. 2004: Microsoft Press.
4. Fox, D., J. Sillito, and F. Maurer, *Agile methods and user-centered design: How these two methodologies are being successfully integrated in industry*, in *AGILE*, IEEE, Editor. 2008. p. 63 - 72.
5. Da Silva, T.S., et al., *User-Centered Design and Agile Methods: A Systematic Review*, in *AGILE*. 2011. p. 77-86.
6. Sy, D., *Adapting usability investigations for agile user-centered design*. Journal of usability Studies,, 2007. **2**(3): p. 112-132.
7. 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.
8. 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.
9. Venable, J., *The role of theory and theorising in design science research*, in *DESRIST*. 2006. p. 1 - 18.
10. Mullarkey, M.T. and A.R. Hevner *Entering Action Design Research*. In *New Horizons in Design Science: Broadening the Research Agenda 2015*. 121-134.
11. Alaszewski, A., *Using diaries for social research*. 2006: Sage.
12. Rechel, B., et al., *Ageing in the European Union*. The Lancet, 2013. **381**(9874): p. 1312-1322.
13. Jacobzone, S., E. Cambois, and J.M. Robine, *The health of older persons in OECD countries: is it improving fast enough to compensate for population ageing?*, in *Labour Market and Social Policy Occasional Papers*. 1999, OECD: Paris. p. 149-190.
14. Schut, E., S. Sorbe, and J. Høj, *Health Care Reform and Long-Term Care in the Netherlands*, in *OECD Economics Department Working Papers*. 2013, OECD Publishing.
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. Arnkil, R., et al. *Exploring the quadruple helix. Outlining user-oriented innovation models*. Report of Quadruple Helix Research for the CLIQ Project, 2010.
17. IBM. *IBM Design Thinking*. Available from: <http://www.ibm.com/design/thinking/>.
18. Direkova, N. *Design Sprint Methods - Playbook for start up and designers*. 2015.
19. Knapp, J., J. Zeratsky, and B. Kowitz, *Sprint: How to Solve Big Problems and Test New Ideas in Just Five Days*, ed. G. Ventures. 2016.
20. Ståhlbröst, A. and M. Holst, *The Living Lab Methodology Handbook*. 2012, Lulea University of Technology and CDT: Published by the SmartIES project, a transnational Nordic Smart City Living Lab Pilot.
21. Da Silva, T.S., et al., *User experience design and agile development: From theory to practice*. Journal of Software Engineering and Applications, 2012. **5**(10): p. 743-751.
22. Preece, J., H. Sharp, and Y. Rogers, *Interaction design - beyond human-computer interaction*. John Wiley & Sons. Vol. 11. 2015. 34.
23. 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.
24. Keijzer-Broers, W., M. De Reuver, and N. Guldemond, *Designing a multi-sided health and wellbeing platform: Results of a first design cycle*, in *ICOST 2014 - Denver*. 2014, Springer. p. 3-12.

25. Keijzer-Broers, W., L. Florez Atehortua, and M. De Reuver, *Prototyping a Health and Wellbeing Platform: an Action Design Research Approach*, in *49th Hawaii International Conference on System Sciences (HICSS)*. 2016, IEEE computer society: Kauai.
26. Keijzer-Broers, W., et al. *Developing a health and wellbeing platform in a living lab setting: An action design research study*. in *DESRIST*. 2015. Dublin.
27. Roots, C.R., *The sandwich generation: Adult children caring for aging parents*. 2014: Routledge.
28. Cohn, M., *User stories applied: For agile software development*. 2004: Addison-Wesley Professional.
29. Verschuren, P. and R. Hartog, *Evaluation in design-oriented research*. *Quality & Quantity*, 2005. **39**(6): p. 733-762.