Taking Adaptable Co-design Action: Flexible Learning Between Health Experts, End-Users and Technology Experts in the Early Stage of eHealth Design

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***Abstract*— Co-design, as a way of integrating users' perspectives and technical possibilities, has been subject to a multitude of interpretations. To facilitate the development of patient-empowerment services, co-design is a central approach needed to ensure high acceptance among users. In this research, we offer a flexible co-design approach by building on adaptive and continuous planning based on sets of co-design actions directed towards participants' mutual learning. The research is based on the experiences of a co-design process within the area of eHealth, specifically the fall prevention area, as a special case of self-training systems and self-management systems. The project team comprises a variety of member groups, including the elderly, technical developers, business developers, methods experts and project management. The key success factor was identified among the persons of the different groups as achieving possibilities for learning. To make learning processes requires adaptability and flexibility in interacting different planning actions in order to balance both the need for technology development and the understanding of users' needs.**

Keywords: Co-design; learning; adaptable; eHealth; fall detection.

I. INTRODUCTION

Understanding the interaction between actors in a systems development process is a multi-faceted affair, open to interpretations of the different preferences of diverse participants. Within eHealth, this is even more complicated due to the nature of the application area, i.e. dealing with sick people, on the one hand, and with professional people responsible for delivering safe and approved care, on the other. The central approach in the field of eHealth is Experience-Based Co-Design (EBCD). EBCD builds on the notion that collecting facts about patients and professionals enables the building of effective and useful support systems [1][2]. Other approaches to co-design stress, e.g., co-creation [3], the transfer of power from technology and design aspects to user perspectives. Empowering users to be active in decision-making is arguably an important step towards better information systems. It can thus be assumed that good co-design should include both facts about practice, users and professionals and the power to act. To achieve positive effects of flexible co-design like these requires, to a great extent, the creation and transfer of knowledge. The co-design process as such could therefore be understood as a learning process. Ward et al. [4] argue that there is a gap within the peer-reviewed literature on how to conduct co-design in practice. In this research, we look at how co-design can become an effective learning experience for the participants by setting it up as an adaptable and flexible method and applying a continuous process of re-planning. We target the early formative parts of the design process, which Sander and Stappers [3] call the fuzzy front end. This is done to ensure that the project receives a proper start and a development of all the parties involved by raising them to sufficient levels of relevant knowledge. Different groups within the co-design process have different needs, which necessitates a well-balanced set of co-design actions that are continuously re-evaluated and re-planned in the process. Although the research revolves around a fall prevention project and the development of technical solutions, we focus in this paper on the properties of the co-design process and reflect on how the experiences can be used to improve co-design practice. Since it has been claimed that it is the flexibility of EBCD that gives good results [5], the aim of this paper is to look closer into how to actually achieve this. The paper is structured accordingly by a quick initial view of the current state of EBCD and related co-design methods, followed by an overview of the research setting and the systems development project forming the core of the research. As a result, a generalized example is provided of how to structure co-design processes in a flexible and adaptable way on the basis of the experiences of the development project. The paper ends with a discussion of central issues related to how to structure a project for learning that helps parties of all types to be active and productive co-designers. A neutral project management with a co-design expertise background could be one path towards a better project structure where all participants can gain sufficient knowledge to be empowered to become creative co-designers. The paper is organized according to the following structure: Section 2 provides a theory background with focus on EBCD and co-design; Section 3 gives the research approach and an overview of the case; Section 4 is the analysis of co-design actions; Section 5 contains a

 ISBN: 978-1-61208-688-0

discussion of the result, with concluding remarks and future research.

II. THEORETICAL BACKGROUND: EBCD AND CO-DESIGN PERSPECTIVES

Co-design in general and EBCD in particular currently attract strong interest, not least in the face of the current surge in eHealth applications. Hence, we give an overview of current topics, issues and debates that seem important for improving the practice of co-design for eHealth development.

The basic approach of EBCD is the design of new solutions, (e.g., ways of working, IT systems or new procedures) based on facts gathered from professionals and patients, molded through joint sessions of design, and hopefully leading to new ways of working that are acceptable to all parties. Bate and Robert [1] provide a basic EBCD cycle, including set-up, gathering experiences, and co-design in groups.

In the area of health, co-design can be seen as a framework for managing an intervention project [6][7]). Co-design functions as a way of creating change in a project research style and as such becomes a ´method for organizational development.

The practice and real effects of EBCD are studied in a review of EBCD studies. Gleeson et al. [8] note that a great many EBCD projects only deal with minor changes in work practice, which are more helpful in implementation than in finding novel solutions. They [8] also observe that surveys are a common way of collecting facts for EBCD projects.

In a larger perspective, EBCD could be understood as a spirit that is supposed to drive a development project including important values like empowerment, trust, autonomy and self-determination among both users and professionals [9]. By this approach, we are looking for more than a technique for cooperation during design.

Brocklehurst et al. [10] point to the fundamental change that EBCD could bring about, from a traditional top-down approach to developing a design that is based on the end user's situation and interests. This is supposed to be especially true when it comes to co-design with elderly people who are moving into a life of greater dependence on support and help from others.

EBCD, as noted by Matthews et al. [11], can be used not only for collecting facts from users but also for engaging them in the co-production, design and development of new services.

In addition to being an important property of the method area [5], flexibility is, in our view, important for the engagement of patients, families and staff.

The situation for both professionals and patients changes when they enter into a co-design process. They are then forced to look upon their situation from new perspectives and to step out of their traditional positions where they feel comfortable [12].

As healthcare staff and patient experiences with patient processes differ, this creates many complex problem situations. To understand and deal with these, a collaborative approach is needed to capture all areas needing improvement and to create solutions that respect all parties. [13].

Hill et al. [14] argue that theories of adult learning need to be part of co-design in order to support user learning during the project. This is a necessity, particularly in light of the different backgrounds of eHealth users, as they are patients and often find themselves in difficult situations.

Since knowledge processes are regarded as central in the research [15], Langley et al. argue that co-design should be understood as a process where knowledge is discovered, created and shared between different groups of stakeholders.

III. RESEARCH SETTING

The research approach builds on the interpretations of what takes place in an action research tradition [16]. The research setting is an innovative development project in the area of eHealth fall prevention solutions for the elderly. The context of designing fall prevention systems is a drive for helping the elderly to continue living at home. This was designed as an innovative technical project in need of a co-design process to ensure a well-functioning connection to potential users. The general approach to fall prevention was to have a data-driven learning system for changing habits and improving the understanding of personal risk behaviors. To attain these goals, the project has devised a co-design process, whose focus in this research lies on the formative first half year.

During this period, an initial technical solution was developed in cooperation between different user groups, including experts, professionals and end users. Five categories of participants were involved in this process: technical experts, end users, professional users, design experts, and project managers. The end users were still relatively healthy elderly people, who were able to live independently in apartments or houses. There were 5 participants in this category, whose age ranged between 70 and 75. From the technical side, 3 representatives from private companies (from which they also received further support) were active in the co-design in crafting the practical IT solutions. The design and management team consisted of project management for the healthcare sector and eHealth experts from universities, a total of 6 people. The health care professionals had 3 representatives, including physicians and physiotherapists. Besides, invited quests were added to some of the meetings. In total, approximately 16 persons were active at the co-design meetings. Two types of meetings were used: physical meetings in a conference room setting, and web conference, voice and video meetings. Both recordings and field notes were used to capture the proceedings. Interspersed between these were periods of field action, patient observations or home testing, as well as of technology development. These activities were prepared in planning meetings. Together, these formed a series of co-design cycles, four of which were performed during the first part of the project. The results of this paper focus on the way actions were mixed during the different cycles.

As the project constituted an action research effort, the authors were active members of the design team. Hence, active observation formed a way of capturing and

 ISBN: 978-1-61208-688-0

understanding the nature of the co-design process. The research stance was interpretative and self-reflecting, aiming at giving a generalizable account of what worked during the project, while simultaneously learning from its mistakes and successes. The further aim was to apply a "reflective practice" approach [17][18] to better understand current practices and provide generalized ones for a knowledge- and learning-oriented way of working with co-design. To do research in the manner of "reflective practice" is a new way of creating a critical awareness of current practices and of facilitating change [19]. Schön [17] works with a view of knowledge and knowledge generation that is based on an epistemology of action. Although experts with their practical knowledge often contribute in a tacit or unspoken form, Schön sees this as a possibility of attaining intellectual rigor in scientific work. The basis of the approach, referred to as reflection in action, lies in the capacity of reflecting on the knowledge that emerges from action.

IV. RESULT: CO-DESIGN AS ADAPTIVE LEARNING

Based on the experiences of the case study, sets of co-design actions organized into cycles of design, which are planned and adapted continuously, can be proposed. We present this in two steps, first in sets of design actions, which are here somewhat generalized in comparison with the actual project. After this, we provide examples of how to combine these into cycles of design.

A. Co-design action sets

The actions are divided into four sets plus a planning set. Each set consists of a number of possible types of actions. The planning set deals with the formation of the co-design actions and their enactment during various meetings and stages of the project. The four action sets form the movement of the design process including the initiation of purpose and mission, the requirements collection and the testing and solution formulation, all guided by planning actions. The list is not exhaustive, but rather a set of key examples that serve as illustrations of how co-design actions can be devised. The list follows a clear and straightforward logic usually associated with a "waterfall" model. However, in implementing the practical cycles of co-design, these should be mixed and repeated, as they are needed to achieve the desired solutions to a desired state, as well as bringing the co-designers to a state of knowledge and understanding to enable them to make informed decisions about what a good design entails. The sets include the following actions:

1) Action set: Planning Actions

- Preparing the co-design project. This entails setting the general direction of the project and stating the purpose and role of co-design. It is very important to be explicit about what outcomes are expected of the co-design process. This action is also important for understanding what the biases of the project are and what taken-for-granted assumptions are held by those setting up the co-design process.

- Preparing the co-design process. This includes, e.g., the style and location of meetings, and the resources and competences required. Setting dates, outlines of meetings, as well as the principles of the planning and coordination of the process, is also included.

- Evaluations and feedback of the project progress. This means tracking the learning and knowledge development of the project participants. On the basis of an understanding of how the co-designers develop during the project, the process should be adapted to the needs and pre-conditions of the members of the team. Active evaluation and analysis form keys to a flexible and adaptive co-design process. To strengthen this feedback process, it is an advantage if end user representatives are invited to planning sessions.

- Recruitment of participating co-designers. Finding and motivating people to take part in a project is a major undertaking. The selection of participants could be decisive for the outcome of the design effort. Their abilities to contribute and remain throughout the project are important to consider to be able to structure the process and meet the goals and expectations of both the users-to-be and the project at large.

- Ethics board approval. As co-design often takes place in the context of research efforts, the ethical aspect of this project could be problematic, as the method also works with discovery and change, which entails that many of its aspects may be unknown beforehand. This makes ethical approval difficult unless the board understands the nature of co-design and agrees with its benefits.

2) Actions set: Initiating phase: facts and purpose

- Ascertaining the facts about the current health care area. In the current project, this means including lectures, e.g., by fall prevention experts and by experts advising people on how to live safer at home. As this is a mainstay of EBCD, it should establish a base line of knowledge shared by all.

- Technology orientation. Experts on current IT trends provide an overview for the design group of the technical possibilities. Providing users and health care professionals with sufficient knowledge is another cornerstone of co-design. To give both groups the right message is a pedagogical challenge. It is also a question of giving just enough information and not drowning people in tech facts, as the insight disseminated must be useful for taking part in discussions and making a personal judgement on the possibilities and usefulness of the technology.

- Project purpose. It entails, in this case, to explain the purpose and mission of fall prevention. The focus lies on current project goals, especially on the purpose of the co-design process. The questions to be addressed here concern what the project is set out to achieve, why co-design is employed as part of the project, and what are the expectations of co-design. The different participant groups need different messages here, since catering for all is decisive for the continued process.

- Story telling. The participants of this project were asked to give their own accounts of the problem area, in this case personal or other people's experiences of fall situations. This meant that all participants told their stories, including tech people, old persons (users), health care experts, project leaders and researchers. The purpose of this was to share an insight into the problems of fall prevention but also to make everyone personally engaged in the problem. This does not

 ISBN: 978-1-61208-688-0

only involve knowing about the particular stories, but also creating a personal understanding, which is important for all, not least for the professionals.

3) Action set: Requirements – initial design

- Initial suggestions for technical solutions. Solution providers give presentations and demonstrations, including both those engaged in the project and selected external solution providers. The sessions comprise the initial testing of solutions, whereby the design group is given the opportunity to see and interact with the solutions (in dry runs) in a conference setting.

- Technology adaptation. Based on experiences, a selection is made of solutions that seem to fit and of redevelopment, when needed. The initial testing, in turn, leads to adapting solutions to current situations and needs.

- Preparing for field testing. This comprises the presentation and demonstration of solutions in a conference setting, including actions such as practical planning for field tests, the assignment of technology to people, and instructions for its operation.

- Field testing: installation and practical support. Packages of solutions are installed on site in the participants' homes. If and when needed, revisits or telephone consultancy to fix problems, capture feedback or change equipment are performed. The co-designers use the equipment at home and in everyday life, making notes of problems and experiences of use in general.

- Open dialogues. This may be regarded as a key action in a focus group style for creating a deeper understanding of problem scenarios and of how technology can support a better life situation. Small mixed groups of people from the different sides of the design groups are engaged in open conversations around topics provided by a session leader. The open and dialogue-styled format is important for allowing all participants to give their views on the topic. The purpose is not to create a consensus around certain solutions but to open up new views on problematic situations, users' needs and technological possibilities.

4) Action set: Design of the solution.

- Feedback sessions from users. Continuous feedback may consist of, e.g., conversations, telephone calls, emails, or meetings between technical staff and testing co-design users. Both physical and web-conference meetings were used to sum up the findings.

- Technical evaluation. Based on field testing, technical evaluations of how the solution performed is conducted. Technical deficiencies or problems of practical use are analyzed, and alternative solutions are developed. If changes are deemed serious enough, it might be necessary to reiterate the field testing of the solution.

- In-depth analysis of the key systems that have emerged during the process and how these have performed vis-à-vis goals and expectations. Here an expanded analysis is undertaken, connecting back to, for instance, overall project goals, more general applications, business cases or general feasibility.

- The design of a solution package for large-scale field testing. This could be seen as the final stopping point of the first part of the project and a period of transition to a second part consisting of large-scale testing.

B. Cycles of flexible and adaptive co-design

There is need for a continuous adaption of the co-design process to ensure that the different participating parties evolve on a par with each other. This means a continuous process involving the re-planning of actions taken during the design process. The project works with a general pattern of four types or phases of project activities: Planning session, physical meetings, home activities/testing, and web sessions with user feedback. Four full cycles were performed in the reported project, ending with a final physical meeting of the whole design group. It should be noted that "planning actions" are not limited only to the "planning" phase of the cycle. To illustrate this, an example of one such cycle is provided.

TABLE 1. EXAMPLE OF ONE CO-DESIGN CYCLE.

Phase	Actions
Planning, including representatives of all groups	- Feedback analysis - Agenda setting, meeting - Design group communication
Meeting - Physical meeting with all of the parties of the design process.	- Facts about fall detection - Technology presentations - Group discussion about living longer at home
Field work - the user at home acting and observing.	- Gear testing at home, - Recording habits - Critical incident reports
Web meeting, feedback and reflection meeting	- Feedback of experiences such as gear testing - Suggesting future actions

To achieve an adaptable approach, we combine actions during the different phases, based on the outcomes from the continuous planning and feedback actions. Table 2 combines the phases of a cycle in a co-design process. The key to a successful planning of the next cycle is repeated feedback action during all the phases of the cycle. The feedback is the challenge of the project and is central to involving the end-users in particular in the design process. As the planning session is central, representatives of the different parties should be present, including the users. To instill a feeling of empowerment especially in the end user is necessary for the dynamics of an innovative design process.

V. DISCUSSION AND FUTURE WORK

The challenges of co-design and the need for an adaptive process can be discussed from several angles. The main arguments revolve around the notion of biases, as they always influence the proceedings of the design process. To elevate the knowledge of those concerned with the project is, as we argue in this paper, a key aspect in avoiding the problems of skewed design and ineffective solutions. In the following, we discuss a number of issues that can help avoiding such problems in the project.

 ISBN: 978-1-61208-688-0

There is need for co-design methodology expertise, considering the set of people with separate skills that form the driving force of the project. Too often, designers with a background in health care are project leaders and thus become the ones defining the rationale of the project, as well as planning the co-design process. In co-design, a very complex stakeholder landscape must be managed. To pick the key driving persons from one of the dominant parties will eventually tilt the progression in that direction. However careful or active those forming a project management are in their effort to create a balance, they will be affected by their professional background. A neutral corner of project management with a methodology expert background could be one path to explore, as a means of working with these types of problems.

Learning during co-design helps participants to evolve in areas of which their knowledge is low was present at the very outset of the project. Self-understanding and the articulation of user experiences are equally important as learning new things. To evoke the everyday experience of living during design sessions might be harder. Users need to be given time to work with their own experiences to be able to retell them in the design setting.

One challenge is to clarify and explain the mission and purpose of the project as well as how to convey an understanding of its rationale. A project means different things to different groups. As initial expectations can vary in a very high degree, it can be a hard task to convey the core message to everyone. However, a unitary view of the project might not always be an advantage, but everyone must at least be given the chance of understanding (a topic further discussed in a coming section). A solid piece of advice would be never to take anything for granted, not even the most basic assumptions.

It is necessary to achieve a human-technology balance. There is a challenge in how to set up a project so as to achieve a good balance between creativity and innovation based on the needs of users and the possibilities that technical experts offer or perceive as possible. This division seems still to be a very important one, which remains very hard to handle. The experience from the current project is that it is actually harder to get the technical professionals to engage in user perspectives than for users to adopt a technological way of thinking. The human-technology balance question as posed in this section underlines the need of raising both experts and users to relevant knowledge levels in their respective areas. This includes the necessity of becoming aware of hidden biases and assumptions. To achieve this requires a more neutral project management perspective which is not entrenched in any particular corner.

An EBCD project in a research setting functions under special conditions. The differences between an organizational development situation and a research setting could strongly influence how EBCD works out. One very important aspect here could be the ethics approval, which is required in a research context. An approval from an ethics board is customary, but the understanding of EBCD and its open-ended plan of action could create difficulties to obtain this. As the process is a search for unknown solutions, it might be hard to predict all that will happen. This could be seen as a weakness in the eyes of an ethics board.

There is a hard question of how to deal with a multiple and complex goal structure. The sentiment of co-design all too often seems be a feeling of constituting a big family that will somehow get along. This might not be the case, nor even very desirable. Co-design seems to build on a consensus view of the group and the design issues. A mechanism for handling disagreements seems in general to be lacking. The experiences of this project show that technology restraints often obtain the role of putting discipline into the design group, by claiming “this cannot be done”, or “this will be too expensive” and similar arguments that often stop discussions. A great many actions within a co-design process aim at getting “all on board”. There could be more active ways of exploring the potentials of dissent as a source of innovation and thinking outside of the box solutions. On the methodology side, this should be explored by using tools and methods that can handle such rather delicate processes. A comparison could be made with ‘critical systems thinking’ schools [20] where expressions of dissent are regarded as a fact and systems design as a way of resolving them and creating better solutions for more people.

VI. CONCLUSIONS

The conclusion of this research is that a standard model of co-design in the area of eHealth, such as EBCD, must be viewed as a learning vehicle that enables the different parties to acquire the necessary knowledge to be productive in the project. The basic model of EBCD seems to rely on facts that can be acquired from participants. In this article, we argue for co-design as a formative process of creation and discovery based on experiences of both patients and professionals, especially in the early “fuzzy front-end” stage, as focused on in this paper. An adaptable approach to co-design is needed which tracks the learning progress and adds necessary co-design action to ensure the ability of all participants to grow and learn. The empowerment process includes all the different parties, like users, health care professionals and tech people. As there is a clear trap if the co-design planners and leaders have too clear a connection to any of these areas, a more definite co-design expertise should be at the helm of the process. Compared to a traditional EBCD approach [2], a more iterative and multi-track approach is proposed here, for the purpose of elevating all parties to a point where they can be active and co-responsible. There is a cross connection of fact and empowerment dimensions in co-design that warrants more research into its theory and practice. The outcome of this particular project shows the necessity for high levels of engagement and drive to find the right solutions that will work in practice both in a technological sense and in the life world of the user. To achieve this reality the knowledge and learning dimension must be at the core of the co-design process. No co-design is possible unless there are well planned processes of what could be described as “co-learning”. In this study, we have proposed some outlines of

 ISBN: 978-1-61208-688-0

what a method of co-design could look like, but further research should be performed to formulate a consistent concept of co-design by co-learning.

ACKNOWLEDGMENT

This research was supported by Celtic+ and Vinnova, founding the project FRONT-VL, Project-ID: C2016/2-5.

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TABLE 2. ACTIONS AND MEETINGS MATRIX DURING A DESIGN CYCLE.

Actions type	Cycle phase			
	Planning	Physical meeting	Field test: User at home	Web conference
Planning Actions				
Initiating phase: facts and purpose				
Requirements – initial design				
Design of the initial solution				