

## Co-creating product-service-system with and for the ageing society in different social cultural contexts

**Citation for published version (APA):**

Lu, Y., Valk, C. A. L., Steenbakkens, J. J. H., Bekker, M. M., Proctor, G. M., Toshniwal, O., & Visser, T. (2017). Co-creating product-service-system with and for the ageing society in different social cultural contexts. In E. Bohemia, C. de Bont, & L. S. Holm (Eds.), *Conference Proceedings of the Design Management Academy 2017* (Vol. 2, pp. 451-469) <https://doi.org/10.33114/adim.2017.105>

**DOI:**

[10.33114/adim.2017.105](https://doi.org/10.33114/adim.2017.105)

**Document status and date:**

Published: 01/01/2017

**Document Version:**

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

**Please check the document version of this publication:**

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

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## Co-creating product-service-system with and for the ageing society in different socio cultural contexts

LU Yuan<sup>a\*</sup>; VALK Carlijn<sup>a</sup>; STEENBAKKERS Jim<sup>a</sup>; BEKKER Tilde<sup>a</sup>; PROCTOR Gavin<sup>b</sup>; TOSHINIWAL Omna<sup>b</sup> and VISSER Thomas<sup>b</sup>

<sup>a</sup> Eindhoven University of Technology, Holland

<sup>b</sup> Philips Design, Philips, Holland

\* Corresponding author: y.lu@tue.nl

doi: 10.21606/dma.2017.105

This paper reports on an empirical study about how designers and design researchers applied a co-creation method to generate product-service-system (PSS) concepts in multi-stakeholder teams, to promote physical activities for elderly people in an EU project. This method is developed based on the Value Design method. The value design method consists of a workshop process and a set of generative research tools to support the value creation process. By analysing the workshop process, results from the end user value creating process, the stakeholder value creating process and the encounter process, this paper demonstrates how designers can use such a co-creation process together with the created generative research tools to enable the value creation for the purpose of adopting the PSS approach by the stakeholders and the end users. The results also showed that different social cultural contexts related to the field of interest determined the stakeholder network construction.

*keywords: co-creation; value creation; product-service-system; ageing*

### Introduction

Ageing has become an unavoidable dilemma and will pose an increasing challenge to the healthcare systems in many different countries. In particular, the health expenditure in the EU is expected to rise 350% by 2050, compared to an economic expansion of only 180%.



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### *Combining multi-stakeholder values in integrated solutions*

To tackle this challenge, a lot of research efforts from different disciplines have been spent to understand this phenomenon and create solutions from their perspectives. For example, research from the biomedical field focuses very much on how to improve the diagnosis and treatment of age-related diseases. Biomedical research addresses how to monitor treatment effect which can eventually reduce long term care costs; while research from the home care perspective focuses on providing efficient care so as to manage the increasing care costs and limited care budgets. However, these mono-disciplinary solutions do not necessarily solve ageing problems, in contrary, new age-related problems may be created. For example, if a new medicine is developed for a certain age-related disease, this medicine may not be available for all elderly patients due to differences in social-cultural background and stage of their disease. Or even if employing advanced care technologies can reduce care costs at home, there is no guarantee that the quality of care can remain as before. All these examples suggest that ageing is a wicked problem (Rittel and Webber, 1973). There are multiple stakeholders present in this field with different competencies and solutions from their own perspectives. There is thus a strong need to pay more attention to the relationships between different stakeholders and connections between their solutions to support their collaborative act in creating solutions.

In addition, advances in social, mobile, information processing (big data analysis), and the opportunities of cloud, i.e. the Nexus of Forces (Howard et al., 2012) have already influenced the way that products and services are being developed today. Howard et al. (2012) argue that the traditional way of developing products or services by passing them from one organizational unit to the next along the product development processes, i.e. the value chain model (Porter, 1985), will not lead to the competitive advantages that Porter (1985) has envisioned. When addressing the evolution from value chains to networks, the value network approach (Normann and Ramirez, 1993) is more desired according to Peppard and Rylander (2006), specifically in the context of mobile network operators. Gardien (et al., 2014) also pointed out that a more collaborative and flexible approach to innovation is necessary under the emerging technological and economic changes. Therefore in the context of designing for the ageing challenge, a multi-stakeholder collaborative network approach is more appropriate and desired.

This conclusion also implies that a single product or service provided by these mono-disciplines will not be able to provide for the involved complexities of ageing, the wicked problem. It is interesting to then introduce the concept of Product-Service-System (PSS) here. The concept of PSS started from the field of sustainable innovation (Mont, 2002; Mont, 2004; Tukker & Tischner, 2006). According to Goedkoop (et al., 1999), PSS can be defined as “a marketable set of products and services capable of jointly fulfilling a user’s need”. Although already existing about seventeen years, PSS has received significant attention recently in the creative industry (Goedkoop et al., 1999, Baines et al., 2007; CRISP, 2010) and in design research (Manzini & Vezzoli, 2003; Morelli, 2003; Morelli, 2006; Baha et al., 2013a; Sturkenboom et al., 2013b). Reim (et al., 2015) conducted a systematic literature review on the implementation of business models for PSS creation and identified five prominent tactics of creating a PSS. These tactics are related to contracts, marketing, network, product and service design, and sustainability. Gültekin et al. (2016) stressed that when designing for multi-stakeholder network innovations a continuous

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reflection on the design space, the business space and the collaboration space is required. The design space refers to the users and use characteristics. The business space, which can be also called as the implementation space, refers to the activities and resources required to realize the design solution. While the collaboration space refers to stakeholders in the network, their motivation and impact on the proposed solution. The discussions above suggest that PSS is a promising method to tackle the wicked problem of interest here.

### *The lack of adoption of PSS solutions*

One of the challenges identified by Omann(2003) related to PSS innovation is the lack of adoption of the PSS. Baha et al. (2013a) identified two barriers to adaptation of the PSS innovation approach: 1) users' difficulty with the cultural shift from 'ownership' to 'usership' (Scholl, 2006; Rexfelt & Ornas, 2009); (2) stakeholders and producers' difficulty with shifting from the value chain approach to the value network approach (Mandell, 2011). These two challenges call for a better understanding of the consumers and stakeholders as well as their needs and wants.

### *The use of the value design method for creating PSS solutions*

Gültekin et al. (2016) created a co-creation method, the Value Design Method, to support the creation of PSS concepts by a multi-stakeholder collaborative network to connect both user insights and stakeholder insights and facilitate the collaborative ideation process. The details of the development process and how the method compares to existing methods on developing experience and business design solutions are described in Gültekin et al. (2016). The main contribution of this method lies in the fact that it enables the designers, together with the multi-stakeholder network, to create design concepts in a broader context by considering business dimensions or stakeholder roles in their collaboration next to user-product interaction. This paper will explore how this method can support the designers to co-create PSS together with multi-stakeholder network in the ageing context with specific focus on improving the adoption of the PSS approach by the stakeholders and end users.

The Responsive Engagement of the Elderly promoting Activity and Customized Healthcare (REACH, 2016) is a EU funded project focused on ageing. It aims to prevent chronic diseases and reduce long-term care costs by promoting physical activity among elderly people. Its consortium consists of 17 partners from more than four different EU countries such as knowledge providers (research institutes, universities), technology providers (sensors technologies, prediction software, intervention mechanisms), multipliers (insurance companies, standardization organizations, etc. who are able to multiply the impact of REACH in long term), and solution operators (clinics, rehabilitation centers, and home care providers) (REACH, 2016a). REACH aims to build a PSS that "will turn clinical and care environments into personalisable modular sensing, prevention, and intervention systems that encourage the elderly to become healthy via activity (physical, cognitive, mobility, personalized food, etc.)" (REACH, 2016). Due to the diverse backgrounds of the stakeholders and their different expertise and interests in various social cultural contexts in EU, this paper investigates how the value design method (Gültekin et al., 2016) can be used by designers to facilitate co-creation workshops for creating PSS concepts with stakeholders from different social cultural contexts and eventually support the adoption

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of the PSS approach by the end users and the stakeholders. In these contexts healthcare policies and business models, stakeholder relations, end-user participation is different.

The paper is organised as follows: Section 2 discusses the stakeholder context of REACH and the motivation of applying the value design method in detail. Section 3 presents the research method that is used to collect and analyse the case study data. Section 4 reports then the detailed results and corresponding analysis. This paper closes with the discussion and conclusion.

## **Background**

### *Related work*

As already discussed in the introduction, PSS creation calls for a better understanding of the consumers and stakeholders as well as their needs and wants. This section briefly discusses what is the current related state of art in the design research field.

#### 1. Understanding the needs and wants of the users and stakeholders

Designers often find it difficult to empathize with user groups when working with complex design problems such as ageing. Due to the diverse ageing population with different physical, sociocultural, environmental, and economic conditions and connections within society, it is difficult to completely understand the needs and wants of these user groups. A more explorative approach at the early stages of the design process to understand the nature of the problem is desired. The direct involvement of users in the design process, in order to move from an understanding of users as a subject of study towards an understanding of users as experts of their own experiences, is more appropriate here (Sanders and Stappers 2014). Participatory innovation and co-design are ways to involve users collaboratively in the design process (Buur and Matthews 2008; Mattelmäki and Visser 2011). When collaborating in multi-stakeholder teams, generative design research toolkits can be used by the stakeholders to create dialogues among stakeholders when co-creating values for the end users (Anderson & McGonigal, 2004, Vaajakallio & Mattelmäki, 2007). The purpose of applying generative design research toolkits is to support the co-creation of ideas, insights and concepts in multi-stakeholder innovation (Sanders & Stappers, 2014).

Co-creation is creative and collaboratives. It is also an interdisciplinary process for people with shared goals, but different skills and knowledge, to collaborate together (Vargo et al., 2008). Co-creation is often seen applied to networked innovations where the value is created for the users through direct and indirect relationships with many partners at the network level (Romero & Molina, 2011). Through co-creation, stakeholders combine their knowledge, resources and expectations to understand and address wicked problems and develop propositions and realization plans (Basole and Rouse, 2008; den Ouden and Valkenburg, 2011). In this way, co-creation is a useful network innovation approach that can help align the different expectations of the stakeholders and create shared values and joint propositions for the intended target users.

#### 2. Tools for developing PSS solutions

As already discussed in the introduction, although the understanding of PSS is relatively new and originated from sustainable innovation, there is an increasing understanding of

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how designers can play a key role in initiating collaborative network innovation (CRISP 2010; Morelli 2003; den Ouden 2011, Baha et al., 2013a). Next to their functional specialism in design, their highly developed skills in making and producing, facilitating and empathizing, leading and entrepreneurship are

relevant for the scope and complexity in PSS innovation (Sanders & Stappers, 2008; Stompff, 2012; Han, 2010; Tomico et al., 2011). Gültekin et al. (2016) proposed a co-creation the value design method that can be used by designers to support the early ideation of multi-stakeholder innovation. In particular, this approach specifically aims at supporting the designers together with the stakeholder network in enriching a design concept by considering not only values for the end users but also values for the stakeholders and their roles in the proposition. The value design method consists of the following four stages:

- **Briefing & Analysing.** This stage starts with an introduction of a design brief consisting of a design problem and an initial concept, followed by the analysing step. In the analysing step, the basic use context is defined, the typical user activities in the use context are identified, and the use scenario is structured. The design challenges including problem areas, un-met needs or conflicting interests between stakeholders are also identified and served as starting points to look for design opportunities.
- **Identifying values:** In this stage, the values of the initial concept are analyzed according to the three different levels defined by the Value Framework (den Ouden, 2013) namely: Value for the User (why the concept is meaningful for the users), Value for the Market (why the concept differentiates itself from the existing solutions), and Value for the Stakeholders (why the concept is attractive to the stakeholders).
- **Synthesizing:** At this stage, the participants discuss which design challenge was more crucial to solve and what the added value would be based on the results from step 1 and step 2. The initial concept is enriched with additional synthesizing activities.
- **Consolidating & Evaluating.** At this last stage, the participants focus the discussion on how to realize the finalized use scenario and the concept. The concept is evaluated through joint reflection.

### *Project background*

In order to create the expected PSS, REACH needs to create a collaborative network with various stakeholders within a joint development team. The development strategy of REACH is to create PSS subsystems in four different fields of application at the four solution providers including a clinical environment, a rehabilitation/care home center, a home care provider, and a home care/care home at a municipality level in four different EU countries before the final integration of the total PSS. These four different application fields, i.e. use cases, were chosen to represent the different health states of elderly users in their recovery journey from hospital to home. In this way, REACH can demonstrate how the value design method can be applied by designers to support the project use cases to co-create the intended PSS with stakeholders from different social cultural contexts.

The table below demonstrates the different characteristics of the four different use cases.

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*Table 1 The four testbeds and use cases*

Use case	Country	Solution operator	Health state
Use case 1	Germany	A: Clinical environment	Hospitalized
Use case 2	Switzerland	B: Rehabilitation /care home	Rehabilitation
Use case 3	the Netherlands	C: Home care center	Independent living with support at activity center
Use case 4	Denmark	D: Home care/care home at municipality level	Independent living with support at home

## **Research approach**

This paper examines how the value design method can be applied in co-creation workshops of REACH to create concepts with values for both the target elderly people and the related stakeholders.

Firstly, the designers and design researchers from the project consortium took the lead in developing the customised workshop method based on the value design method and facilitating the workshop. A set of generative design research tools were made to support the co-creation processes in the workshops. Then, multiple-case studies (Benbasat et al., 1987; Yin, 1994) of co-creation workshops based on the workshop method were conducted related to different use cases (see Table 1) to strengthen research findings related to the way in which the value design method could be applied to support the ideation of value co-creation with the target user group and different stakeholders.

As mentioned, the value design method aims at supporting stakeholders to create PSS in the early ideation phase. Based on service-dominant logic (Lusch & Vargo, 2006), Payne (et al., 2008) proposed a conceptual framework to analyse the co-creation process from three different processes: the customer value-creating process, the supplier value-creating process and the encounter process. These three processes demonstrate how customers experience the created values for them through the interaction and exchange processes with the suppliers and enabled by the suppliers' action in creating such values. They argued that the insights generated from the combined perspectives could help the stakeholders to see the opportunities for adopting the co-creation of values. This paper discusses a PSS network co-creation process. Using similar logic, the workshop process and results will be analysed from the following three perspectives: the end user value-creating process, the stakeholder value-creating processes and the encounter processes. Figure 1 below depicts the relation of these three processes.

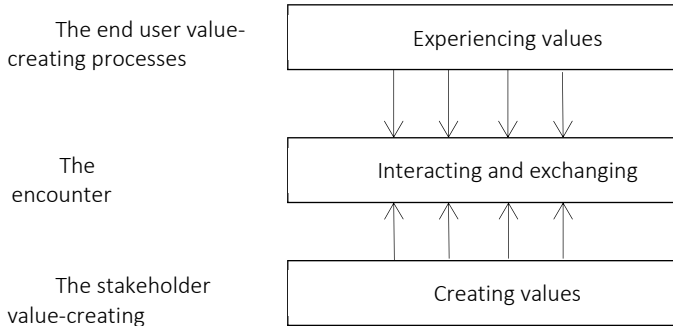


Figure 1. Three different processes in the co-creation process

### *Co-creation workshop program and created generative research tools*

As discussed above, four co-creation workshops based on the value design method were conducted at the four different test bed locations in the context of REACH. Below the general set up of the workshop and the created generative research tools are discussed. Since this workshop program was based on the value design method, the program follows the 4-step approach discussed earlier. Added features due to consideration of the specific REACH context are discussed below.

#### 1. Brainwriting

Gültekin et al. (2016) recommended applying the value design method when there is already an initial design concept and a need to integrate knowledge from experts and related stakeholders. However, when starting the project, there were no initial design concepts yet and it was therefore not possible to apply this method directly in the co-creation workshops. Thus, this method was adapted in order to embed ideation activities. Since these co-creation workshops quite often involve multiple yet unacquainted stakeholders with different interests and expertise from various nations in Europe, the brainwriting technique instead of brainstorming technique (VanGundy, 1984) was chosen to organise the group ideation session prior to the application of the value design method. During the brainwriting session, each individual participant writes his/her ideas on a sheet of paper. After five minutes, the sheets are rotated to a different workshop participant, who builds off of what their predecessor has written. This process continues until everyone has written on everyone else's sheet. The entire session can take about 20-30 minutes. In the end, all group members will rank the created ideas individually and jointly elect favourite ideas to work on further as a group.

Afterwards, the value design method can then be applied to support a multi-stakeholder team to iteratively develop a proposition. The iterations consist of idea development based on pairwise comparisons between design considerations (who are the users, what are their characteristics and what is their context of use?), stakeholder considerations (what are the drivers behind their actions, and what can they contribute to the propositions?) and business considerations (what is needed to implement the propositions?). Scenarios are used as a dynamic thinking tool to evolve the propositions during the process.



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## 2. Co-creation input and output templates

The layout prompts introduced in the value design method was designed specifically to guide the flow of the workshop following the 4 steps. The created lay-out forms were found limited in providing guidance when filling up the contents by the participants in earlier studies (Gültekin et al., 2016). Therefore, a number of co-creation templates were created as generic design research tools to support, on the one hand, the documentation of the workshop results and on the other hand, guide the participants through the workshop process and allow them to share their knowledge on specific topics based on their expertise when creating PSS concepts. The types of input templates created include: input cards, triggering cards and output cards.

Input cards consist of experience-mapping cards based on Philips' experience map method (Philips, 2014) and were served as input for the co-creation workshop. The local use cases created these experience maps from their own user research based on the template provided by the designers. The contents of the input cards contain the user insights from the four use cases. The triggering cards, as sources of inspiration, aim at supporting the ideation of the different stakeholders and consist of

- Insight cards: these cards were created by designers prior to the workshop to describe the user insights based on the local use cases and project objectives.
- What-if cards: these cards were created to stimulate the brainwriting session. What-if questions on these cards were formulated based on the interests of REACH and the needs of the use cases.

A number of templates were created to capture the workshop output. These templates are:

- Framing opportunities template: this tool was made to identify the design opportunities and formulate the design challenges based on user insights identified earlier.
- Idea template: this template was made to capture the created ideas by specifying what the idea is, why this idea, how it works and what capabilities are needed to make it happen.
- Experience flow template: this template helps record any thoughts, feelings and actions the user might experience or do when using the designed product or service. One might uncover important aspects of the design that one has overlooked, which can pose equally as an opportunity as well as a threat. It helps to carefully examine what users of your product and/or service might experience, and document your observation. This template was created based on Philips (2014).
- Service blueprint template: this template was based on the service blueprint technique. By defining customer actions, the resulted physical evidences, separating visible from invisible customer-employee contact, and identifying the support processes in the background, this technique can demonstrate different processes provided by a stakeholder organization, in order to create and deliver the intended services (Shostack, 1984). The service blueprint was made to describe the different actions that the stakeholders need to take in

order to realise the intended services and experiences for the target customers.

The following figures give an example of the insight cards and what-if cards used in the workshop.

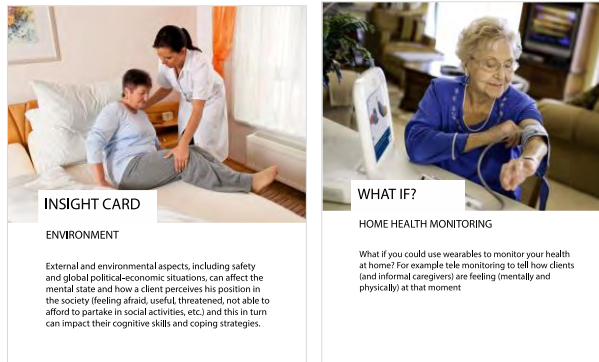


Figure 2. Example of Insight cards, What-if cards

### 3. Stakeholder Empathy Wheel

In addition to the content-related workshop activities as discussed above, in order to have a successful workshop it is important to realise that the design workshop process is a social process (Cross and Cross, 1995). It is necessary to align the moods and spirit of the participants and create a trusting and safe atmosphere for the follow-up co-creating activities. Therefore an ice-breaking activity was designed for the participants to take at the beginning of the workshops. This activity was based on professional empathy principles (Steenbakkers et al., 2015) and the stakeholder empathy wheel template (see Figure 3), a generative research tool created to help the stakeholders to introduce themselves to each other and express their needs.

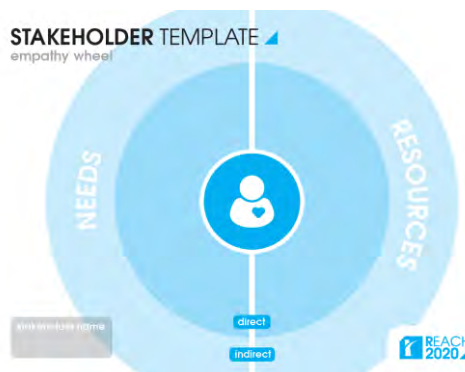


Figure 3. Stakeholder Empathy Wheel Template

Since the purpose of the workshops was to create initial PSS concepts that the development team of the project could continue to work on, at the end of the workshops,

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all concepts were ranked and prioritised based on the purpose of the REACH and the preferences of the stakeholders.

As a result, the co-creation method based on the 4-stage of the value design method lasts for two days and consists of the following steps:

- Professional empathy

Creating a trusting, collaborative atmosphere for better acquaintance in multidisciplinary teams

- Design considerations

Creating common ground for further ideation based on experience maps and personas from the local use cases

- Ideastorming

Brainwriting in teams and concept selection

- Stakeholder considerations

Creating experience flows for each different stakeholders involved in the concepts

- Business Considerations

Creating service blueprints for the selected concepts, and defining actions at both the front and back stage to realise the intended user experiences

- Joint reflection and conclusion

Ranking the created concepts and select those to develop for the next project stage.

### *The workshop participants*

The first workshop was organised to take place on June 21 and 22 2016 in test bed location A. In total 30 people (9 project consortium partners, 3 elderly patients, 3 caregivers, 11 staff from the solution operator A and 4 local stakeholders outside the project consortium) participated in the workshop. Among them there were 3 designers/design researchers who facilitated the workshop.

The second workshop was organized to take place on September 5 and 7 2016 in test bed location D. In total 26 people (including 17 from the project consortium partners, 2 elderly patients, and 7 staff members from solution operator D) participated in the workshop. Among them there were 3 designers/design researchers who facilitated the workshop.

The third workshop was organised to be on Sept 13 and 14, 2016 in test bed location C. In total 40 people from the project consortium partners, the elderly, their formal and informal caregivers, local partners with the solution provider C, including other care organisations, municipalities, insurance companies and physiotherapists, participated in the workshop. Among them there were 3 designers/design researchers who facilitated the workshop.

The fourth workshop was organized to be on Oct 17 and 18 2016 in test bed location B. In location B, 21 project consortium partners, 3 patients, 3 caregivers and 3 local partners participated in the workshop. Among them there were 4 designers/design researchers who facilitated the workshop.

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The participants outside the project consortium were invited based on their organizational position and expertise. In this way, a mixed-gender, multi-age group with different knowledge domains participated in each workshop.

## **Results and analysis**

### *Co-creation workshop process*

The workshops mostly went according to plan, except for one situation. Initially, it was expected that the workshop could be organised in English for solution operator A. However, due to the participation of the elderly patients with English language deficiency, the workshop had to be given in German. To better accomplish this, designers/design researchers decided to change the group brainstorm and idea-storm activity in a fishbowl discussion session. The elderly and care providers were organised together in the centre of the session as the insight-gathering focus group and two ideation groups were organised, and positioned around, to create ideas based on the insights/feedback received from the continuous ping-pong discussion and interaction with the focus group. In this way the input from the patients and caregivers could be used iteratively to develop the intended concepts.

#### 1. The end user value-creation process

The end user value-creation process took place in the co-creation process during the pairwise comparison between the design space and the collaboration space. In all workshops, the elderly participants primarily participated in the sessions on the first day. These elderly provided extra insight to the personas, defined earlier, and to the experience mapping done prior to the workshops. Some of the elderly participants were also available on the second day and provided feedback on the ideas that the stakeholder teams created. Their primary input to the co-creation workshop were twofold: inspiring and informing. They interacted with the stakeholders with support from a number of generative research tools such as the idea template, the experience mapping template and the service blueprint template. These tools allowed the elderly to understand the created ideas and supported them to formulate their input.

The stakeholders gained many user insights through the interaction with the end user and also by using the insight cards. The values for the target elderly group were defined in the ideastorming section of the workshop and recorded in the experience mapping template and the service design blueprint template to support further dialogue between stakeholders and the end users.

#### 2. The stakeholder Value-Creation Process

It was observed that the created generative research tools had different functions at various moments in the workshops when creating values for stakeholders.

During the ice-breaking phase, the stakeholder empathy wheel template allowed the stakeholders to express who they are, what resources they have and what they want to achieve with the workshops.

The experience flow template was used in the stakeholder consideration phase to understand the motivation of different stakeholders and what impact they could have on the end user experiences. The service blueprint template was used in the business

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consideration phase to identify the important resources and activities for the value creation.

When reviewing the end user value-creation process and the stakeholder value-creation process, it can be concluded that the combination of using the workshop approach based on the value design method and generative research tools enables the designers to facilitate the workshop and support the stakeholders and the end users in adopting this co-creation approach. The designers and design researchers keep defining and facilitating the co-creation approach, while the stakeholders and the end users are active in co-creating values.

### 3. The encounter process

Since the ideastorming session started with enriching the personas and experience maps the insight cards and what-if cards helped the stakeholders to get informed and inspired for additional ideas.

The stakeholders first made use of framing opportunities template to come to an agreement on the design challenge during the design consideration phase. The stakeholders then used the idea template to capture different ideas during the ideastorming phase.

It was observed that during the workshop the generative research tools were able to

- Support the participants to become motivated when interacting with each other using the professional empathy wheel
- Support the participants to emphasize with the elderly target group when using insight cards.
- Support the participants to identify and express opportunities for innovation when using the what-if cards and the framing opportunity template
- Support the participants to describe the ideas using the idea template
- Support the participants to define the realisation activities using the experience flow template and the service blueprint template. It is interesting to note that the ideas were further developed when the workshop moved forward to the stakeholder consideration phase and the business consideration phase and the templates used later also captured the evolvement by detailing the ideas using the experience flow and service blueprint.
- Support the designers/design researchers to gain the ability to improvise in action when the elderly participants were not able to provide comments in English for example.
- Support the designers/design researchers to document the co-creation process with co-created outputs and reflect while facilitating the workshops.
- Support the participants to build on the results further step by step and reflect while participating the workshop.

The generative research tools were able to capture the changes made and create a platform to inform, inspire and create dialoge between stakeholders when expressing their ideas (Sanders, 2008).

The table below indicates where in the co-creation process different generative research tools support the value creation for the end users and stakeholders.

Table 2. Different use of generative research tools in the co-creation workshops

Co-creation process	End user value-creating	Stakeholder value-creating	Encounter
Professional empathy wheel		X	
Insight cards	X		X
What-if cards	X		X
Framing opportunity template	X		X
Ideate template	X		
Experience flow template	X	X	X
Service blueprint template	X	X	X

What can be concluded is that the workshop program allowed the participants to move from the design space, the collaboration space to the business space fluently. In this way, the elderly participants could inform the stakeholders about their needs and wants and help to create a common ground (values for the end user) for co-creation. They could also give feedback to the stakeholders on the ideas generated. The stakeholders could exchange their ideas with each other, define and express their intended values (values for stakeholders) and negotiate based on the common ground defined (encounter process).

### *Co-creation workshop results*

At solution operator A, 4 concepts were chosen as the most preferred concepts at the end of the workshop. The PSS concepts focus mainly on objectively measuring health progress and activity status in a hospital context, including incontinence, physical activity, and providing feedback about the overview of user progress, motivating more activities or preventing unwanted situations. The resulting stakeholder network consists of the target elderly patient group, the solution operators including healthcare professionals, multipliers such as insurance and technology providers for sensing, rehabilitation, and data analytics.

At solution operator B, the participants chose 3 preferred concepts. The PSS concepts focus mainly on sensing physical activities, locations and social connections, documenting healthcare progress in both at-home and in-hospital contexts, so as to motivate a more active lifestyle within their capability. The created stakeholder network consists of the elderly target group, solution operators including healthcare professionals and informal caregivers, technology providers for sensing, rehabilitation and data analytics.

At solution operator D, 3 preferred concepts were chosen as the output of the workshop by the participants. The PSS concepts primarily focus on both subjective and objective measurements of health status and provide feedback to motivate more physical activities. The resulted stakeholder network consists of the elderly target user, solution operators including informal caregivers and healthcare professionals from municipality and technology providers for sensing and data analytics.

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At solution operator C, the participants chose 3 concepts as the more preferred concepts. The PSS concepts focus on detecting irregularities in daily activities, sensing environmental changes and promoting physical and social activities. The created stakeholder network consists the elderly target group, the solution operator including informal and formal caregivers, the multipliers such as insurance, and the technology providers for sensing and data analytics.

From the workshop results it can be observed that the main values created for the end users were similar: focusing on sensing physical activities and health status and creating motivation for a more active lifestyle. However, the stakeholder networks (the collaboration space) were somehow different. Multipliers only appear in the stakeholder networks at solution operator A and C but not B and D. This has to do with the national healthcare policies in these countries. Solution operator B and D operate in welfare-based healthcare systems, while solution operator A and C operate between welfare and private insured healthcare systems.

Prior to the workshop it was expected that the role of technology providers should differ in home and hospital/clinic situations. Rehabilitation technology provider was expected to be relevant for the hospital/clinic situations while sensing technology providers were more relevant for home context for the purpose of preventive care. The resulting concepts suggested that sensing technology providers would also be needed in the context of hospital/clinic contexts for REACH for the purpose of sensing and monitoring of the recovering progress. Data analytics was found to be generally required for both home and clinic set up.

These observations imply that when applying co-creation workshops in socially culturally different contexts with participants from other social cultural contexts, although the values for the end users may be comparable, the collaboration space and the business space can differ much depending on the local social cultural contexts.



Figure 4. Workshop session

## Discussion and limitation of the study

The value design method for multi-stakeholder ideation was applied to create PSS concepts at four solution operators for REACH. The workshop process and the workshop results demonstrated that such a method is capable of creating value for both

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stakeholders and end users so as to motivate their adoption of the PSS approach. The generative research tools utilized, created a platform for end users and stakeholder to communicate about their wants and needs. It is necessary to mention that the workshop participants were from different disciplines with various experiences with co-creation from limited experiences to expert facilitators.

At the same time the stakeholders had had some interaction and commitment, because they had already been selected and had interacted in developing the REACH project proposal before participating in the workshops.

This paper was written from the observation and experiences of the designers and design researchers who developed the workshop program based on the value design method and facilitated all workshops. With the expertise of these designers and design researchers and the support of the generative research tools the stakeholders were empowered to socialize with each other, communicate their needs and wants, identify the innovation opportunity together, and express their intension in the project through the PSS concept co-creation. At this moment, the stakeholder networks formulated at the four workshops are working together to further develop the PSS concepts within the context of REACH. It is expected more research data related to the co-creation process with the stakeholders from their perspective will be collected so as to contribute to the empirical research on managing and measuring co-creation process and adoption of PSS approach further.

## **Conclusion**

The paper demonstrates the usefulness of the value design method in supporting the designers to facilitate the stakeholder network to conduct design iterations between the design space, the collaboration space and the business space. The created generative design research tools were found useful in particular when designing and documenting the details related to PSS design. Yet it is important to realise that the discussed co-creation workshop at the early design stage of PSS innovation is just the first step towards the creation and realisation of the intended PSS innovation. How to co-make business from these concepts and make real society impact along the development and realisation process of the PSS innovation remains a challenge for the multi-stakeholder network. Value co-production (Ramirez, 1999) has been widely discussed on its implications on defining business, organising work and managing the creation of values. The question of how designers can support the value co-production and make the co-created values sustainable along the multi-stakeholder innovation processes needs to be addressed from business, management and organizational perspective as the continuation of the agenda in the Crisp (2010).

## **Acknowledgement**

This project has received funding from European Union's Horizon 2020 research and innovation programme under grant agreement No 690425. We would like to thank all workshop participants from the partners within and outside the REACH consortium.

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## About the Authors

**Dr. Yuan Lu** works as associate professor in designing for healthy and active ageing. She is interested in exploring the use of probes to create motivational strategies for behaviour change and support design decisions with multi-stakeholders.

**Carlijn Valk**, alumna of Carnegie Mellon school of Design and Eindhoven University of Technology, is pursuing a PhD, at the latter, focussing on design for personalization of motivational strategies.

**Jim Steenbakkers** works as a freelance business designer throughout multiple sectors including TU/e. He aims to accelerate innovation by applying design methods, business modeling, (design) strategy, creativity and (rapid) visualizations for behaviour change to support healthy ageing.

**Dr. Tilde Bekker** works as an associate professor in designing playful interactions for play, learning and wellbeing. She is interested in theory-informed design research in the context of designing motivational solutions for children and elderly.

**Gavin Proctor** is head of design for Philips global brand management. His interests involve the understanding of human values, issues and concerns, utilizing new design tools and methodologies to develop new products and services generating business growth.

**Omna Toshniwal** works as a Design researcher at Philips. She is interested in applying psychological theories to design, and using a mixed method approach (quantitative and qualitative) to understand people's motivations and behavior and exploring techniques to support better health.

**Dr. Thomas Visser** is a senior design researcher at Philips Design, currently leading design innovation project on sleep and respiratory care. He focuses on health-related topics and design for behavior change and is responsible for collaboration with universities and design-schools.