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Smart Home Service Opportunity Identification

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Abstract
The challenge to provide an aging population with health and care services while also improving the opportunities for a self-determined and independent lifestyle of elderly people can be enabled by systems for smart homes or ambient assisted living. One of the key potentials is to improve the delivery of services to consumers within their own habitation. Achieving these improvements thus requires combining smart home systems, other IT and traditional service delivery into effective and efficient smart home services. Such a combination is unlikely to emerge without systematic development efforts. The research presented in this research-in-progress paper seeks to extend service engineering methods for better supporting the development of product service systems. It focuses on the early phases of service engineering by proposing a method for identifying opportunities for the development. Besides the method, the prerequisites, an informal evaluation, and limitations are presented.

Keywords: Service Engineering, Smart Home, Ambient Assisted Living, Product Service System

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INTRODUCTION

It is a widely recognized challenge for many societies around the globe how to provide an aging population with health services and care service while also improving the opportunities for a self-determined and independent lifestyle of elderly people (Chan et al. 2008, 2009). Information technology is an enabler to meet this challenge, in particular systems for smart homes or ambient assisted living (e.g. Nehmer et al. 2006). One of the key potentials of such systems is to improve the delivery of services to consumers within their own habitation, e.g. health services (Tang/Venables 2000). Achieving these improvements thus requires combining smart home systems, other IT and traditional service delivery into effective and efficient smart home services. Such a combination is unlikely to emerge without systematic development efforts.

Research on new service development (Froehle/Roth 2007) and service engineering (Bullinger et al. 2003) provides guidance for organizing the development of new services. In particular service engineering provides concepts, models, methods, and tools for "… the systematic development and design of services" (Bullinger et al. 2003, p. 276). In the view of service engineering, individual services can be purposefully conceptualized, developed, tested, and launched into the market. To support these activities, service engineering research often adapts methods and tools from product or software development for creating new services.

The research presented in this research-in-progress paper seeks to extend service engineering methods for a better supporting of the development of smart home services. Smart home services use smart home information and communication technology for proposing, agreeing, realizing, and recovering services for assisted living (based on Maglio et al. 2009). In particular, we focus on the early phases of service engineering by proposing a method for identifying opportunities for the development of smart home services. In order to leverage the potentials of smart home technology, such opportunities need to generate opportunities that combine service and technology.

METHODOLOGY

According to the existing literature smart home service opportunities cannot be systematically identified, yet, but collaboration of an interdisciplinary team can deliver necessary resources for this task (Kersten et al. 2006) and can cover the complexity where a single individual would not be able to (Hlupic et al. 2003). "Several studies have shown that, based on measures of performance such as creativity, quality of problem-solving, and effective decision-making, heterogeneous groups, if managed effectively, have significantly higher potential than homogeneous groups." (Board on Higher Education Workforce 1997, p.11)

In our case, the team comprises experts from the following domains: smart home technology for hardware requirements and ambient assisted living solutions, as well as software engineering for service platform requirements, including interface and usability research, also service providers with a rich understanding of health and care services, and finally facilitators with knowledge in service-engineering to integrate all perspectives and manage the groups as demanded above. Since these experts have long-time experience in their field, we can assume there is a great amount of necessary implicit knowledge to identify relevant smart home service opportunities.

An additional challenge in the given setting is the need of simultaneous development of services, smart home solutions, and IT platform development – using existing standard home automation devices and service providers who are resident in the neighborhood. The specific

characteristics of product-service systems require specific requirements for the development, especially cross-domain collaboration (Berkovich et al. 2011). Existing process models put on a variety of criteria but are not detailed or evaluated enough (Gräßle et al. 2010).

(Greenbaum 1997), e.g., recommends focus groups for idea generation. Our research design is based on that approach to integrate the perspectives of all experts into a systematical development of smart home service opportunities. In social science, qualitative data can be collected using focus groups by letting the experts work collaborative. However, the experts must be guided through the process (see e.g. Marshall et al. 2010; Morgan 1997).

For this research the experts were guided through the process as shown in Figure 1. In multiple workshops a relevant set of services for the product-service system was developed.

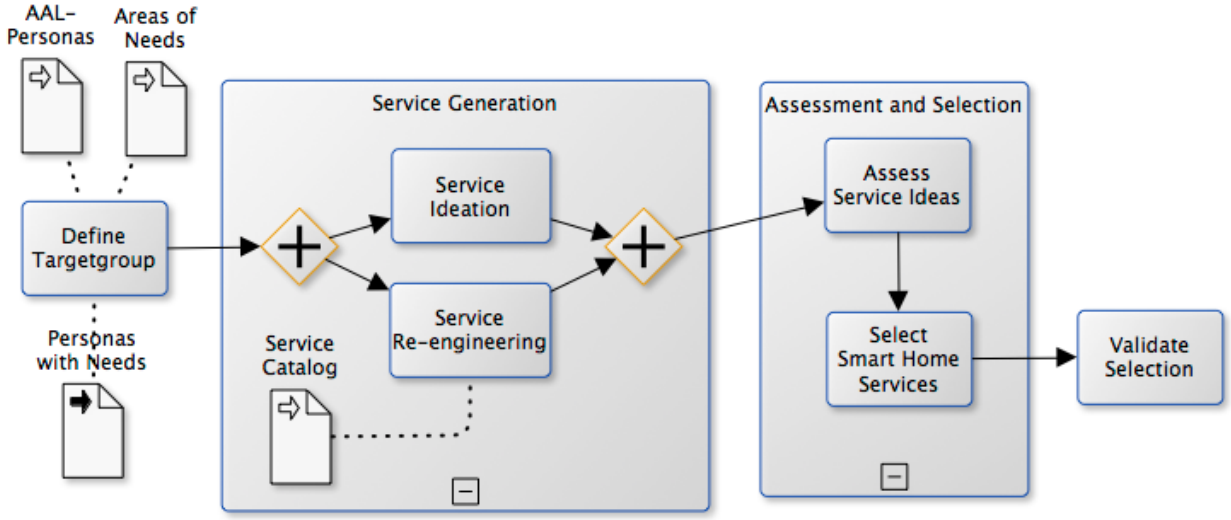

Figure 1. Overview of Smart Home Service Opportunity Identification

Preparation

Creation of personas to define target group: Personas are a concept from the field of interaction design (Cooper et al. 2012). They represent fictional but realistic examples of users. An advantage of the concept is a concrete description of the target audience members. This can keep the team focused on the user's needs (Pruitt et al. 2003), which is especially important in an interdisciplinary team. A disadvantage is the subjectivity of the description. This could possibly lead to a distance to the real target group.

Areas of needs for target group: To ensure all areas of needs are covered, clusters of activities were used as an input for the innovation. (Belbachir et al. 2010) provide four clusters of activities: home care, safety, security and privacy, health and wellness, and social interactions. All fields have to be covered for all personas by innovated services.

Generation of service ideas

First, a decentralized generation of service ideas using ideation and reengineering techniques was initiated: The facilitator of the opportunity identification defined a structured set of information for a high-level description of services (Figure 2). All experts used this structured set to allow combining and comparing service descriptions afterwards.

The early interested, healthy person	The sophisticated, younger senior	The resident in ser. living w. chronic physical dis.	The senior with early-stage dementia	The working family caregiver	Area of Need	Service	Service Portal – Establish Service	Service Portal - Completion of Service	Smart Home Usage	Frequence of Use
	X				social	Culture Share: Accompanied participate in cultural event	Find partner, book tickets	Reminder	Reminder	monthly
X	X	X	X	X	comfort	Food Service	Order	Reminder, Feedback, Monitoring	Presence, time of day	daily-monthly

Figure 2. High-level service description with assignment to personas

Each partner generated a list of services. One part of the service innovation process was based on ideation: thinking up possible services with respect to the defined personas. The other part was based on reengineering: A service catalogue, provided by one of the partners in the project, was reviewed. From this catalogue, the team incorporated those services with a potential for reengineering their proposal, agreement, and realization using smart home technology.

In an additional workshop, the facilitator created a full list of service ideas and the team used needs-based categorizations to cluster and merge similar ideas and check the services for a sufficient coverage of needs.

Assessment and selection

To identify a core set of service ideas, the facilitator proposed the following criteria:

1. *Feasibility*: A key concern to all team members was feasibility. Each of the service ideas could require development efforts for the service, the smart home technology, and/or the service platform. To evaluate the feasibility of realizing a service idea, every service was assessed as shown on the left hand side in Figure 3 by the respective experts for service delivery, smart home technology, and the service platform. The pre-selection is based on the average of the three single estimates.

Feasibility Platform (easy/med./difficult)	**Feasibility Smart Home** (easy/med./difficult)	**Availability of Service** (service exists, partly, non existing)	**Pre-Selection - Potential for Project** (negativ/neutral/ positiv)	**Potenzial for Smart Home AAL** (negativ/neutral/ positiv)	**Adoption Support** (negativ/neu-tral/positiv)	**Re-usabilty** (yes/no)	**Selection**
easy	medium	partly	neutral	positiv	neutral	yes	no
easy	easy	existing	positiv	positiv	positiv	no	yes

Figure 3. Assessment and service selection (Continued from Figure 2)

2. *Adoption support*: User acceptance of technology-based services is another key concern. The team decided to identify services that are frequently used by all personas. Such services can enable service customers to learn how to use the technology for requesting and co-creating

services. Life-long and non-supervised learning are essential aspects of a smart home service (Bien et al. 2010).

3. *Smart home potential*: The team also identified services that significantly leveraged smart home and ambient assisted living technologies.
4. *Service reuse*: Some services are reused in other services and thus facilitate the implementation of other services.

The assessment proposed to give priority to services that have passed the feasibility pre-selection and at least meet one of the three other criteria.

Validation

To ensure that all areas of needs for all personas are covered, a matrix was filled out by one of the experts as shown in Appendix 1. This matrix was reviewed and agreed by the other workshop participants.

RESULTS AND EVALUATION

Personas and areas of needs

For this research, five existing personas have been reused and adapted, based on work from (Glende et al. 2011): An early interested, healthy person (male); a sophisticated, younger senior (female); a senior with chronic physical diseases (female); a senior with early-stage dementia (male); and a working family caregiver (female). The team agreed on the personas to represent diversity regarding gender, age, and needs. These personas can be clustered into three groups: users on the move into a new phase of life (first two), users with support needs (next two), and supporting network (last persona).

The four clusters of activities — mentioned in the method section — have been described in this project as areas of needs. These areas are distinguished between needs for the first and needs for the second group of personas. Whereas the first group is looking for services that cover e.g. *comfort,* it is more important for the second group to cover *security. Mobility* becomes *supporting services, prevention* becomes *health,* and *leisure (free time)* becomes *participation (social)*.

Generation, assessment, selection, and validation of service ideas

In total, the team created 60 service ideas, covering all categories of needs. Nine of those services were technology-based[1]. After the assessment of feasibility, 30 services were left as theoretically feasible services. However, for the scope of the given project a smaller number of services were needed. Therefore, an iteration was run to apply the other selection criteria. Finally, 15 service ideas were selected as opportunities — realistically feasible for the project.

Appendix 1 shows the selected services and their relation to the persona and their areas of needs. All personas and all their areas of needs are covered. The selected services represent a balanced covering for a smart home service solution.

Evaluation

This approach was tested in a smart home project to innovate and identify relevant services for a given focus. Both, technology and service experts used this method and considered

[1] Technology refers to services for maintaining and supporting the technology in the home.

the method as helpful. The selected smart home service opportunities cover the target group's areas of needs in a balanced manner – no field is under – or overrepresented.

Yet, a structured formative evaluation of the method is required as a future step in research to identify required improvements to the method.

OUTLOOK AND LIMITATIONS

The method section above describes the methodology used in several workshops to develop service opportunities as listed in the results section. Since a qualitative approach was used, the results are influenced by the individual experts in the focus groups and therefore constitute a non-representative sample in a statistical sense.

Also, the integration of end-users (both: smart home residents and service provider employees) into all phases of service engineering is a key concern (Chesbrough 2011). A limitation of this approach is the lack of user participation throughout the process. The high level description of services is too abstract to perform quantitative user research like surveys. Qualitative research could be done but would be limited to personal needs and interests of few interviewed volunteers. Useful ways to integrate users into the process have to be found.

Therefore, the projects next steps are to integrate users and validate the results. The selected services will be described in a way to discuss them with user groups. Afterwards, they will be implemented and evaluated in a smart home laboratory, where potential users will test the service settings.

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APPENDIX

Appendix 1. Identified smart home services and their relations to target group and areas of needs.

Persona ------- Service	Early Interested	Sophisticated Senior	Chronic Physical Diseases	Early-Stage Dementia	Caregiver
Leisure / Participation	Gourmet Buddy, Contacts/ Friends, Scheduling, Provide Services, Online Community	Gourmet Buddy, Contacts/ Friends, Scheduling, Provide Services, Online Community	Contacts/ Friends, Scheduling, Online Community	Contacts/ Friends	Gourmet Buddy, Contacts/ Friends, Scheduling, Provide Services, Online Community
Comfort / Security	Technical Hotline, Technical Maintenance	Technical Hotline, Technical Maintenance	Technical Maintenance	Technical Maintenance	Technical Hotline, Technical Maintenance
Mobility / Service	Grocery Shopping, Clothes Service, Cleaning Service	Grocery Shopping, Clothes Service, Cleaning Service, Social Care Service	Grocery Shopping, Clothes Service, Cleaning Service, Social Care Service	Grocery Shopping, Clothes Service, Cleaning Service, Social Care Service	Grocery Shopping, Clothes Service, Cleaning Service, Social Care Service
Prevention / Health	Medical Care	Medical Care, Medical Monitoring	Medical Care, Medical Monitoring, Medical/ Nursing Support	Medical Care, Drug Ingestion, Medical Monitoring, Medical/ Nursing Support	Medical Care, Drug Ingestion, Medical Monitoring, Medical/ Nursing Support

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