AAL Service Development Loom – From the Idea to a Marketable Business Model

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Abstract. The Ambient Assisted Living (AAL) market is still in an early stage of development. Previous approaches of comprehensive AAL services are mostly supply-side driven and focused on hardware and software. Usually this type of AAL solutions does not lead to a sustainable success on the market. Research and development increasingly focuses on demand and customer requirements in addition to the social and legal framework. The question is: How can a systematic performance measurement strategy along a service development process support the market-ready design of a concrete business model for AAL service? Within the EU funded research project DALIA (Assistant for Daily Life Activities at Home) an iterative service development process uses an adapted Osterwalder business model canvas. The application of a performance measurement index (PMI) to support the process has been developed and tested. Development of an iterative service development model using a supporting PMI. The PMI framework is developed throughout the engineering of a virtual assistant (AVATAR) as a modular interface to connect informal carers with necessary and useful services. Future research should seek to ensure that the PMI enables meaningful transparency regarding targeting (e.g. innovative AAL service), design (e.g. functional hybrid AAL service) and implementation (e.g. marketable AAL support services). To this end, a further reference to further testing practices is required. The aim must be to develop a weighted PMI in the context of further research, which supports both the service engineering and the subsequent service management process.

Keywords: ambient assisted living, new service development, avatar, home care, informal care, business model

1. Introduction and description of problem

In Europe demographic change and childlessness and the increasing number of one-person households are leading to increasing isolation and loneliness, particularly of the elderly [1]. Furthermore, the influx of mobile young people in urban centres increases the aging of people in rural areas [2]. This leads to an increased need for support services for the elderly and non-mobile people with health problems in the home environment [3].

1.1. Potential of the AAL market

In the past few years older customers (Generation 55+) have increasingly become the target of considerations [4]. This older customers market is determined both by the growing opportunities resulting from technological progress and the purchasing power located of this customer segment (Push-perspective). On the other hand, this market (e.g., quality, personal benefit) is characterized by needs (e.g., assistance systems, supporting services) and particular expectations (pull principle) [5]. The new Ambient Assisted

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Living (AAL) market is emerging as an essential sector [6]. AAL encompasses the range of age-appropriate assistance systems for ambient assisted and independent living through appropriate technologies, products and/or services that support the everyday lives of older and disadvantaged people, depending on the individual situation [7].

1.2. Iterative service development

Such AAL services are comprised typically of hardware and software components as well as a service component. Furthermore, hybrid AAL services require not only a modular structure; the participation of a service provider is also an essential part. The service provider is the continuous interface for end users and includes the capabilities of information, explanation, and provision of after sales services including end-user training [8]. The development of such services requires suitable and adapted concepts and tools. Based on traditional linear iterative product development concepts, service development models have been developed in the past [9]. The iterative development of services encompasses a sequential approach. Starting from a stepwise approach there is, if necessary, the possibility of back jumps to previous development stages. [10]

1.3. Transparency through performance measurement index

During the iterative development of services, it is necessary in addition to the push and pull perspective to measure continuously, visualize and analyse [11] the specific criteria of services (e.g., uno actu principle, external factors) [12] as well as multiple influential factors. Due to the complexity and variety of such development processes and to achieve the desired and required service quality, sufficient transparency of the structures, processes and outcomes is crucial. Such transparency is important and can be implemented using a meaningful performance measurement approach. [13] The resulting question is: How can a systematic performance measurement strategy along a service development process support the market-ready design of a concrete business model for AAL service?

2. Methods

In addition to the development of a specific avatar-based AAL service, the exploration and testing of iterative service development models is an essential part of the EU research project DALIA (Assistant for Daily Life Activities at Home) [14]. The goal is on the one hand to provide an integrated home system that supports older adults as primary end-users, offers support to their informal/non-professional caregivers as secondary end-users, and can be extended to interface with services of formal/professional care and medical services [15]. On the other hand, it is important to develop a workable approach which is suitable for the targeted design and development of marketable AAL services.

2.1. Empirical development and testing of an avatar-based AAL service

The research project DALIA can be divided into the following work packages: Project Management, End-user Centric Requirements Specification and Evaluation, System and End-User Requirements Elicitation, Development and Testing of Components and

Functionalities, Business Development, Dissemination and Exploitation [16]. Different methods and tools of the conceptual development of services are applied. This includes corresponding qualitative creative techniques (e.g., 635-method) [17]. The design phase includes, inter alia, technology development, the engineering of processes and blueprinting [18]. During the implementation phase, the focus was set on the use of technology and customer integration. Figure 1 gives an overview of the different methods and instruments used for the AAL service development.

2.2. Construction of an AAL Service Development Approach

The previous use of traditional product development models will not meet the needs of service development. Therefore, the development and application of special service development models is increasingly targeted [19]. In addition, the target market is a new one which needs to be developed [6]. Modelled on current research and development, the different phases of the service development process (idea generation, design, and implementation) were iterated in the framework of the research project DALIA. A multitude of different methods and instruments (e.g. end-user surveys, workshops with experts) were applied with the corresponding indicators, including those of process and outcome quality (e.g., distance to the ideal scenario) [17]. It became clear that targeted AAL service development is dependent on the continuous collection and presentation of different indicators. Hence, the need to develop a meaningful performance measurement index is obvious [20].

3. Results

In addition to customer requirements, previous research regarding cross-sector service development sees as special performance aspects, the identification of relevant use cases and the development of meaningful and viable financing concepts and business models [21].

3.1. Avatar-based support system for self and informal care

The core of the avatar-based support system developed for self- and informal care is, aside from a personal assistant (avatar), the related service. This involves a mixed model of appropriate technologies and related services and support (hybrid AAL service). Based on the concrete elaboration of eleven different dimensions (customer segments, customer relationships, value propositions, channels, sources of revenue, cost structure, key resources, key activities and partners, Privacy and Ethics) different use cases (e.g., avatar-based support system for caregivers, incl. knowledge management for informal carer) were modelled, based on different combinations of the eleven dimensions. To support the (informal) care process in an optimal way, an AAL system should not stigmatize and must also focus on the appropriate emotional components [22] to keep the service sustainable for ongoing use by the end-user. Previous analyses have shown that this aspect is a relevant part of the DALIA business model, which covers several dimensions simultaneously. For this purpose a empowerment model served as the theoretical framework for the development of the DALIA system. [22].

3.2. Conceptional AAL Service Development

Because sales, support and manufacturing of the DALIA system are provided by different partners of the development consortium, the business model consists of several different layers (e.g. key partners on the distribution level vs. key partners on the combined level of sales and production). These should be taken into consideration and configured. The special situation with complex key partner structures (described above) in the field of AAL can be seen as a typical and sometimes difficult starting point for a business model. Therefore the AAL service development process requires a conceptual approach [10]. The application of an iterative service development method is therefore useful and offers the possibility to visualise and consider various environmental and influential factors. The different applied methods and instruments were used in an iterative approach several times in the development process and serve as basis for a permanent analysis process in the context of the service/business model [17]. The goal is to enable an optimal fit between real supply and realizable demand in terms of quality, service, flexibility and costs [23]. The development of (new) hybrid services in the social and health sectors, derived from the problem-solving cycle and the quality circle of Deming [24], can be linked to the four main screws (problems and idea generation, design, implementation, market establishment) of innovation and change. The goal is to create optimised AAL service through the application of individual steps in an iterative procedure. This procedure focuses on the particular requirements of the customers [25].

3.3. Performance Measurement Index for AAL services

In connection with the project DALIA, different relevant performance measurement indicators were identified, measured and analysed (see Table 1). In addition to reducing complexity (increased transparency), the value of applying a performance measurement is to ensure relevant market reference (goal orientation). Furthermore, the use of performance measurement is aligned on increasing the forecasting ability is (input / throughput / process) and the measurability of the success (output / outcome / impact) [26]. During the course of AAL service development and AAL service management, it became clear that in addition to the basic business performance measurement system, the use of non-numeric and qualitative input, process and output-oriented indicators [27] are also critical to success. A further performance-critical criterion is the active involvement of customers and end users [26] in AAL service development. This is an important aspect with respect to an early evaluation of AAL services.

4. Discussion

Regarding the development of market relevant AAL service business models, different interviews and surveys with various stakeholders and interested parties have been conducted related to the research project DALIA. [17, 20]. The survey results show that in the context of development, production or distribution of products or the provision of services in the health and social services, success is strongly influenced by a variety of factors (e.g., technology concept, customer requirements, legal framework) [28]. It is therefore important, particularly in terms of combined service packages or hybrid services, to take different aspects into account. A detailed and systematic analysis of the various aspects and sections is helpful. One approach for visualizing and considering

Adjusting Lever	Targets	Activities / Instruments (selection)	Indicators / Metrics (selection)
Idea generation [36]	• Brainstorming [37] • Customer Perspective [8] • Design [38]	• Market Research [43] • Expert interviews [44] • Creative Workshop [45] • Potential analysis [41] • Problem identification [39] • Evaluation Customer benefits [17] • Customer integration [17] • SWOT analysis [46] • Service Blueprint [47] • Service use case [47] • Marketing concept [48] • Evaluation of performance [49] • Selected customer segments [49] • care / eel laboratories [49]	• # ideas • # Used creative techniques • # Professions involved, employees, customers • # Iteration and innovation cycles • # R & D Employees • # Participating external partners • End-user involvement • Service Blueprinting • End-user feedback
Technology development [36]	• Technological Innovation [39] • Provider Perspective [40] • Technological Requirements [41]	• Create a profile technology [50] • Technology development [51] • Process engineering [47] • Hybrid product [10] • Modularization of hardware and software [9] • Technology testing and deployment [50] • Technology Assessment [9] • Technology scouting [52]	• Prototype testing (laboratory / field) • Service distribution network • # Innovative products (product portfolio) • cost-benefit analysis • Earned Value Analysis • Established suggestion scheme • Number of R & D employees affected • Number of submitted / approved patents
Legal framework incl. Privacy and Ethics [36]	• Regulatory compliance [41] • Securing financing [41] • Notice [42] • The ethical review [41]	• Service Business Plan [48] • Paragraph Designer [10] • Performance [10] • After-sales service [53] • Continuous improvement process [53] • Privacy concept [42] • Examination of social and ethical implications [41] • Liability and contracts [41]	• Health Technology Assessment (HTA) • Return of Investment (ROI) • Of the profit and loss account • Debt / equity ratio • AAL-service • Time to market • After-sales service activities • Customer Survey respect. 'Willingness to pay • Qualifications of the service staff • Number of complaints

Table 1: Categories and indicators of a Performance Measurement Index

different factors and screws of successful products and services is the service business model by Osterwalder and Pigneur [29]. The different modules and their deeper analysis can provide relevant product- or service-related information. They are instructive regarding the design of an optimal or required solution- and customer-oriented value range [30]. For use in the AAL field, the model has been extended to the dimensions Privacy and Ethics due to the specific market requirements (e.g., social services, an essential component of privacy).

4.1. Performance Measurement Index as a development and success Instrument

A goal-oriented performance measurement relies on the definition and description of relevant goals, actors and stakeholders, as well as conditions, structures, processes, methods and results for the successful development and sustainable establishment of hybrid AAL solutions. Furthermore, the evaluation and measurement of efficiency gains and positive value creation require meaningful indicators regarding service quality, supply, resources and customer orientation. These indicators need to be applied in the context of a future evaluation grid for integrated AAL solutions and services and observed. The analysis of the user acceptance of the relevant stakeholders involved has a special importance. Furthermore, enhanced qualitative evaluation methods and tools (e.g., health technology assessment, evidence based medicine) will be used to improve the data quality of the selected indicators in the future. The adapted AAL service business model provides the essential dimensions of a meaningful performance measurement (see Figure 1).

Figure 1: Performance Measurement dimensions of an AAL service business model [20]

4.2. AAL Service Development Loom for orientation

A required performance measurement (PM) with a meaningful set of indicators can be seen in the context of a targeted and conceptual product and service development of AAL solutions in combination with the relevant strategic objectives. Through the PM, the relevant processes, structures and service dimensions which take place during the service development can be evaluated continuously [31]. This results in an AAL Service Development Loom (see Figure 2) for the individual development of AAL services. Thereby the service-business-model-based PM acts as a reed which supports a targeted procedure that error free.
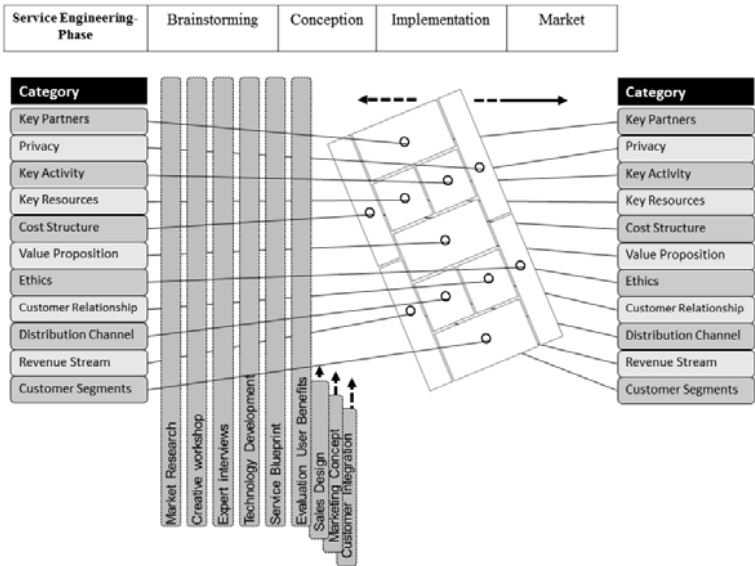

Figure 2: AAL Service Development Loom

A further step in a targeted and evaluated development of hybrid AAL services as well as the subsequent service management will be the development and testing of a PM system for AAL services. The aim is to promote the assessment and quantification of hybrid AAL services and to evaluate an empirical weighting of the different dimensions on the basis of marketable practical examples and good practice solutions. In the past the main focus of research and development activities in the field of AAL was on the supply-oriented and technology-based push strategy [32]. In contrast the pull strategy tries to analyse the customer needs and their requirements to optimise the service [33]. An optimal push-pull mix depends on the type of product, customer demand, the length of the distribution channel and the availability of significant information [9]. In some cases successful service innovations are even dependent on customer initiatives [34] [54]. It can be observed that in some areas of service development, the involvement of external actors, through for example innovation operas or agile service development, is increasing [35]. Additionally, the resources of Big Data are becoming more important in the context of analysing the differences between customer requirements and customer behaviour.

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