Trade-offs in designing ICT platforms for independent living services

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***Abstract*—Bringing independent living services to market requires common service platforms that connect service providers to elderly people and informal carers. Realizing such common service platforms is challenging as issues like organizing model, openness, governance and subsidization models have to be decided upon. This paper elicits trade-offs in designing ICT platforms for independent living services by developing three generic value network configurations. We do so through an action design research project in which series of workshops and stakeholder interviews are done. Analysis of the case suggests several core dilemmas for realizing ICT platforms for independent living services. Besides contributing to academic theories on ICT platforms, we also provide practical recommendations on how to realize the potential of independent living.**

Keywords— Independent living; digital platforms; ICT platform

I. INTRODUCTION

Independent living has become an umbrella term to refer to all kinds of ICT solutions that enable elderly people living longer at home. Societal challenges in healthcare are evident as the number of people with multiple chronic conditions is growing [1] and the aging population is increasing [2]. Despite the hope that deinstitutionalization will save costs in the healthcare system, increased support for homecare still has to be sustained [3]. ICT solutions such as monitoring, alarm systems, fall detection and medication reminders are often suggested as tools to facilitate independent living in a cost effective manner.

Although many independent living demonstrators have been delivered in R&D projects (e.g. within FP7), products are typically not brought to market yet [4]. Consequently, current ICT and Health calls in Horizon2020 are calling for integrating previous R&D results and – most importantly – getting them ready for the market. While this ambition is laudable, we still see major hurdles on the way. Independent living services are hindered by a lack of interoperability, leading to incompatible data exchange formats and protocol, expensive integration efforts, and lack of economies of scale as sensors and devices are typically dedicated to only one service offering [4]. As a result, independent living systems are typically hard to configure and complex to manage due to their many components and subsystems that use different communication technologies [5]. A major hurdle is therefore that there are no common platforms that independent living providers can utilize to bring their services to end-users [6]. Such platforms should integrate various health-related services but possibly also convenience and entertainment services.

Such an ICT platform for independent living services can be seen as a multisided platform which potentially connects end-users (elderly people, family, carers) with a range of service and application providers (e.g., health, convenience and entertainment applications). Launching a multisided platform is challenging as it requires overcoming the chicken-and-egg problem of simultaneously attracting end-users and service providers [7]. The basic features of an independent living platform such as finding services, recording events and enabling payment will not provide sufficient value for end-users to sustain themselves.

Design knowledge on how and when to shape a platform architecture is largely lacking in literature. Although theory on digital platforms is evolving in engineering and information systems literature, most current digital platform studies take an ex post perspective to explain successful platforms. Less attention has been given to critical issues that start-ups will face creating a viable platform business [8].

The objective of the paper is to elicit trade-offs in designing ICT platforms for independent living services. We analyze a design case, in which a portal has been developed that integrates various health, convenience and entertainment services. The portal is accessible through a smart TV and possibly other end-user devices, and mainly to be used in the home environment. Target groups for the portal are elderly people, their family and informal and formal carers. The portal will provide access to the services through a calendar on which events are being stored. We analyze the design process by utilizing the results workshops and interviews with the key providers of the envisioned independent living platform.

The paper contributes to the domain of independent living by providing understanding of independent living platforms. We also contribute to emerging theories on ICT platforms architecting by eliciting trade-offs in the design of platforms for independent living.

Section II provides a background on independent living and multisided platforms. Next, Section III provides details on the method followed, and Section IV provides results. Section V concludes the paper by discussing our findings.

II. RELATION TO EXISTING THEORIES AND WORK

A. Related work on independent living

Achieving disruptive innovations in healthcare is typically hindered by issues of fragmentation in the care system [9]. Another issue is that a patient is the central end-user, but insurers typically control the money flows, i.e., the user and customer are not the same actor [10]. From a regulatory perspective, healthcare innovations are hindered by regulation that cannot adapt to new technologies and service models, for instance on privacy, quality of online content and access to development resources [11]. Because the government or insurers typically pay for healthcare solutions, quantifying the impact of eHealth concepts is important, but conducting clinical trials is often impossible [12]. From an organizational perspective, independent living platforms can become rather complex as they require billing relations with a variety of insurers and government institutions as well as service relations with a variety of care organizations [13].

Most research on independent living and e-health focuses on technological issues and ignores social and organizational issues [14]. Only recently, research is shifting towards issues of strategy, organizational change and technical platforms [15].

Academic work on how to bring independent living and e-health services to market is scarce. Van Limburg et al [10] discuss business models for e-health. McCue and Palsbo [16] analyze the business case for telemedicine applications, but mainly from a financial perspective. Mettler and Eurich [17] suggest archetypical revenue models for eHealth: freemium, two-sided market and crowd-based models.

Studies on platforms for independent living services have mainly been done from a technological perspective. The universAAL platform aims to be a single platform and application store for any independent living service, based on open source technologies [18]. Rentea et al [19] propose an agent based system for a digital health ecosystem which should allow eHealth services to evolve and emerge over time. Hein et al [5] develop a service oriented architecture for independent living services based on a home device (e.g., home gateway or set-top-box) using OSGi architecture, which offers services of tele rehabilitation, support for hearing impaired and monitoring of activities of daily living. A similar service oriented platform is developed in the MPOWER project [20].

B. ICT platforms

A platform can be seen "as building blocks (they can be product, technologies or services) that act as a foundation upon which an array of firms can develop complementary products, technologies or services" [21]. The objective of a multisided platform is to facilitate the transactions between different user groups, such as elderly people, service providers and informal carers. Multi-sided markets have similarities with an industry platform, like existence of indirect network effects [22-24]. The focal artifact in this paper can be seen as a platform as it connects multiple groups of actors (i.e., end-users and service providers) while providing generic functionality on which services can be developed (i.e., calendar, scheduling events, messaging, search and access to services on the screen).

Multisided platforms pose specific issues that have to be dealt with [21, 25]. In the remainder of this section, we derive core design variables for ICT platforms from existing literature, which will subsequently be applied to the case in section IV.

The division of roles in the value network around the platform is a first major issue. A value network is defined as a dynamic network of legally independent, collaborating actors who intend to offer a specific service, and in which tangible and intangible value exchanges take place between the actors involved [26]. A specific concern is who fulfills the *platform provider* role, as this can be an independent living service provider as well or an independent party. Moreover, in some cases, multiple organizations are jointly providing a shared platform [6].

A second issue is that of finding a *launching strategy*. Launching a multisided platform imposes a chicken-and-egg problem as both end-users and service providers need to be on board for the platform to add value [7]. How to attract a critical mass of both service providers and end-users is thus a critical issue, especially in the initial phase of commercialization. Creating trust in the platform [27], subsidizing one side of the platform by having the other side pay a premium [28], installing incentives for the first launching service providers or launching the platform with a set of killer applications are strategies to overcome this chicken-and-egg problem.

The issue of *platform openness* is relevant [29]. From a technological perspective, openness refers to whether the platform offers tools to develop new applications such as application programming interfaces (APIs) or software development kits (SDKs) [30]. From an organizational perspective, openness refers to the rules that service providers have to adhere to in order to be allowed to offer services on the platform. Sufficient degree of openness is required for the platform to become generative (i.e. be usable by a large group of unrelated actors to create new services), but control is required to protect the end-user from malicious service providers and keep control over critical resources.

Governance of a platform is another crucial issue. The provider of the platform and the service providers utilizing it do not have a typical principal-agent or buyer-supplier relation but still they are highly interdependent [30]. The provider of the platform typically exerts some form of governance over its service providers. Typical trade-offs include how to balance control over third parties with granting them flexibility to be creative on the platform [30, 31]. A related issue is how to balance power and control over application providers while at the same time earning and sustaining their trust [32].

Related to network effects is the issue of *platform subsidization*: if one user group of the platform is considered to be of more value than the other, it may be that they are subsidized by lowering prices [28]. The concept of marquee user specifically refers to those user groups that have such great value for the other user groups that their adoption of the platform should be subsidized [33]. Other subsidization issues are whether the user should pay for the platform or its services, and whether users are free to select any service or have to choose from predefined service bundles.

III. RESEARCH APPROACH

This research is positioned within the design sciences paradigm [34, 35]; a fundamentally problem solving paradigm that has its roots in engineering and the sciences of the artificial [36]. We follow an action design research approach [37], aiming to elicit trade-offs in designing independent living platforms.

The design case is situated in a European R&D project in the Ambient Assisted Living Joint Program. The name of the project is omitted here for purpose of anonymous reviewing. In the project, a portal is being developed that will enable access to various care and comfort related services for elderly people living at home. A central part of the portal is scheduling appointments and events from the applications in the user's agenda. The portal allows the user to access applications and provides notifications to access specific applications.

The action design research project comprised two cycles in which we went through problem formulation; building, intervention and evaluation; and reflection and learning. The first design cycle aimed to design and evaluate generic value network configurations for the platform (i.e., visual descriptions of which actor will fulfill which role). We did so through a workshop with ten participants from within the project (April 2013). The evaluation of these three generic value network configurations was done through seven one-on-one interviews with partners in the project (October – December 2013). The second design cycle aimed to specify trade-offs from Section II.B. onto the domain of independent living. The starting point for the second design cycle were dilemmas that were elicited from the interview results. Solutions to these platform dilemmas were developed and evaluated in a second workshop with all participants present (January 2014).

Interviewed partners are clearly heterogeneous in terms of existing markets, products and business models. Some technology providers have limited presence in the health and care market. On the other side, some of the service providers have an existing business but each with a different focus.

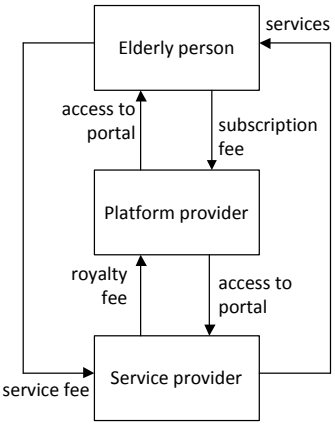
IV. FINDINGS

A. Value network configurations

As a starting point for eliciting platform dilemmas, three generic value networks were developed.

First, a direct-to-consumer model was developed. In this basic model, a platform is being provided by a for profit platform provider to the end-user. The end-user will pay for subscribing to the platform, or alternatively such subscription fee can be covered by a relative of the elderly person. The end-user also pays to the service providers for using the service. The service providers pay a royalty fee to the platform provider. See Figure 1 for an illustration.

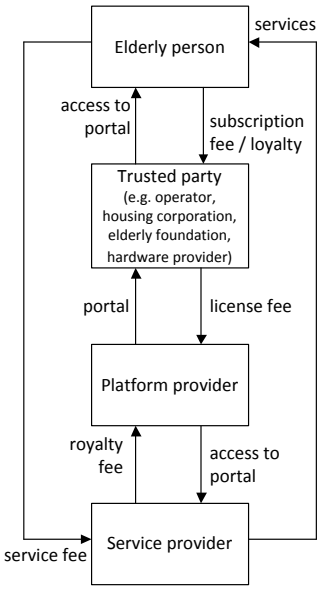
Fig. 1. Direct-to-consumer model



The direct-to-consumer model is most simple but also challenging. Having the end-user pay for the platform requires an established set of services on the platform that are sufficiently attractive for end-users. However, service providers will only start to deliver services if end-users are already connected to the platform.

Second, a white label model was developed. In this model, a trusted third party offers the independent living portal under its own brand to end-users. For instance, a telecom operator could bundle access to the platform within its Internet subscription, specifically aimed at elderly people. Alternatively, a housing corporation could integrate the independent living platform in their rental costs for elderly-friendly housing. The trusted party would then pay a royalty fee to the platform provider. See Figure 2 for an illustration.

Fig. 2. White label model



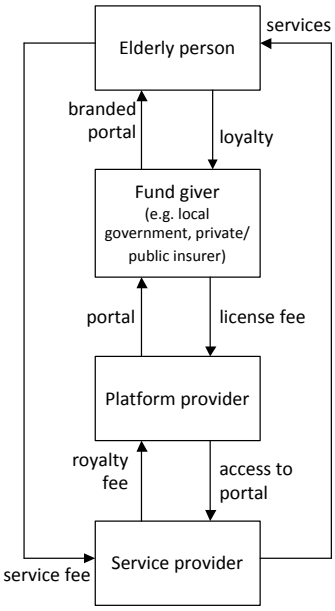
The advantage of the white label model is that the portal can be bundled with the existing offerings of those trusted parties. The model allows modifying the services but also the financial model according to the national-level conditions in terms of regulation and reimbursements. By bundling the subscription fee into the larger fee for housing or telecommunications costs, the end-user will be less aware of the platform costs. A telecommunications operator could even

offer the platform at no costs in an attempt to differentiate itself in the elderly market from its competitors.

Third, a fund giver model is developed. In this model, a fund giver such as an insurance company or a local government sponsors the platform. The end-user pays for the portal indirectly through regular taxes or insurance fees. The fund giver may also sponsor some of the basic independent living services, for instance those that reduce costs for the regular care system such as remote access to doctor consults. The end-user may also pay for specific premium-services that are not sponsored by the fund giver, such as entertainment or comfort living services.

As the fund giver pays directly to some of the service providers to provide basic services on the platform, the startup problem of the platform is resolved. However, when spending public money on such independent living platform, accountability and demonstrable impact on health of end-users becomes an important concern as well.

Fig. 3. Fund giver model



B. Design trade-offs

During the interviews with project participants, we discussed a broad set of issues relating to the services, technologies, organizations and financial model of the platform. When analyzing the material, we used the four platform design issues from Section II.B. as synthesizing concepts.

Platform provider: There was no clear consensus on who should provide the platform. Some participants suggest telecom operators and technology providers, others only software developers and service providers. This choice strongly depends on which of the three generic value network configurations is chosen.

Platform launching strategy: Participants argued that the platform itself does not add sufficient value, and that launching services should be included to attract a critical mass of end-users. However, which services to launch first was not agreed between participants. Launching services being discussed ranged from home automation and grocery lists towards highly specific telecare services such as administering visits of home carers on the platform. Several participants argued that elderly people are generally reluctant to adopt a platform that is clearly intended towards care or home automation. Especially young elderly that do not face major impairments yet intend to postpone the adoption of care services as long as possible, and feel that care services are useful for other elderly but not themselves. A strategy to get such young elderly to use the platform is to instead provide comfortable living and entertainment services. Once hooked onto the platform, the user can slowly adopt care services.

Platform governance: Participants had strongly differing opinions on how open the platform should be towards third party service providers. Several participants argued the platform should stay closed in order to create a competitive advantage for themselves as service providers. Similarly, a closed platform can be attractive to third parties that wish to brand the platform under their own name, such as a housing corporation, as they can then control which services should be on the platform. Independent living specific reasons to keep the platform closed were to prevent malicious services, to protect end-user data, and to ensure that a trusted brand such as an insurance company or charity would be willing to be linked to the platform. A more technical reason is that the space on a screen is limited and that the end-users should not receive an overload of potential applications like in an open app store model.

Reasons to open up the platform were primarily that users should have the freedom to choose any application they prefer. However, all participants agreed that an open platform should have strict governance rules. Governance mechanisms suggested included that only trusted service providers should be allowed on the platform, that quality checks should be done on new services or that users should be enabled to vote which services should be included or not.

Platform sponsoring: A major point of discussion was where the revenues should come from. Some participants suggest a subscription model for end-users or relatives. Especially if the platform would take away part of the burden on informal carers, relatives may be willing to pay for it. Others suggested a sponsorship model from care providers or municipalities. Another trade-off was whether end-users should pay for the platform, the services or both.

Table I summarizes the elicited trade-offs

TABLE I. ELICITED DESIGN TRADE-OFFS

Platform design issue	***Associated trade-off***	
	Design option 1	***Design option 2***
Who provides the platform?	A collective of service providers	Third parties (e.g. telecom operators, hardware providers)
Platform launching strategy	Telecare and telemedicine services	Comfortable living and entertainment services
Platform governance	Closed to third party providers	Open to third party service providers

Platform design issue	*Associated trade-off*	
	Design option 1	***Design option 2***
Platform sponsoring	Subcription for end-users / relatives	Sponsored by care providers / municipalities

V. CONCLUSIONS

In this paper we developed three generic value network configurations for independent living platforms, and identified the main design trade-offs in shaping these models.

Regarding who provides the platform, we suggested a direct-to-consumer model (i.e., the user or family member pays for the platform and services), a white label model (i.e. the platform is bundled in an existing offering from a third party, such as a telecom operator or housing corporation) and a fund giver model (i.e. the platform and basic services are sponsored by a third party, such as a local government or insurance company).

The trade-off of how to launch a platform and which services to have first relates to the typical chicken-and-egg problems in initiating a platform [38]. However, in the specific domain of independent living, we found that differing launching strategies may be followed. A specific trade-off was to focus on mainstream entertainment or comfortable living services first, to include care and medicine related services only once a critical mass of users has been achieved.

The issue of openness and governance rules of a platform is one of the central themes in digital platform literature [39, 40]. In the specific domain of independent living, we found that the issue of platform openness plays out differently in at least three ways. First, by keeping an independent living platform closed, sponsors like insurers or charities may be enticed to attach their brand and funding to the platform. By maintaining strict control over what is on the platform, malicious service providers can be avoided that would harm their brands, and a premium fee may be collected from service providers to be allowed on the portal. Second, because independent living and telecare services are highly sensitive for people, more strict governance policies should be implemented to protect the end-user. Third, because the platform is aimed at elderly people that may face impairments, keeping the platform closed to service providers may prevent a cognitive overload of making selections from a large amount of services.

Finally, the issue of the financial model and cross-subsidization between end-users, sponsors and service providers is a common issue in digital platform literature as well [33]. In the specific domain of independent living, we found that many configurations are possible. On an abstract level, we found that either (1) the user or relative may pay for the platform and services; (2) the platform may be bundled into an existing offering from a third party like telecom operator or housing corporation; (3) the platform may be sponsored by a government, insurance company or charity.

In this paper, we focused on the organizations offering an independent living platform. In the institutional environment of independent living, we see several hurdles that prevent actors from realizing these models. Regarding regulation, inflexible privacy and healthcare regulation is a major hurdle. On a technical level, the lack of secure electronic health records as a building block for independent living platforms is a hurdle.

We did not specify the value network configurations to the specific regulatory and financial conditions in different European countries. When offering health and medicine services specific regulation applies regarding availability, reliability, data protection, and certification of devices and operational processes. Although the case does not specifically focus on medicine applications, care services also have specific regulation involved. Regulation differs per country, even within Europe. The financial system of health and care is highly complex with different types of reimbursement fees covered by different actors (e.g. national government, local government, insurer, employer, consumer). The financial system and stakeholder environment again differs per country. In other words, implementing the generic organizing models in practice will involve extensive tuning towards the local regulatory and institutional conditions.

Despite these hurdles, we argue that common platforms for independent living services will become increasingly important. The field of elderly care is changing as policy visions on integrated and chronic care are shifting. For instance, the chronic care model by Barr [41] is currently central to the formulation of European healthcare policy. The proposed paradigm shift in healthcare systems comprises a transition: 1) from mainly a mono-disciplinary to a multi-disciplinary care provision, 2) from a curative approach to preventive medicine and public health, 3) from institutional care to community care, and 4) from professional care to informal care [41]. Healthcare services are thus increasingly becoming localized to the area of the user, and care providers are no longer well-known large players but can increasingly be small organizations even other citizens that offer informal care. These multidisciplinary, informal and community-oriented care concepts will only be viable if supported by shared ICT platforms that shield the complexity for elderly people as well as care providers.

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