The project ActiveAdvice no AAL-2015-2-058 is funded under AAL JP.

Decision Support Solutions for Independent Living using an Intelligent AAL Product and Service Cloud

D2.1
Baseline report on AAL advice, decision and authorization
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<td><strong>Coordinator:</strong></td>
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<td><strong>Project Duration:</strong></td>
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**Work Package:** WP 2  
**Deliverable:** D2.1  
**Title:** Baseline report on AAL advice, decision and authorization  
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1 Introduction

The evidence gathered by the Centers for Disease Control and Prevention (2007) suggests that up to up to 89 percent of older adults would prefer to age independently and in the comfort of their private households. With regards to their health status, family situation, motivation, interests and capabilities though, these older adults constitute a highly heterogeneous group, which means that new approaches and concepts are required to meet the great variety of needs these people have. In addition, throughout Europe, in different places yet with corresponding characteristics and consequences, the number of caregivers - both on a professional as well as informal level - is declining.\(^1\)

Due to the above, several pan European initiatives were launched to promote and foster innovations which would allow financially affordable, life enhancing solutions.\(^2\) The intent is to create a critical mass of research, development and innovation at EU level in technologies and services for ageing well in the information society, including the establishment of a favourable environment for participation by small and medium-sized enterprises (SMEs).\(^3\) In 2007, the European Union accepted the action plan “Ageing well in the Information Society”. This plan also was the stimulus for the creation of the Ambient Assisted Living Joint Programme. The Joint Programme combines social, technological and business aspects and aims to develop new models of service delivery and care.\(^4\) Nevertheless, in recent years there has been no consensus on a precise definition of AAL. There is the agreed understanding, however, that AAL must integrate ICT. The latter lays the ground for the paradigm of ambient intelligence (AmI). It is that “ubiquitous computing” that is a central feature of AAL.\(^5\)

With respect to the term AAL, numerous definitions are currently in use among experts (ICT or social scientist have different takes on it). Laying the basis for the ActiveAdvice project the following considerations help to clarify the key elements of active and assisted living technology, of AAL. AAL encompasses concepts, products and services. New technologies and social surrounding are combined, aiming to improve quality of life; AAL attempts at supporting individuals in their ageing process. The goal is to increase the individual’s autonomy and self-confidence and also tries to support the formal and informal carers. Furthermore, it guarantees personal safety while everyday activities are eased and resources saved.\(^6\) The DKE\(^7\) understands AAL as a “hybrid product referring to a basic technical infrastructure in the home and services provided by third parties with the aim of continuing to lead an independent life in one’s own home”. Most important though, is that AAL tries to create “...personalized continuity of care and assistance, dynamically adapted to the individual needs and circumstances of the users throughout their lives”.\(^8\)

\(^1\) http://project.icarecoops.eu/
\(^2\) ibid.
\(^3\) http://www.aal-europe.eu/about/objectives/
\(^4\) http://www.aal-europe.eu & http://project.icarecoops.eu/
\(^5\) Weiser (1999)
\(^6\) see van der Broek et al. (2010); Sixsmith & Gutman (2013); Memon et al. (2014); http://www.aal-europe.eu/about/objectives
\(^7\) DKE (2012)
\(^8\) Tazari et al. (2008, p. 1171)
Building on the above statement, Gassner & Conrad\(^9\) added that AAL brings about the emanation of contemporary ICT based products and services that assist older adults at home, or at work, and ultimately improves the quality of life, thus reducing the reliance on others for constant assistance. Others too argued that the main goal of AAL is to apply technology that helps people with special needs to prolong their living in their preferred environments. Finally, AAL is simply described as independent living in a supported environment.\(^{10}\)

Three areas of interest can be summarized: emergency treatment (prediction, detection, prevention), autonomy enhancement service (e.g. cooking, cleaning, medication, travelling) and comfort services (e.g. orientation, infotainment) further to be divided into indoor and outdoor assistance.\(^{11}\)

The ActiveAdvice project applies an AAL understanding that promotes products that are either/or & both/and context - and situation-aware, pro-active, and adaptive as well as self-organizing.\(^{12}\) AAL products thereby are stand-alone solutions or are integrated in services for older adults and their caregivers. The ActiveAdvice project also applies a rather wide AAL understanding and includes “innovations ranging from low-tech devices, such as walking canes to alarm systems to high-tech-solutions, such as fall detection systems or systems that automatically detect falls or monitor the health of the user.”\(^{13}\)

## 2 Methodology

### 2.1 Task Work Package 2 – Deliverable 2.1

Work package 2 is the layout for the project. The aim is to identify and analyse studies, analyses, concepts and best practices on AAL advice, decision support and authorization systems. Deliverable 2.1 is designed to generate a comprehensive overview of the European situation. This Baseline report on AAL advice, decision and authorization serves the consortium as the basis for the further actions.

### 2.2 Analysis of Studies Research & AAL Landscape

#### 2.2.1 Review of Studies and Service Platforms

A set of keywords and concepts were identified to be searched for in selected scientific databases; parallel AAL, health care, ageing, etc. Websites and platforms were identified. Based on relevant keywords, selected databases were consulted and checked for recent publications. The search was not limited to just the European context as that would have yielded just few relevant articles or studies. Furthermore, it was of interest to learn from best practice, even when they are not based in Europe. Articles, websites and so-called platforms from the English, German and French speaking

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\(^9\) Gassner & Conrad (2010)  
\(^{10}\) Camarinha-Matos et al. (2015) & Weegh & Kampfel (2015)  
\(^{11}\) Nehmer et.al (2006, p. 44)  
\(^{12}\) Sabou et al. (2009)  
\(^{13}\) Weegh & Kampel (2015, p. 858)
contexts were taken into account. Table 1 shows the data bases which were selected, as well as the numbers of hits and the timeline.

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In a next step search results were generated, by narrowing the search criteria and only include publications no older than 2013 and/or the geographic area (Europe, USA, Canada, and Australia).

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Table 2: Search History for Scientific Studies and other Publications between 2013 and 2016

Over 100 articles were identified, and over 30 included into the final analysis. In addition further articles were included when it came to identify the most recent general developments in the social network and platform development context.

For the service platform investigation, a search was carried out for websites/portals/platforms that promote AAL technologies as well as elderly health care and general health care. Hits for the service-platform search were uncountable; thousands of references popped-up e.g. when searched with the
keyword combinations of ‘senior advice’ or ‘elderly care advice’ (Table 3). A simple google search task therefore was not constructive.

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Table 3: Search History for Platforms and relevant Websites

First, articles and studies which discuss or introduce platforms as well as websites for older adults or healthcare issues in general were sought. In addition to the reports published by the European Union itself and other scientific bodies, the search for platforms was expanded to French speaking parts of the world such as Quebec (Canada), and English-speaking countries such as the USA and Australia. Finally, for the ICT-topics most recent posts and expert platforms have been consulted.

2.2.2  Data Analysis
The articles were analysed based on and the qualitative method of thematic coding.\textsuperscript{14} The analysis is based on short case descriptions and thematic coding; it is applied for the purpose of comparison.

In a first phase, the selected 70 articles were thematically assessed along the topics of

- Studies on AAL user information
- Platforms (discussed & evaluated in research/studies)
- User feedback and social features
- Digital support algorithms
- Authorization process.

For each article, the following information is available: topic, keywords, country, article name, source, additional notes/description, priority. Table 4 gives an idea of what the information was in the area of topic, keyword, and additional notes/description (see Appendix 9.1).

In the second phase, 42 articles were analysed based on a thematic structure (categories and codes) and almost 600 codes were assigned.\textsuperscript{15}

\textsuperscript{14} Flick (2009, p. 318ff)
\textsuperscript{15} Nadi and Cassell (2004, p. 256ff)
A total of twelve (12) service platforms were found and analysed in parallel. These platforms were evaluated based on certain predetermined criteria such as country of origin, stakeholders, type of services provided, promotion of ICT products, as well as accessibility of the platform. Following this initial evaluation, the service platforms were assessed based on the following critical criteria necessary for the purpose of AAL platforms: Usability, Feedback/Interaction & Area of Improvement. Moreover, an investigation was conducted to find out whether advice and training was provided to customers and if so, how it was conducted (see Appendix 9.2).

The expert posts have been thematically assessed and the most important insights summarized; these insights constitute the starting point for further discussions in the project consortium.

3 Studies on AAL User Information Needs

Bjørkquist et al.\textsuperscript{16} assumed for their research that innovative developments need to be based on “true user needs” and users’ systematic involvement. They speak of the need to identify ‘lead users’, based on their experience the needs of the rest of the target group can be assumed. Most critically however, they ask the question whether in the context of telecare and telehealth lead users can be identified at all. A question we need to consider for AAL solutions too.

\textsuperscript{16} (2014, p. 4)
Other studies identify primary, secondary and tertiary end-users. Primary end-users are older adults using AAL solutions. Secondary end-users are people using AAL solutions for the benefit of a primary end-user. They take advantage of such solutions to make their caring easier. Tertiary end-users are not directly in contact with AAL solutions. These are private or public organisations e.g. a hospital or insurance company which however benefit from increased efficiency or patient satisfaction, such as shorter hospital stays. Four aspects relevant for AAL-product and service designing need to be considered:

a) clearly define the value and how precisely a person can benefit from an AAL solution;
b) make sure AAL-products and –services come along with the necessary support; marketing AAL-technologies needs to address areas where consumers’ experience inabilities rather than offering them support in areas where they themselves still can manage on their own;
c) attractive design and ease of use is a key for acceptance; for older adults it has to meet a set of individual requirements as well as approved usability and accessibility standards; and
d) facilitate positive experiences.

In addition, also other users rather than the primary users are regularly affected by the installation of AAL-solutions. Their requirements need to be taken into consideration when designing, promoting, and installing AAL solutions. For the ActiveAdvice platform secondary users need to be considered too; they are very often directly involved in the care process or monitor it remotely. While we would expect spouses to be the ones carrying most of the caring, the OECD for 2011 identifies children as the main care givers. As a consequence AAL-solutions need to also attract these stakeholders as they most likely very often decide whether or not and which device best fits the needs of a parent. But informal care providers themselves also seek to find advice on support strategies, there is a need to share experiences and information with fellow sufferers and a need to know more about support services. However, there is no explicit mentioning of AAL or specific requirements for technical advice. When asked explicitly, primary end-users identify seven favourite AAL-applications:

- Saving energy/cost
- Enhancing comfort
- Improving health status
- Preventing hazards
- Acting as an alarm
- Supporting everyday activities
- Automation for one’s home

In another study the most important services identified were: safety, particularly personal alarms, and the importance of social relations as a platform for coping with problems and well-being.

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17 Nedopil et al. (2013)
18 ibid. (2013, p. 18)
19 OECD 2011 in Nedopil et al. (2013, p. 28)
20 ibid. (2013, p. 30)
21 ibid. (2013, p. 35)
22 Bjørkquist et al. (2014, p. 9f)
older participants expressed their interest and need for a better access to information as well as training. However, they also expressed reservations about some new technologies.

Also professional care givers are important stakeholders in the AAL-context. However, too often they are considered only as experts for older adults’ lives rather than for their working environments and situations. In their professional reality they face many different and changing challenges as well as new job requirements. This is an important observation, as there are only limited opportunities for these stakeholders to inform themselves about AAL, train themselves on its technologies as well as empower them to introduce AAL-solutions into formal and informal care settings. It is also remarkable that the factors influencing professional care for older adults are unrelated to technological developments. The secondary users, however, favour the monitoring and supporting options of AAL-solutions. Yet they also have requirements to technology; if used it should above all save time. Finally, there is another group which is in need of more AAL related information and which needs to become more actively involved into the development and distribution of these technologies. These are e.g. medical doctors, real estate developers, housing cooperatives, insurance companies, social services providers, and municipalities or governmental institutions. For them system designs and the need for parallel organizational innovations is of importance. The wish for more information on technologies is expressed by all stakeholders though; they frequently ask for funding information and expertise in that field – both accessible to end users and care providers. In this Norwegian example it was the request to establish not only a show home but also a central agency which is providing such information.

4 Existing Platforms & Portals for Information and Solutions

In the following, the selected platforms are introduced. They have been evaluated based on usability, feedback/interaction and potential area of improvements evaluated. Finally, some general observations based on selected articles from the literature review are summarized.

4.1 Platforms under Review

4.1.1 Aging Care (USA)

This platform seeks to promote ICT products on the website where ICT/Technical support products are directly promoted as "Senior Care Products". They are categorized into different headings and only address patients (elderly) as stakeholders. These categories are: (The Bathroom & Bathing, Bedroom & Sleeping, Medical Alert Systems, Mobility, Organization Tools, Personal Care & Dressing, Security, Safety & Falls, Vision & Hearing).

Summary: This platform is very easy to use, does not offer instant feedback, but it does offer a forum where users can openly discuss AAL issues.

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24 Nedopil et al. (2013, Figure 12)
25 Bjørkquist et al. (2014, p. 10ff).
4.1.2 National Association for Home Care & Hospice (USA)
This platform promotes home care and hospice products and services. These are grouped into: Communications Technology, Computer Software, Computer Hardware, Data/Performance Measurement, Education and Training, Home Care Business Services, Insurance Services, Legal Services, Media, Medical Supplies, Office/Business Products, Telehealth/Technology.

Summary: This platform is not easy to use, it gives no form of feedback, and it could benefit from the inclusion of a user forum.

4.1.3 Make it ReAAL (Europe-Denmark, Germany, Italy, Netherlands, Norway, Spain)
This platform is still under construction and therefore does not offer any product promotion. However, it offers a list of some products and services, as well as vendor information.

Summary: It is very easy to use, it offers no feedback, and it looks like being a very useful platform when it is completed.

4.1.4 Unforgettable (UK)
The above platform offers assistive products and services. However, the range of products is limited to people living with dementia.

Summary: It is very easy to use, it does not offer instant feedback, and it could benefit from the inclusion of other AAL technologies.

4.1.5 AALIANCE 2 (Europe)
This site does not offer products, services or advice. It simply displays the latest scientific findings with regards to AAL.

Summary: This platform is not at all easy to use, does not offer feedback, and the website could be made a bit more user-friendly.

4.1.6 Silver Eco (France, Belgium)
This platform conducts promotion of AAL technologies directly on the site. It also links manufacturers directly with potential users. There is no user forum.

Summary: The platform is very easy to use, there is guaranteed feedback.

4.1.7 Pour les personnes âgées (France)
This platform does not promote products and services but rather focuses on giving advice and help to the aged and their family relations/caregivers. There is no user forum.

Summary: It is very easy to use, there is guaranteed feedback.
4.1.8 Services Québec (Canada)
This platform does not promote products and services but rather offers advice to older adults/caregivers using some predefined criteria of the most relevant information. There is no user forum.

Summary: It is not easy to use, does not give feedback.

4.1.9 Independent Living (UK)
It offers information and advice on products and services.

Summary: It is very easy to use, it offers delayed feedback, and finally it could benefit from the inclusion of a user forum where users and potential users could interact about the usage of the products and services.

4.1.10 Parent giving (USA)
Technologies are not promoted on the website. However, there are articles related to technology. There is no user forum.

Summary: It is quite easy to use, does not offer any form of feedback.

Two platforms have potentials becoming reference sites for the ActiveAdvice platform:

4.1.11 Independent Living Centre (Australia)
This site offers products and services concerning older adults, living and health. It offers direct advice to users and potential users. It also directly links users to manufacturers and provides articles and publications related to assisted living. There is no user forum.

Summary: This site is a model site for the purpose of this project since it provides a strong basis for decision support. It is very easy to use, it offers guaranteed feedback.

4.1.12 Ooreka (France)
On this site, technologies are generally promoted. Specifically, technologies for older people are addressed under "Family". Here, the stakeholders can select from a wide range of different gadgets available for old people. Secondly, a price range is also included for budgetary purposes. There is no user forum.

Summary: This site is very easy to use. It offers direct feedback.

Table 4 presents the most important characteristics of the selected platforms. Feedback/Advice or interaction in the manner of e.g. a forum is the exception. In addition, most do not meet the user needs in terms of usability or have a clear understanding of their stakeholders.
4.2 Studies on Platforms - Review and Summary

Out of almost 100 articles, less than one third dealt explicitly with the development and establishment of platforms and online information portals. And if the development of platforms was discussed at all, it was with respect to the individual living environment, where various different AAL devices have to be integrated, adapted to each other and some are meant to facilitate the interaction of various stakeholders in the care setting. Yet, none explicitly discussed a meta-AAL platform integrating services and products, expertise and different stakeholder perceptions nor is there anything like an EU-wide AAL marketing platform.

In the following, however, some of the key insights are presented and the authors also want to draw on the experience and knowhow in the fields of telehealth and e-health. Here service platforms with the attempt to integrate different stakeholders, promote self-management and guarantee online-support are more common. These case summaries provide some general insights:

- First, to learn about data safety, usability, and stakeholder involvement, peer support, network building and platform architecture, one is best advised to learn from the present e-health platforms.
- Second, guaranteeing interactivity is still a challenge.
- Third, stakeholder involvement asks for clear role understandings, responsibilities and communication logics.
- Fourth, personalized feedback and advice is not yet common; there are only few examples to learn from.
- Fifth, more people prefer to actively contribute rather than to only consume in the online environment.
Sixth, trust (i.e. confidentiality and credibility) still is one of the biggest concerns. Seventh, hesitant but existing AAL-ecosystem development can be identified, yet, we still speak of prototypes rather than success stories.

E-health platforms aim to be interactive and in general offer education tools, peer support tools, online healthcare consultation as well as collaboration tools for different stakeholders and they also post most current information on health issues and treatment. They intend to link and empower stakeholders as well as expedite the exchange of information.\textsuperscript{26} Already in 2008\textsuperscript{27} an article describing a web-based platform that integrated databases, decision-making tools and geographic information systems was published. The system components then were an Http Daemon, database, decision support models, and a GIS. The authors consider the system

\begin{quote}
“a robust web-based portal/platform for environmental health tracking in Virginia. The system provides a variety of functions including: web-based data entry, secure and automated exchange of data between agencies, data visualization, automated data analysis and decision support, environmental health information dissemination and environmental health information infrastructure development”.\textsuperscript{28}
\end{quote}

Thereby Http requests are handled through an Http Daemon. The Daemon was described as “a program that runs continuously and exists for the purpose of handling periodic service requests that a computer system expects to receive”.\textsuperscript{29} In that particular pilot, the purpose was to assess environmental health effects to help to formulate healthcare strategies. Therefore, mathematical models have been incorporated to the program.

The literature analysis has confirmed that the development of a platform that supports both sharing of information, knowhow and products as well as building up networks between different stakeholders is considered to be a challenging task. Furthermore\textsuperscript{30}:

\begin{quote}
“Patients have special demands with regard to the dimensions of product, people, processes, and placement resulting from the special characteristics of good health. The health services as a product are generally provided from person-to-person and supported by product applications. These components are combined to form hybrid services. This means that these health care services consist of an intangible service with software and hardware components, which are provided with a focus on the users.”
\end{quote}

As platforms annul the typical person-to-person interaction in health care, the user’s acceptance of it has to be a priority concern of developers and promoters. What is from a technological point of view possible and from the developer side assumed, must not meet the users’ needs. In that respect, “(F)or a service to be successful it must be provided under consideration of these criteria: the right good (product or service), in the right quantity and quality, at the right time, and the right place for the right customer at the right price”.\textsuperscript{31} A platform furthermore is not a stand-alone solution; it has

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{26} Fowler et al. (2014)
\item \textsuperscript{27} Li et al. (2008)
\item \textsuperscript{28} ibid. (p. 534)
\item \textsuperscript{29} ibid. (p. 535)
\item \textsuperscript{30} Kriegel et al. (2013, p. 78)
\item \textsuperscript{31} ibid. (p. 78)
\end{itemize}
\end{footnotesize}
to be part of a service logic. Moreover, data security, ethical and cultural issues as well as market development and legal regulations are of importance.

Developments in the e-health context are of interest as there is the twin challenge of dealing with a huge amount of data while still aiming to provide personalized and individual support. This is e.g. most relevant for communities of chronic diseases. That is the case because, first, people with a chronic disease can profit from the experiences of others, and, second, they are better informed and better individual treatment can be provided. Nevertheless they need to have their very individual situation to be taken in to consideration. Furthermore, early and timely intervention as well as self-management is of importance and is best brought to the people through online tools. The ‘Virtual Assistant System for Personal Health Management’ is a most recent project introduced. The VASPHM serves as a framework which analyses self-management reports. Originally developed as a tool for self-management only, it today offers a browser-based and an interactive mobile application. It “provides more interactive interfaces for users to easily feedback their vital signs to the system. (…), users can quickly get the responses from the system as well. Most of the responses are suggestions for health management“. Personal health management data are examined, the health risk is evaluated and personalized health services are provided. It clearly empowers the users and in automatically supervising and reminding them, has the potential for timely intervention. However, it used to lack the personalized feedback and did not support the interaction of users. Only in a next step could prove that based on the VSAP framework individual, personalized feedback can be provided and interaction supported. They included among other things a personal health management module (PHMM), a real-time interaction module, a reminding app for mobile phones. PHMM and real-time interaction should guarantee in-time, interactive, integrated dealing with user’s data and supervising them.

The more interactive platforms are, the more users become providers of content “in the form of evaluations, recommendations, opinions, instructions, facts and experiences “. In a study on online contribution 142 articles were analysed; the role of users as providers were discussed in 110 of them. Obviously there is an interest to contribute rather than just to consume information from others. Fifty percent of all articles dealt with the various different motivations to contribute and discuss in which form people do so and the analysis of these articles also showed that contributions could be - in positive as well as negative manners - blogging, reviewing or message propagations. User-generated content also presents itself in the form of decision-making and product evaluation contributions. Finally, the others identified trust as still one of the most critical user/consumer issues.

Also in the AAL context, attempts to develop platforms to better support older adults and their relatives as well as to better integrate them can be observed. However, even after a decade of projects in this field, we still lack this kind of platform. One reason might be that a health care ecosystem is a rather complex construct that involves many different stakeholders, with many different interests, needs and capabilities.

32 Tseng et al. (2015)
33 ibid. (p. 525)
34 ibid. (p. 527ff)
35 Cummins et al. (2013, p. 177)
36 ibid.
Furthermore, it is believed that people still find it difficult thinking of their supporting network being virtual rather than face to face. As a consequence, we also need to consider the use and active provision of content as discussed earlier is still a challenge for many people. In the AAL4ALL project “it is important to consolidate concepts in order to mobilize and align all the needed stakeholders. As such, one of the initial results of the project was the establishment of a conceptual architecture for AAL (...)”.  

Therefore the project was about the overall architecture of a service ecosystem for older adults. A 3-layer model was developed, with a so called logical hierarchical structure between the layers: from the lowest layer, the support-infrastructure layer, through the care and assistance service layer, to the AAL ecosystem layer (see Figure 1). This conceptual architecture helps to facilitate the evolution of the technology architecture of a highly integrated platform which meets very individual needs and allows personalized services. However, there is the critique that “only few of those have produced sustainable systems. Most frameworks focus only on a few aspects, ignoring the requirements of an entire AAL system as seen from different stakeholder and design perspectives”.

Figure 1: AAL4ALL architecture

In the VDE report by Gassner & Conrad (2010) several projects with attempts to develop service platforms for older adults and their relatives were introduced. Hearcom e.g. was a FP6 project funded between 2004 and 2009. In addition to other features, the intention was to provide

37 Camarinha-Matos et al. (2012, p. 118)
38 Memon et al. (2014, p. 4331)
39 http://hearcom.eu/main.html
information about equipment already on the market, and family members were meant to be able to find general information. The idea was that all services would be accessible through an e-platform. This platform was to be offered to the general public as well as experts. The ‘hear companion’ was meant to be a step-by-step support for people to access their own hearing and find their hearing aids. The project site is still online; the step-by-step support presents itself as a set of pages which are accessible through predefined questions and answer sessions only. There is no personalized advice, no feedback or other marketing relevant information. The support is based on predefined scenarios.

In their comprehensive literature analysis on “Ambient Assisted Living Healthcare Frameworks, Platforms, Standards, and Quality Attributes” Memon et al. also summarized some interesting insights for the AAL market and its developments. The overall healthcare IT industry, and with it the AAL community, has so far failed to facilitate the development of interoperable and affordable systems. Heterogeneous and open infrastructure platforms do not exist. The people affected, caregivers and governmental institutions are – so to say - still waiting to be guided through the variety of options and possibilities. There is definitely a need “for more open standards and open source solutions. Eventually, this could lead to more AAL services and devices being deployed at the existing end-user population, and more evaluation data reaching the AAL community, and thus provide the synergetic effects that are needed for the AAL vision to prevail”.

Another observation relates to open source solutions. This is an issue in need for critical assessment. Users today know – although most might not be aware of that - that a) social networks share intellectual property and data on their systems, b) data about oneself or from a person is stored in many different places; if users want to share information they should know where to store and how to access; c) cloud services help to consolidate data from different sources; they are identified because of complex search algorithms, d) there are websites which support the users to not only find data on different sources put also from different devices, and e) virtual assistants promise a lot but do not support users sufficiently. In summary, users are confronted with high complexity, which they hardly know how to manage; they need to develop trust and believe in reliable and trustworthy systems. As most of our online-activities take place through mobile devices, is there a need for a critical reflection on these issues. Lam et al. focused on mobile devices and prototyped an open social platform. The key components were a ‘thingEngine’ and a ‘thingPedia’. The former supports users to access data across different devices and web services; the latter hosts all public interfaces to web-sites, device, and IoT apps. The prototype users saved their data on Omlet (an open chat app). Most importantly, compared to other social networks, Omlet does not own the users’ data. And communication data are only stored for two weeks; if users want them to be stored longer time they shift to other cloud systems e.g. Google Drive, Dropbox. Omlet also handles the authentication, the management, the notification and delivery of messages. Of interest is also the ThingTalk. It offers users an ‘if/when’ functionality. A trigger on one side, results in an action on the other side, e.g. if the weather app reports rain, an email or a short message reminds the user to take precautions.

40 Gassner & Conrad (2010, p. 47)
41 (2014)
42 Memon et al. (2014, p. 4331)
43 Lam et al. (2016)
44 ibid.
What is going on in the ICT and AI world is impressive; however there are authors who still request a better involvement of older adults in Web 2.0 social networks. Social network platforms are required to be more user-friendly. Interfaces still do not meet the needs of older people and in the worst case exclude them from communication and interaction. The Senior Social Network e.g. declared the following criteria as guiding principles: simple interface, extended interface, easy to feed and find, user based, user-generated content creation and exchange, interactive and entertaining, emotion over content, relationships, community-driven, person event promoter. Some of these features they included in their prototype and defined as must criteria are: on a IP multimedia subsystem (IMS) application server web applications and databases should be hosted; they integrated a speech recognition server, used YouTube Data API to allow users to see videos and - through YouTube Upload Widget - to send or share videos. Users of the platform have to register.45

Finally, two platform projects are worthwhile to be looked at more closely: the AAL “We.Can platform” and - from the US - the “Virtual Healthcare Neighborhood”. In the Portuguese project “TICE.Healthy” research and industrial partners recognized the need for a platform “supporting applications in the health and quality of life”.46 The “We.can platform” is based on the principles of service oriented architecture (SOA). “This platform intends to complement the existing clinical communication networks. Its main requirement is the support of informal and formal care providers, outside the hospitals’ wards, that, nowadays, do not have access to services providing structured information related with their clients.”47 The main aim was to keep the stakeholders informed. However they also had to assure the following: “audit services responsible for verifying all interactions conducted among services and end users”; “authentication services to provide access to the information only to authorized services or end users”; “encryption services to enable secure communications of sensitive information” as well as “users identification services, enabling a unique identifier information distributed across multiple entities and systems”.48 With respect to the “We.Can platform” architecture several problems had to be solved. First of all, the end-user group was expected to be rather heterogeneous. That has an influence on the usability, on access permissions and on the type of information provided. It is an interesting example for further investigations.

The “Virtual Healthcare Neighborhood” is a project initiated in the USA.49 It is an interactive, low-investment website developed for the primary user group ‘informal care givers’ and in the pilot for a very regional audience. Through the platform the following services are offered:50

- data safety, which is secured by a firewall and a password-protected website; users sign in on a homepage
- healthcare support by peers (through blogs) and interprofessional actors (in person)
- includes educational modules for informal care providers
- informs about community resources

45 Marcellino et al. (2015)
46 Cardoso et al. (2014, p. 417)
47 ibid.
48 ibid. (p. 418)
49 Fowler et al. (2014)
50 ibid. (p. 830)
allows users to upload pictures and share personal information.

The most crucial elements from a platform development perspective are educational modules, social support through blogs, and the community resources. Although a low budget project, that focuses the needs of a distinct care giving group and with a limited geographic stretch can it be of interest for the ActiveAdvice to learn more about the technological features.

5 Social Networks and Platforms: Current Developments and Relevance for ActiveAdvice

Hereafter a summary review of potential technical and social features as well as of recent relevant network and platform developments is presented.

Let us set the scene:

“People – whether consumers or service suppliers – are complex agents, with highly diverse cognitive frameworks, values and attitudes, physical and emotional needs, and so on. Service systems are thus complex to model and manage – but they may also be resilient and innovative. People can be empowered to act in non-mechanical ways, responding to unexpected circumstances and collaborating to solve problems. They can be linked together in new ways through new information technology.”

As discussed above, in the AAL-context many different stakeholders - even when bundled in user groups of customer (end-users), business, or government – could be considered so called lead users. Some AAL-solutions are used by all of them, others only by one user group. The complex user interface and the fast changing ICT reality constitute many challenges for the development and implementation of AAL-solutions in the market. Promoting these solutions, e.g. via a platform, means both, to take the different user group interests into consideration and to hold up with the technical changes to guarantee a sustainable offering. Again a look at the developments in the e-Health sector helps to better understand these dimensions. PHS (Personal Health System) Technology development and promotion faces two important challenges which are also of interest for AAL platform designers:

1. Clients of the PHS are on the one hand users and on the other patients. They assume that the focus on users is ICT oriented - whereas the focus on patients is rather health oriented. This differentiation has a tremendous financial impact. Users will have to pay for themselves, whereas patients acquire the services on a predominantly reimbursed basis paid by either insurances or the state.
2. The multi-stakeholder approach takes time. If the focus of the products and services promoted through the PHS are senior people, it is not guaranteed that they can be directly

51 Schartinger et al. (2015, p. 47)
52 ibid. (p. 51ff)
accessed, as formal and informal care providers would often make decisions according to the needs of the older people.

5.1 Social Features

In his blog (https://blog.hootsuite.com/new-social-media-features-2015/) Evan LePage informs about most recent social networks’ updates and changes. In the following some social feature developments which might be adapted to the ActiveAdvice platform (see Table 6):

<table>
<thead>
<tr>
<th>New Features</th>
<th>Functionality / Changes</th>
</tr>
</thead>
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| Pinterest – Pinning full articles | “Whether you’re reading an article on your desktop or on your phone, you can click the Pinterest button and save the link to a board and check back whenever you feel like it.”  
It is not only for articles but also for links. |
| Pinterest – Local search      | Location and language qualifiers are included in the search function. You receive pin information about people who live where you live and talk the language you talk. |
| Facebook – Saved replies      | Facebook more and more becomes a network for businesses, however did not address safety issues properly. “Saved replies are essentially canned responses to common customer service questions or issues on your Facebook page.” And further: “Should the need arise, these messages can also be edited for the particular situation a customer is in. Quick and clean: a perfect social media customer service experience.” |
| Facebook – Live-streaming video | “Live video can be a tool for garnering immediate feedback, getting a real-time look at events, or hosting off the cuff Q&A sessions. Facebook Live’s early testers’ found that live streams worked best for behind-the-scenes look at work culture or a preview of a new product or service.” |
| Twitter – Event targeting     | “Twitter is used as a second screen during millions of events, from the music festival in the park to the big tech conference downtown. Twitter’s new event targeting functionality allows brands to reach the users who are interested in and engaging around these events.”  
“Once you’ve identified the event (Twitter has a helpful calendar full of them), you can go into the Twitter ads platform, see what kind of attention these events earned last year (including the top performing Tweets, for inspiration), and activate your own ad campaign in just a few clicks.” |
| Twitter - Polls               | Currently not used – and often criticized – does it have potentials. “That very fact, that not many businesses are using Polls, shouldn’t discourage you from using it. It should do the opposite, since your brand will stand out from the pack.”  
“This new feature is a valuable way to get inside of your audience’s heads, while creating a more engaging, participatory experience around your business on Twitter. Polls can be used as basic content research, allow you to engage followers around culture, plan events, contests and sales, and much more.” |

Table 5: Changes in Social Media Features
Obviously, there are numerous developments going on which need to be closely observed.

5.2 Feedback and Advice

Feedback mechanisms as well as navigation cues and advice from providers of products and services are important determinants of trust for the younger online shoppers - for Baby Boomers, however, the privacy cue has primacy.\(^{53}\)

An option to enhance the information retrieval in ActiveAdvice through user feedback is the inclusion of social media features dedicated to community exchange. This can support a user in decision making and resource selection processes. The following sections illustrate different approaches, deriving from different business models of the respective information platforms.

Another important observation concerns the active participation of consumers in general. Consumers become content producers when they comment on products and services online (eWom). In doing so, consumers become guides for others and significantly influence the purchasing decisions of others. A research conducted on information search on holiday topics confirmed that consumer-generated sites were well visited. It was assumed that this is because of the more specific, user-like and up-to-date information that the users expected to find - in contrary to marketer-generated and therefore less credible sites. Rating and giving advice is a favoured activity. Thereby consumers post positive as well as negative ratings. In summary the study carried out in the Netherlands confirms that eWOM plays a more important role for consumers in experience-determined sub-decisions. However, most authors recommend both eWOM as well as marketer-generated sites.\(^{54}\)

5.2.1 Rating and Comments

The option to rate and comment on a piece of information is a common option in e-commerce applications. The online shop of the German instrument and score book retailer Thomann\(^{55}\) is a best practice on the inclusion of social media features for customers. This is illustrated best when viewing a single product, i.e. a book with scores: The product page presents feedback from customers, who bought the product, as a visual rating scale with five stars and as text review. Furthermore, the page presents the current selling rank in the category of the product and links it to related parts of the catalogue with product recommendations and a link list called “Smart Navigator”. The social features are completed with the option to share the product on various external social media platforms like Facebook or Pinterest, to enable further comments.

\(^{53}\) Obal & Kunz (2013)  
\(^{54}\) Bronner & Hoog (2010)  
\(^{55}\) www.thomann.de
5.2.2 Interaction & Collaboration

Taking social features to a higher level, information platforms like Stack Overflow or Wikipedia foster an interactive community which collaborates to build up knowledge. The approach of Wikipedia is the creation of an open, comprehensive encyclopaedia platform by enabling any volunteer to contribute his or her knowledge in a wiki system, ever expanding the content. By employing web interface, user management, a version tracking and discussion feature, Wikipedia enables the collaborative creation of information and quality assurance among its users. Furthermore, researchers delved into the topic of quality improvement of content. In contrast to the aspiration of comprehensiveness, Stack Overflow aims to provide information based on problem definitions. As a service platform for programmers, Stack Overflow offers the users to submit obstacles faced with specific pieces of code, in order to enable overcoming those with the help of the volunteer community. Answers provided by other users can be commented and rated by everyone using the platform. In contrast to the rating scale, as it is used in the Thomann Online Store (www.thomann.de), Stack Overflow enables users to up- or down-vote answers, showing a total score for every answer. The user posting the problem can also select an answer as “best answer”. These two features then determine the order of answers presented to the audience.

5.2.3 Direct File Exchange

Expanding the idea of sharing code snippets, the exchange of actual executable code files can be considered the next logical step. Two prominent examples are the platforms MATLAB Central provided by Mathworks Inc. to support their software MATLAB and the code sharing site GitHub. MATLAB Central offers similar collaborative services like Stack Overflow, but expands them on the one side by including an expert board, consisting of MATLAB employees, and on the other by a repository for user generated MATLAB code. The so-called File Exchange offers similar options for rating solutions like the Thomann Online Store described above.

GitHub is primarily conceptualized as a web-based file-hosting system. Nevertheless, the platform offers collaboration features for developers that are interesting to be considered in the field of information retrieval and cooperative knowledge creation. GitHub offers users the management of file repositories, building on the versioning system Git. This system enables the user to manage derivatives of codes ("forks"), creating them as a new instance independent from the original source ("branch") with the later option to recombine them again ("merge").

5.2.4 Digital and Virtual Advice

“The benefit of virtual agents in e-commerce is particularly relevant to the senior population (over 65 years) due to an age-related digital divide in e-commerce adoption owing to declining:

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56 stackoverflow.com and www.wikipedia.org
57 Hu et al. (2007) and Stvilia et al. (2008)
58 www.mathworks.com/matlabcentral
59 www.github.com
60 stackoverflow.com
61 www.thomann.de
62 www.git-scm.com
• physical abilities and out-of-home mobility leading to greater dependence on e-commerce; and
• cognitive abilities such as attention, working memory, processing speed, and visualization ability (Czaja and Lee, 2007).  

Virtual agents can take various forms: presentation agents gather information from web sources, then restructure the information and present it to the user; pedagogical assistants guiding students through programs; recommendation agents give directions for making decisions; customer service agents provide product information or guide through online transaction processes.

Many studies confirm the strong impact of virtual agents. They “have the potential to address this age-related navigational need since they have been found to serve as effective navigational aids in complex and unfamiliar web and virtual environments by preventing the user from getting lost and disoriented”. In the context of online-shopping, virtual assistants increase trust of older adults in the technology and the online-shopping process. Recent investigations have proved, however, that older adults appreciate the text-only assistance option and they do not desire social conversation during the shopping process. With respect to the online representation older adults perform more successfully in the shopping event when not distracted by a moving agent; and it seems that a male voice is easier to understand.

5.3 Trust in Digital and Human Advisory

Trust is a key area of concern - and a rather complicated one. Consumers need to trust the web site, the communication and finally the products themselves. If a web-designer fails to satisfy only one expectation, failure in total can be expected. Knowing how to build-up trust and identifying the drivers of online trust are key responsibilities. Trust in e-commerce compared to real life shopping experiences is even more complicated and challenging. The latter conclude it is because “this medium uses a different look, feel, and interaction”, furthermore the environment is per se considered uncertain. “Online trust occurs when expectations are met, information is believable and confidence is achieved from the consumer’s perspective.”

Consumer trust is dependent on different conditions and is contradictory. Consumer cohorts have different trust understandings and thereby reference systems. Studies have shown that one of the most important criterion, peer endorsement, has different impact on consumer behaviour depending on the national context. Women are believed to feel more uncomfortable with online purchasing than men and young people feel much more comfortable with online-shopping. Moreover, trust is more dependent on web site-interface variables rather than not. Providers brand strength, online

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63 Chattaraman et al. (2011, p. 277)
64 ibid.
65 Rickel and Johnson (2000) ibid. p. 278
66 Chattaraman et al. (2011, pp. 292-294)
67 Cummins et al. (2013, p. 178)
68 Obal & Kunz (2013)
69 ibid. (p. 46)
70 Bart et al. in Obal & Kunz (2005, p. 47)
71 ibid.
expertise or web site familiarity were less influential. The presence of provider advice, privacy cues and community features have higher influence.\textsuperscript{72} In summary the web site design quality is a crucial trust building criteria and one that most influences people revisit. E-services for older adults need to take into consideration the potential impact of generational differences on online trust. In investigating two age cohorts, the digital natives - the Millennials, and the digital immigrants - the Baby Boomers, they learned that age is a critical dimension when it comes to online trust. “(..) consumers of e-services from different generational cohorts develop online trust in dissimilar manners.”\textsuperscript{73} The Millennials value time and the saving of it. Navigation enabling a quick search of information and products, easy findings; shorter response times and quick delivery are highly valued. In contrast, the Baby Boomer appreciates security of their personal information; they only want to share that information that is absolutely necessary when purchasing online. Privacy cues are actively sought. Provider information is another critical aspect. While the younger people prefer having information about the product and the seller right on the site they want to do business with, Baby Boomers don’t trust the sellers promotional materials and are more likely to look for consumer feedback (see Figure 2). Microblogs have become interesting tools to interact with users and customers. The more problem-solving posts a customer could find, the more empathic for the company or the brand a customer becomes.\textsuperscript{74}

ActiveAdvice will also need to learn to understand how and why consumers attempt to consult the platform. Beside trust the psychological attachment to an online community is a strong driving force. Within a community one more easily asks for information, seeks advice or obtains feedback; and it was confirmed that “respondents are utilizing online communities more for need recognition and information searches than for evaluation of alternatives and post-purchase evaluation”.\textsuperscript{75}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Profile plots for experimental scenarios}
\end{figure}

\textsuperscript{72} Bart et al., 2005; McKnight et al., 2002; Liang & Lai, 2002; in ibid., p. 48
\textsuperscript{73} ibid., p. 55
\textsuperscript{74} Coyle et al. (2012)
\textsuperscript{75} Park & Cho (2012, p. 407)
5.4 Digital Support Algorithms

For the (near) future David Cearley, vice president and Gartner Fellow, summarizes:

"Systems built on GPUs and FPGAs will function more like human brains that are particularly suited to be applied to deep learning and other pattern-matching algorithms that smart machines use," and "FPGA-based architecture will allow further distribution of algorithms into smaller form factors, with considerably less electrical power in the device mesh, thus allowing advanced machine learning capabilities to be proliferated into the tiniest IoT endpoints, such as homes, cars, wristwatches and even human beings."

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76 http://www.gartner.com/newsroom/id/3143521
Algorithms are integrated in more and more internet-based applications; users hardly know of their existence. However, without them, many online activities could not be carried out. In referring towards Latzer et al. (2014) they summarize nine groups of online services which rely on algorithms. These are search, aggregation, observation/surveillance, prognosis/forecast, filtering, recommendation, scoring, content production, allocation. Critical voices stress their impact on the users’ choices and as a consequence on their decision making. For the ActiveAdvice platform clear and transparent governance principles are to be lied out. These should address and reflect the risks of any biases and diminishing of variety, of manipulation, of censorship by intelligent filtering, of threats to privacy and data protection, of social discrimination, of violation of intellectual property rights, of abuse of market power.

The following governance options are referring to changes in the market conduct of consumers, content providers and suppliers of these algorithmic services; and they should help to reduce user risks:

<table>
<thead>
<tr>
<th>Governance Option</th>
<th>Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Consumer) Technical self-help solutions</td>
<td>“Consumers can make use of tools for anonymization, such as Tor, Virtual Private Networks (VPN) or OpenDNS to protect their privacy or circumvent censorship.”</td>
</tr>
<tr>
<td>(Consumer) Privacy-enhancing technologies (PETs)</td>
<td>“... for data protection, for example cryptography, cookie management and do-not-track technologies (browser).”</td>
</tr>
<tr>
<td>(Consumer) De-personalization of Services</td>
<td>These services help to reduce bias.</td>
</tr>
<tr>
<td>(Supplier) Product innovation</td>
<td>“Some news aggregators’ business models integrate content providers, who receive compensation (e.g. nachrichten.de). To avoid privacy risks, there are algorithmic services that do not collect user data (e.g. the search engine DuckDuckGo). Such product innovations – if successful – might also contribute to diversity and the reduction of market concentration.”</td>
</tr>
<tr>
<td>Technological Design</td>
<td>“Services such as ConsiderIt, Reflect and OpinionSpace are designed to avoid filter bubbles and bias by integrating elements of serendipity.”</td>
</tr>
<tr>
<td>Company self-organization</td>
<td>“Suppliers of services that rely on algorithmic selection can commit themselves to certain “values” (Introna and Nissenbaum, 2000), such as search neutrality or the “minimum principle” of data collection (Langheinrich, 2001; Cavoukia, 2009).”</td>
</tr>
<tr>
<td>Company self-regulation</td>
<td>“Suppliers of services that rely on algorithmic selection can commit themselves to certain “values” (Introna and Nissenbaum, 2000), such as search neutrality or the “minimum principle” of data collection (Langheinrich, 2001; Cavoukia, 2009).”</td>
</tr>
<tr>
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<td>“Suppliers of services that rely on algorithmic selection can commit themselves to certain “values” (Introna and Nissenbaum, 2000), such as search neutrality or the “minimum principle” of data collection (Langheinrich, 2001; Cavoukia, 2009).”</td>
</tr>
</tbody>
</table>

77 Saurwein et al. (2015)  
78 ibid., p. 35  
79 Latzer et al. (2014), in ibid. (2015, p. 37)  
80 ibid., p. 39ff
5.5 Interactive Information Retrieval

Various measures, e.g. time-on-tasks or user satisfaction are applied to assess search processes and outcomes. Measures might relate to user perceptions (of the results, the search experience or interface) or to user behaviour (see Table 6); the latter refers to what a user does when interacting with a system. The data from the searching and browsing process are collected with system log files.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>User Perception measures</strong></td>
<td><strong>the User Engagement Scale (UES)</strong></td>
</tr>
<tr>
<td>Aesthetic Appeal</td>
<td>Perception of the visual appearance of interface.</td>
</tr>
<tr>
<td>Felt Involvement</td>
<td>Feelings of being drawn in and entertained in interaction.</td>
</tr>
<tr>
<td>Focused Attention</td>
<td>The concentration of mental activity, flow an absorption.</td>
</tr>
<tr>
<td>Novelty</td>
<td>Curiosity evoked by content.</td>
</tr>
<tr>
<td>Perceived Usability</td>
<td>Affective and cognitive response to interface/content.</td>
</tr>
<tr>
<td>Endurability</td>
<td>Overall evaluation of the experience and future intentions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>User Behaviour measures</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Queries</td>
<td>Number of queries used</td>
</tr>
<tr>
<td>Query Time</td>
<td>Time spent issuing queries following the links</td>
</tr>
<tr>
<td>Items viewed (Queries)</td>
<td>Number of items viewed from queries</td>
</tr>
<tr>
<td>Bookbag (Queries)</td>
<td>Number of items added to Bookbag from queries</td>
</tr>
<tr>
<td>Topics</td>
<td>Number of categories used.</td>
</tr>
<tr>
<td>Topics Time</td>
<td>Time spent exploring categories and following links</td>
</tr>
<tr>
<td>Items viewed (Topics)</td>
<td>Number of items viewed from categories</td>
</tr>
<tr>
<td>Actions</td>
<td>Number of actions (e.g., keystrokes, mouseclicks)</td>
</tr>
<tr>
<td>Pages</td>
<td>Number of pages examined</td>
</tr>
<tr>
<td>Bookbag Time</td>
<td>Total time spent reviewing contents of Bookbag</td>
</tr>
<tr>
<td>Bookbag (Total)</td>
<td>Number of items added to the Bookbag</td>
</tr>
<tr>
<td>Bookbag (Topics)</td>
<td>Number of items added to Bookbag from category.</td>
</tr>
<tr>
<td>Task Time</td>
<td>Total time user spent on the task</td>
</tr>
</tbody>
</table>

Table 6: Algorithm Governance Options

Table 7: List of Perception and Behaviour Measures

Source: Zhuang et al., 2016, Table 1, p. 297

In the underlying study the researchers analysed a set of data which was produced when people were interacting with an unknown interface; the participants were seeking for information. The aim was to learn about the relationship between perceptions and behaviour. Some of their key insights are presented here - though their results are preliminary. First, the type of data (text or image) have no influence on the UES structure. Second, they identified three different user types based on their query actions. Third, “(H)ow people searched and browsed through the images seems to be unrelated to their subsequent perception of the system. This may be attributed to user expectations about aesthetics and usability that limit the degree of variation among individuals”. Fourth, user searching and browsing behaviour did not show any correlation with perceptions, e.g. focused

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81 Zhuang et al. (2016, p. 293f)  
82 ibid., p. 302
attention or felt involvement. What and how people seek for online information doesn’t say anything about their engagement. Fifth, the users’ backgrounds and experiences are influential. This means, as a conclusion, that IIR evaluation on log file data needs more investigation.

In view of the potential visual problems older adults frequently face a Spoken Conversational Search System (SCSS) is an interesting development. This system provides a conversational approach and they, therefore, correctly stress the need to integrate both document search and conversational processes. Furthermore, they stress that the searching is an iterative, heuristic process, with no way to predict the user satisfaction or to know when the result meets the user’s needs. Additionally, they assume that the search process is highly influenced by age, gender, experience, cognitive capacities, etc. Therefore, it seems to be easier to concentrate either on perceptions or behaviours. And they present the Tague-Sutcliffe’s informativeness measure as the one that integrates both, i.e. assessing the performance of the system and the perception of the user at the same time. 83

A meta-study conducted in 2003 explored four central models in IIR, dedicated to the study of human interaction. Each opens a different perspective on human information retrieval, which will be relevant to ActiveAdvice as well, as it aims to supply users’ information needs:84

- **Stratified Model of Interactive IR**: This model accounts dimensions like environment and situation, user knowledge, goals and beliefs, as well as intent and tasks. Thus, there is no consideration on the factor time in Saracevic’ model.85
- **Episodic Model of IR Interaction**: This model is based on differences in user knowledge on the search subject. The varying knowledge is supported by an episodic perspective.86
- **Interactive Feedback and Search Process Model**: Considering the cyclical nature of information retrieval, Spink explores the meaning of feedback between each new search inquiry. The volume and iterations of feedback between search cycles can vary as well as the number of search cycles in this model.87
- **Global Model of Polyrepresentation**: Ingwersen explores the broadest perspective on information retrieval, considering the IIR system, the user, the environment and time. Through increasing redundancy of multiple search inquiry outcomes, the outcome of the search will be more useful to the user.88

As all three of these models highlight the fact that multiple cycles of information retrieval over time are required to improve the search output, ActiveAdvice will encounter yet another issue: older adults’ cognitive capabilities might decline over time, complicating extensive search tasks. Therefore, search tasks need meaningful support, i.e. through guided search and smart machine learning algorithms, as described in the following section.

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83 Trippas (2015)
84 Robins (2000)
85 Saracevic (1997)
86 Belkin (1996)
87 Spink (1997)
88 Ingwersen (1996)
5.6 Guided Search and Machine Learning

At the Gartner Symposium in October 2016 in Orlando David Cearley, vice president and Gartner Fellow, furthermore identified - besides other technology trends - the shift from classical computing and information management to systems which learn autonomously, i.e. on their own. DNNs (deep neural nets) support to manage the high quantity and complexity of information.89 Machines will learn themselves in their respective environments. This would have effects on developments in robotics, for virtual personal assistants and so called smart advisors. It would also influence the developments described earlier such as the example of Lam et al. (2016) and ThinkTalk.

Teachable agents foster the interaction between generations. They have been used in a project on intergenerational communication.90 The teachable agent asks the user simple questions – in that respective case about peoples’ biographies – and records their answers. The questions were imported from community-driven Q&A sites, and then were categorized and indexed with Apache Lucene. To let older adults take part in young people’s life – e.g. their grandchildren – did they introduce a topic matching to the platform. Whenever a person’s post on Facebook e.g. fit the predefined topic, the person was asked to also post the same content on a silver assistant platform. For that they adopted the latent Dirichelet allocation (LDA) model. The self-learning model was trained to identify the various places of post distributions.

“Guided Search” is a term referring to the interactive search service of the photo platform Pinterest. Based on the users input, the system suggests relevant search terms in order to refine the query created. For every term entered, the algorithm updates the images in the result list and provides the user with further terms to be used to concretise the terms. With the Guided Search approach the Pinterests algorithm addresses the influences of human behaviour and language on the information retrieval processes, which was identified as crucial challenge to be tackled in IIR.91

6 Authorization and authentication Processes

For open social platforms for mobile devices e.g. Omlet is an option. It handles the authentication, the management, the notification and delivery of messages across devices and clouds. In this project the ThingEngine is introduced as a personal server. It works on behalf of the user. Not Siri can be approached but Sabrina. It functions as a personalized language assistant in the Omlet feed. It guarantees privacy.92 However, a central issue for such service platforms is the authorization. In this process a user gives permission to store and use data.

On http://www.networkworld.com/article/2296774/access-control/seven-strong-authentication-methods.html seven strong authentication methods for bank account management are described; most of them are known and users have experience applying them. Therefore they may be of interest to be also applied for a service platform; see Table 7 for details:

<table>
<thead>
<tr>
<th>Authentication Method</th>
<th>Characteristics</th>
</tr>
</thead>
</table>

89 http://www.gartner.com/newsroom/id/3143521
90 Borjigin et al. (2015)
91 https://about.pinterest.com/en/guided-search
92 Lam et al. (2016)
Computer recognition software | On one’s computer a small authentication software plug-in that places a cryptographic device marker onto the consumer’s computer, is installed. The authentication process takes place based on a password the user knows and the so called device marker on the consumer’s computer. The user only has to recall the user and password.

Biometric readers | Fingerprints and eye scans through a hardware device – which usually has to be bought by the user themselves.

Email / SMS one-time password OTP – One Time Password token | The user has a registered Email-address. Through this address does the user receive the second however one-time password. This one is constantly-changing. However the user needs to always have the token for the respective account.

Out of band | The user is known by an institution through a registered phone number. Once called a user has to verify him/herself by the means of a password.

Peripheral device recognition | Using peripheral device recognition as a second factor is accomplished by placing a cryptographic device marker on a user’s existing device such as a USB flash drive, an iPod, Smart Phone memory card and then requiring that device to be plugged into the computer when the user logs into the online banking Web site.

Scratch-off card | Using a Scratch-off card as a second factor is accomplished by issuing the user a card containing several PIN numbers that the user scratches off and then used only one time to log in. This is a lower-cost, one-time password option than tokens. Yet, for future developments in the ICT context less adequate.

Table 8: List of Digital Authentication Processes Components

Yet, the IC-Community by and large doubt that authentication through passwords will cease to exist for the following reasons: First, compared to other possibilities passwords are considered less reliable and second their management is problematic and third they are not save. But nevertheless, they are easy in dealing with. It is generally anticipated that the future solutions will be based on multi-factor authentication mechanisms. On http://thenextweb.com/insider/2016/03/31/5-technologies-will-flip-world-authentication-head/#gref five such potential authentication methods are introduced. One is KodeKey, which considers phone number and fingerprints sufficient for the authentication of a person. Users prompt with a fingerprint scan their identity. Launch-Key-authentical services offer a second option. There is no personal information stored in the LaunchKey Engine but it applies a set of authentication methods to verify the user. Users can choose various combinations of methods at their discretion, if they want.

7 Conclusion & Outlook

Generally speaking, AAL systems still lack openness for sharing applications and algorithms - an important insight for ActiveAdvice to take into consideration. It has to keep in mind that not only the
operability of the ActiveAdvice platform is at stake but also how and which AAL devices are promoted. In addition, the ActiveAdvice platform will also have to deal with the same challenges such as usability, reliability, data accuracy, cost, security, and privacy issues. Following Memon’s et al. (2014) evaluation, one can expect that ActiveAdvice will fill a gap if it is able to guarantee support and supervision as well as reduce costs and provide information for the different stakeholders involved.

The AAL community currently fails to provide a majority of people with information, sufficient products, nor does it integrate and guarantee personalized support; and it fails the to integrate the many different information sources, services and products in one context. Furthermore, while projects generally are carried out in an international atmosphere, growing old and being in need of support is usually a rather local or regional experience. An interactive, highly flexible, approved and continuously updated platform needs to take that into consideration. ActiveAdvice would be well advised to less learn from past AAL projects and platform developments but instead more from other online communities and efforts. This to, on the one hand, support people with very specific needs in their regional context, but on the other, to give them access to an international community, knowledge base and up-to-date means. However, there are attempts to develop service platforms also within the AAL context e.g. in the HicMO project which from a technical point of view are of interest to have a closer look at. HicMo is a service-oriented system architecture. It attempts to combine smart objects and sensors, and to develop a flexible platform for user-centred services.93

On “http://tech.eu/features/1472/health-startup-europe/”, over 40 Health 2.0 platforms or app based start-ups are introduced. All aim to provide a selected on-line community with advice, information and service. Furthermore, tech.eu aims to keep an eye on the overall development within Europe. Beyond the AAL developments, platforms exist that might be of interest to look at when it comes to best provide their users with information, advice. https://www.healthvault.com/ch/de is a platform addressing patients, caregivers and providers. It is a free personal health record that guarantees the secure storage of information and management of health information. And https://ifttt.com/ has been mentioned in several articles; although privacy and authorisation was critically mentioned does it provides insight to some interesting features.

For the ongoing ActiveAdvice platform development it is recommended to keep in mind that the usage of the AAL platform highly depends on the acceptance, usability and usefulness. The different stakeholders might have different standards with that respect. Besides, taking into consideration the ISO standards 9241-110 is mandatory. And as Schartinger et al. 94 (2015, 52) elaborates, business models have to be developed very early in the innovation process and as clear value propositions drawn. However, this is a challenge, as we have rather complex service logics to consider.95 For the ongoing development process ActiveAdvice might have a closer look on the We.Can platform development, on the smaller however successful projects such as the Virtual Healthcare Neighborhood as well as on Vitanet, which was launched in 2001 in Germany and since then has successfully informed about health related topics.96

93 Peruzzini & Germani (2015)
94 2015, p. 52
95 Peters et al. (2015)
96 Marschollek et al. (2007)
Finally, an article published in 2014\(^{97}\) refers to a shift in the perception and influence of physical and virtual realities. They assume a shift from engagement platforms to engagement ecosystems; the customer-firm interactions are changing. Engagement platforms are “purpose-built, ICT-enabled environments containing artefacts, interfaces, processes and people permitting organizations to co-create value with their customers”.\(^{98}\) There are trends which oppose the very dominant perception of purely virtual service landscapes. With prominent examples e.g. Google or Microsoft do the authors prognosis the integration of virtual/physical environments into an engagement ecosystem (see Figure 4 and 5).

![Figure 4: Conceptual framework of Google’s engagement ecosystem](image)

This engagement ecosystem consists of four engagement platforms where customers interact with the company.

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\(^{97}\) Breidbach et al. (2014)

Also ActiveAdvice needs to take into consideration that shift from purely online, virtual interaction to an integrated logic. The concept as well as the framework of engagement ecosystems would be an appropriate guidance for further activities of the ActiveAdvice team.
8 References


van de Broek, G., Cavallo, Ph. & Wehrmann, Ch. (eds.) (2010). *AALIANCE Ambient Assisted Living Roadmap*. Amsterdam • Berlin • Tokyo • Washington, DC: IOS Press.


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# 9 Appendix

## 9.1 Article - Example

<table>
<thead>
<tr>
<th>Topic</th>
<th>Keywords (AND, OR…)</th>
<th>Country</th>
<th>Article name or type of service</th>
<th>Source / URL / PDF</th>
<th>Data-base used</th>
<th>Additional notes/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT Services</td>
<td>AAL Services, ICT Services, Quality of life QOL</td>
<td>UK</td>
<td>The impact of ICT services on perceptions of the quality of life of older people</td>
<td><a href="http://www.emeraldinsight.com/doi/abs/10.1108/17549451311311318">http://www.emeraldinsight.com/doi/abs/10.1108/17549451311311318</a></td>
<td>Emerald Insight</td>
<td>In: Journal of Assistive Technologies</td>
</tr>
<tr>
<td>Medicine management system</td>
<td>Assistive technologies, AAL, Health behaviour change, Home technology, Medication management, Reminders</td>
<td>Finland, Spain</td>
<td>Expectations and user experience of a multimodal medicine management system for older users</td>
<td><a href="http://www.emeraldinsight.com/doi/full/10.1108/JAT-10-2013-0031">http://www.emeraldinsight.com/doi/full/10.1108/JAT-10-2013-0031</a></td>
<td>Emerald Insight</td>
<td>Scientific Paper found in: Journal of Assistive Technologies</td>
</tr>
</tbody>
</table>

**Note:**
- The table includes a variety of articles with different topics related to ICT services, medicine management, trainings, telecare services, healthcare experience, and stakeholder perspectives. The articles discuss various aspects of technology implementation, user experiences, and service quality, among other topics. Each entry includes the title of the article, the source URL, and additional notes or descriptions.
### 9.2 Service Platforms

<table>
<thead>
<tr>
<th>Service Platform</th>
<th>Country</th>
<th>Stakeholders</th>
<th>Type of services provided</th>
<th>Promotion of ICT products</th>
<th>Open / Closed Platforms</th>
<th>Additional notes</th>
<th>URL</th>
<th>Date</th>
<th>Done by</th>
<th>Usability</th>
<th>Interaction/Feedback Mechanism</th>
<th>Areas of improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>AgigCare</td>
<td>USA</td>
<td>(Family)</td>
<td>(Elderly)</td>
<td>Make it ReAAL &amp; Hospice</td>
<td>Open</td>
<td>Face-to-face</td>
<td><a href="https://www.agigcare.com">https://www.agigcare.com</a></td>
<td>01 Apr 2016</td>
<td>Paul</td>
<td>Poor</td>
<td>The platform is very interactive with lot of icons and buttons. There is no fixed feedback mechanism. Some areas of improvement are mentioned on the website. There is also a screen for asking questions.</td>
<td>The platforms are not currently available for users without a valid login or certain roles and functions are limited depending on the user. There is a means of interaction which is not user friendly.</td>
</tr>
<tr>
<td>ReAAL (Europe)</td>
<td>Germany</td>
<td>Staff: (Health coordinator, social worker)</td>
<td>(Elderly)</td>
<td>Make it ReAAL &amp; Hospice</td>
<td>Open</td>
<td>Face-to-face</td>
<td><a href="http://www.cip-reaal.eu/home/">http://www.cip-reaal.eu/home/</a></td>
<td>01 Apr 2016</td>
<td>Paul</td>
<td>Very good</td>
<td>The platform is responsive, easy to navigate and has a lot of information. There is a means of interaction which is user friendly.</td>
<td>The platform is not currently available for users without a valid login or certain roles and functions are limited depending on the user. There is a means of interaction which is not user friendly.</td>
</tr>
</tbody>
</table>

### Areas of Improvement

- **Usability**: The platform is not fully completed. The platform does not talk about AAL technologies. This site should include a means for user interaction such as a forum, a feedback form, and a means of interaction which is user friendly.
- **Interaction/Feedback Mechanism**: The platforms are not currently available for users without a valid login or certain roles and functions are limited depending on the user. There is a means of interaction which is not user friendly.
- **Areas of Improvement**: The platform is very interactive with lot of icons and buttons. There is no fixed feedback mechanism. Some areas of improvement are mentioned on the website. There is also a screen for asking questions. The platforms are not currently available for users without a valid login or certain roles and functions are limited depending on the user.
There are numerous products offered over the shop. There can be divided in between the "traditional" products and the "innovative" products. All products are accompanied by detailed information (Applications, Setting & Cleaning, Books & DVDs, Care Home Products, Bath, etc.), on the different stages of dementia - The Journey, Challenges (Aggression), Setting & Cleaning, etc. Furthermore, the shop offers a hotline (Depends on your location) for support and advice. As part of the "innovative" section, there is a separate "Silver Eco (Le Portail National de la Silver Economy)" section, which is quite similar to a shop.

AALIANCE2 has not yet got a specific online platform for itself. However, you can get information on the different projects that are part of the AALIANCE2 network. As part of the AALIANCE2 network, the manufacturer and business model both of the shop are mentioned.

"Pour les personnes âgées" is a National Information Platform for elderly people. It offers various functions such as mails, short forms, and FAQ. The site is of a French platform, which is more or less a service that can be found in other countries. It is very clear although it offers very little interaction with users.

"Schmitter is the French National Platform for Silver Economy. Silver Economy is part of the French department for the seniors of the age. It is under the Ministry of Health and Social Affairs. Schmitter focuses on sustainable technologies and on products and services for all people.

AALIANCE2 does not aim at offering directly advice to old people regarding the installation, use, and maintenance of AAL technologies on the market. It is rather an advisory source to old people and their caregivers. The platform is very interactive, it displays the most relevant information and offers comprehensive advice. It offers a hotline as well as email for questions. It only focuses on people living in France and does not cover products in general.

The platform is very easy to use and offers many useful background sections. It is suitable for people of all ages to use. It does not offer too much user interaction. It is easy to navigate and to read. It only offers no interaction with users. It is pretty international.

The website should be made more interactive with proposed new features as well as a clear guide for the various components of the site.

The site could be made more interactive with proposed new features as well as a clear guide for the various components of the site.
<table>
<thead>
<tr>
<th>Private Individual/Family caregivers</th>
<th>Care Professionals/Therapists</th>
<th>Hospitals, Residential Homes, Clinics, etc.</th>
<th>Other, such as professionals, students, etc.</th>
</tr>
</thead>
</table>

### Independent Living Centre NSW

**Website:** http://www.independentliving.co.uk/

**Description:** This site allows for easy navigation and provides a wide range of resources for caregivers, including product reviews and articles. Products are categorized by type, such as mobility equipment, home safety, and personal care. There is a customer service section available online, but the site does not offer direct interaction with experts, nor does it provide feedback integration or any sort of community interaction.

### Parentgiving USA

**Website:** http://www.parentgiving.com/

**Description:** This site is very colorful and user-friendly, offering a wide range of resources and articles on caregiving. However, there is no customer service section available online, and the site does not offer direct interaction with experts, nor does it provide feedback integration or any sort of community interaction.

### Independent Living Centre UK

**Website:** http://www.independentliving.co.uk/

**Description:** This site is very colourful and user-friendly, offering a wide range of resources and articles on caregiving. However, there is no customer service section available online, and the site does not offer direct interaction with experts, nor does it provide feedback integration or any sort of community interaction.

### France

**Website:** http://www.comdot.fr/

**Description:** This site is quite straightforward and user-friendly. It is very interactive and allows users to share their experiences. However, there is no customer service section available online, and the site does not offer direct interaction with experts, nor does it provide feedback integration or any sort of community interaction.