Ambient Assisted Living

Trend Report 2011/2012

Other CDTM print publications

M. Huber, C. Bachmeier, A.Buttermann, S.Vogel, P. Dornbusch (Eds.)
Smart Dust
ISBN 978-3-8311-4297-2. 2002.
X, 280 p.

M. Huber, P. Dornbusch, J. Landgrebe, M. Möller, M. Zündt (Eds.)
Visions of Advanced Mobile Communications
ISBN 978-3-9808842-0-4. 2003
VII, 272 p.

P. Dornbusch, M. Huber, M. Möller, J. Landgrebe, M. Zündt (Eds.)
Leveraging Business with Web Services
ISBN 978-3-9808842-1-1. 2003.
VI, 238 p.

P. Dornbusch, M. Huber, J. Landgrebe, M. Möller, U. Sandner, M. Zündt (Eds.)
The Future of Telematics: New Business Concepts and Technologies
ISBN 978-3-9808842-2-8. 2004.
XII, 370 p.

P. Dornbusch, M. Möller, J. Landgrebe, U. Sandner, M. Zündt (Eds.)
Generation 50 Plus - Products and Services in the TIME Sector
ISBN 978-3-9808842-3-5. 2005.
VII, 338 p.

P. Dornbusch, U. Sandner, P. Sties, M. Zündt (Eds.)
Fixed Mobile Convergence
ISBN 978-3-9808842-4-2. 2005.
V, 259 p.

B. Kirchmair, N. Konrad, P. Mayrhofer, P. Nepper, U. Sandner, M. Zündt (Eds.)
Seamless Context-Aware Services in Converged Mobile- and Enterprise-Networks
ISBN 978-3-9808842-6-6. 2007.
344 p.

A. Balevic, B. Bozionek, B. Kirchmair, N. Konrad, P. Mayrhofer, P. Nepper, U. Sandner (Eds.)
Effective Collaboration in Dynamic Communities with Service-oriented Architectures
ISBN 978-3-9808842-7-3. 2007.
VI, 150 p.

B. Kirchmair, N. Konrad, P. Mayrhofer, P. Nepper, U. Sandner (Eds.)
The Future of Publishing Trends for the Bookmarket 2020
ISBN 978-3-9812203-0-8. 2008.
260 p.

P. Nepper, N. Konrad (Eds.)
The Future of Social Commerce
ISBN 978-3-9812203-1-5. 2009.
XX, 320 p.

M.-L. Lorenz, P. Nepper, N. Konrad (Eds)
The Service Centric Car in 2020
ISBN 978-3-9812203-4-6. 2009.
XXII, 304 p.

M.-L. Lorenz, C. Menkens, N. Konrad (Eds.)
E-Energy
ISBN 978-3-9812203-5-3. 2009.
XXVIII, 382 p.

M.-L. Lorenz, C. Menkens, J. Sußmann, N. Konrad (Eds.)
Developer Platforms and Communities in the Telecom Industry
ISBN 978-3-9812203-6-0. 2010.
XXVI, 356 p.

B. Römer, J. Sußmann, C. Menkens, M.-L. Lorenz, P. Mayrhofer (Eds.)
Smart Grid Infrastructures
ISBN 978-3-9812203-7-7. 2011.
XXVI, 333 p.

J. Sußmann, B. Römer (Eds.)
Urban Mobility Concepts
ISBN 978-3-9812203-8-4. 2011.
XXII, 382 p.

Julian Sußmann · Benedikt Römer (Editors)

Ambient Assisted Living

Trend Report 2011/12

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Preface of the Editors

"Everybody can learn from the past. Today it is important to learn from the future."

As Herman Kahn – one of the founding fathers of modern scenario planning – states it is tremendously important for strategy and policy makers to get a deep understanding of and to prepare for possible future developments.

In this preface we give an overview of the approach for the creation of future scenarios and the development of innovative product and service ideas, which was used to create this Trend Report. This approach was developed at the Center for Digital Technology and Management (CDTM) and was refined during the last ten years in more than 20 projects. The methodology aims on creating foresight studies related to information and communication technologies (ICT). It relies on a tight cooperation between industry partners and academia. Combining the creativity and impartiality of interdisciplinary participants from academia with the knowledge of corporations it provides long-term foresights and innovative ideas on how to expand the participating company's business and how to prepare for emerging challenges. Recent industry partners have been large corporations as, for instance, Siemens AG, Telekom Innovation Laboratories and BMW AG for topics ranging from Smart Grid Infrastructures and Ambient Assisted Living Technologies to Urban Mobility Concepts.

At the core of the futures study approach is the CDTM Trend Seminar. The Trend Seminar is a course with around 20 selected students of various disciplines, such as business administration, economics, computer science or electrical engineering that work on a relevant topic related to ICT. Before the seminar starts the topic is defined, broken down to smaller modules and structured together with the industry partner.

The seminar itself is an intense university course format. During this course the participating students dive deep into the new topic, apply knowledge they bring from their main studies, extend it in extensive research, learn and apply new methodologies, conduct trend analyses, design future scenarios and develop business ideas for new products or services. The seminar is structured into three phases: Basic Phase, Scenario Phase and Ideation Phase.

In the Basic Phase the class is split into five teams that look at different aspects of the overall topic. Following the PESTLE approach the status quo and trends in the fields of technology, society, economy, politics, law, environment and business are analyzed. The literature research is complemented by a series of input talks of experts from the project partner or other organizations. In addition, teams present the key findings to each other to provide a holistic knowledge base to build upon in the following phases.

The following Scenario Phase starts with a two-day workshop. The partic-

ipants work in four new teams to spread the gathered knowledge of the first phase throughout the teams. Within the workshop driving forces for the overall topic are identified and structured. Two key drivers are used to span a matrix of four different future scenarios, which are envisioned for around 15 years in the future. The scenarios as well as the possible timelines to these futures are already sketched within the workshop. Afterwards each team describes and writes down a vivid view of the life in one of the four scenarios in detail.

In the third phase, the Ideation Phase, participants are once more regrouped in new teams. Each team's topic is a different perspective of the overall topic. The goal is to develop possible business concepts, which are then tested against the previously developed scenarios. The phase starts with a two-day workshop to learn and apply ideation methods. This approach, which is based on patterns described by Jacob Goldenberg, Roni Horowitz, Amnon Levav and David Mazursky, is a very structured way to develop ideas for new products or services. A selection of these ideas are then combined and further developed into detailed business concepts. The concepts are described using the approach of business model generation, which was developed by Osterwalder and Pigneur. At the end of the seminar, the concepts are presented to the project partner and guests.

After this short introduction we want to thank several persons, who made this CDTM Trend Report possible: We thank Ernst-Joachim Steffens, Michael Balasch and Harald Klaus of our project partner Telekom Innovation Laboratories, who helped to define the topic and scope of the project, gave interesting kickoff talks and coordinated the contact to experts within their organization throughout the whole project. We thank Felix von Held, Felix Werle and Julia Butter for their support in the Scenario and Ideation Phase. Their experience and motivation is always leading to an enjoyable workshop atmosphere and excellent workshop results. Especially, we want to thank all students of the CDTM class of fall 2011, who put a lot of energy and enthusiasm in this project and by that made it a pleasure for us to supervise the course and coach the individual teams. We wish all readers exciting light bulb moments and inspiring thoughts about the future of ambient assisted living.

Benedikt Römer and Julian Sußmann
Center for Digital Technology and Management

Preface of the Industry Partner

Living healthily and comfortably, both safely and securely within one's home and staying in contact with family and friends are important requirements for many people. These needs are gaining additional importance within societies that are experiencing demographic change with a rising number of older people: it is essential to enable and extend autonomous daily living in the home, also for people of an advanced age. This is what most people give highest priority, if asked, and it helps a society to cope with limited resources such as lack of money and qualified staff.

Ambient Assisted Living (AAL) refers to all kinds of innovative products based on information and communication technologies (ICT) that can be integrated into one's environment – often going unnoticed or being almost "invisible". They shall improve quality of life, autonomy, active participation in social life, and employability for a better, healthier and safer life, often at the same time reducing the costs of health and social care. Let us have a look at some examples.

Sensors fixed to electrical devices, on doors and windows may be integrated into an easy-to-use house control system which may enhance personal health, safety and security. An intelligent system may remind you to switch off devices and/or lights in the apartment or not to forget important medicine or a mobile device which may be required at some point on your journey e. g. to get in touch with an acquaintance and/or neighbour if necessary.

Personal safety can be improved if vital data measures are combined with monitoring and control of devices in the household. By doing so, emergency situations in the home can be recognized quickly and reliably. Additionally, remote monitoring of devices which may be potential sources of danger increases the individual feeling of safety and can make life much easier and more comfortable.

Special attention must be paid to integrate solutions and components already available on the market as well as newly developed products into conclusive and overall systems which are easy to use.

There are still a number of open issues which require attention, careful research and development activities in order to meet central user requirements:

- Technical solutions should be adjustable in order to meet individual requirements, personal preferences and habits.
- Ease of use is essential for user acceptance.
- Support of users over the complete supply chain must be guaranteed: implementation, configurations and adjustments during operation, coping with system errors, component issues etc.

Other demanding issues with regards to autonomous living are to continue communication in several manners. Today's standard fixed or mobile telephony

services will be developed in appropriate ways, using point-to-point or multi-point high quality video conferencing or extended messaging services which make it easier for the user to get in touch with family members, friends and other contacts alike.

We appreciate that the Center for Digital Technology & Management (CDTM) investigated the most relevant trends in the emerging field of Ambient Assisted Living and e-health in greater depth and, through instruction and support, lead the students at their deep-dive study into its technological complexity and challenging economic and social impacts. We thank the guest lecturers for sharing their valuable insights, and we are glad that the creativity and perseverance of excellent students once more contributed to existing knowledge. We regard the results of this seminar as remarkable, providing useful information and insights for research, politics and industry. We gratefully thank the students for their enthusiasm and dedication.

Harald Klaus and Michael Balasch
Telekom Innovation Laboratories

Berlin, June 2012

For more information about the CDTM and its related projects,
please visit http://www.cdtm.de

The entire trend report was written by CDTM students under the close guidance of research assistants in 2011. The papers compiled here do not claim to be scientifically accurate in every case; they are rather meant to give a structured and broad overview of trends relevant in the smart grid context.

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Nomenclature

AAL	Ambient Assisted Living
AC	Air Conditioning
API	Application Programming Interface
AALIANCE	European Ambient Assisted Living Innovation Alliance
B2B	Business to Business
B2C	Business to Consumer
CIP	Competitiveness and Innovation Programme
CPU	Central Processing Unit
DSL	Digital Subscriber Line
CPU	Central Processing Unit
EB	Exabyte
EC	European Commission
EHR	Electronic Health Record
FP7	7th Framework Programme
GPS	Global Positioning System
GUI	Graphical User Interface
HTTP	HyperText Transfer Protocol
HTML	HyperText Markup Language
HMI	Human Machine Interface
ICT	Information and Communication Technologies
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IR	Infrared
IT	Information Technology
JSON	JavaScript Object Notation

JP	AAL Joint Programme
LERU	League of European Research Universities
LPS	Local Positioning System
LTE	Long Term Evolution
Mbps	Megabits per Second
NFC	Near Field Communication
PLC	Power Line Communication
REST	Representational State Transfer
RF	Radio Frequency
RFID	Radio Frequency Identification
SME	Small and Medium-Sized Enterprise
SOAP	Simple Object Access Protocol
TV	Television Set
UDDI	Universal Description, Discovery and Integration
UGC	User Generated Content
UI	User Interface
UMTS	Universal Mobile Telecommunications System
W3C	World Wide Web Consortium
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network
WSDL	Web Services Description Language
XML	eXtensible Markup Language
YAML	YAML Ain't Markup Language

Part I

Trends

Chapter 1

1 Internet of Things for AAL

Dominik Franz, Courtney Lynch, Simon Meyer, Ludwig Schubert, Sinan Taifour

The Internet of Things is the concept of a web of everyday objects connected to the Internet. This allows them to communicate between themselves and in turn influence their environment in a smart way.

Many objects already contain digital components and environmental sensors. But even with the Internet infrastructure already in place, most of those devices are not yet connected amongst themselves. The current usage paradigm still acts on the assumption of conscious use.

In the Internet of Things devices will evolve to both know about their environment and be able to influence it. A more open, flexible, and high-performance infrastructure together with smarter devices will facilitate this development. Computing becomes ubiquitous due to the increase in mobile devices and smart objects that have access to the Internet.

Agreeing on universal communication standards and data management will be a challenge to market players. Advancements in energy storage technologies, wireless communication, and greater network coverage are a crucial foundation for the Internet of Things to enable AAL.

It will be difficult to tell when the Internet of Things has fully arrived. However, it is a logical next step from the concept of the Internet to real-world everyday objects, and the upcoming developments in technology are solidifying the basis for this development.

1.1 Introduction

The Internet of Things is the concept of a web of everyday objects connected to the Internet. Thus, these physical objects are given a virtual representation. Through this representation, these objects are enabled to interact with Internet services, users, and each other [65, p. 110].

One of the earliest applications of the Internet of Things is a logistics operation. When pallets of goods are shipped, logistics companies often have a Global Positioning System (GPS) chip located inside the pallet that allows them to track the shipment and notify the customer on its status or determine the location of lost goods. The entire operation involves a number of devices working together to ensure the product is delivered, including objects previously not considered part of the technological world such as the pallet used to hold goods. The Internet of Things is no longer solely for the commercial market however. As technology becomes more affordable and advances to meet consumer needs, the Internet of Things is playing a significant role in the creation of opportunities such as Ambient Assisted Living (AAL).

The Internet of Things is the foundation of Ambient Assisted Living because it allows different aspects of everyday life to become interconnected. This improves the user's quality of life by automatically manipulating actions based on prior knowledge and adjusting to new circumstances. For example, some car driver seats and mirrors adjust to each user's settings when their keys are inserted into the vehicle. This is useful when multiple drivers are using the car so the users no longer need to readjust each item themselves.

In this chapter, the current state of data retrieval, processing, and presentation will be analyzed. Then expected trends in the Internet of Things and their relevance to Ambient Assisted Living are identified. The trends are followed by potential barriers that will yet need to be overcome. Finally, the conclusion will sum up the findings and raise critical questions.

1.2 Status Quo

A broad range of assisting technologies is already available. However, most of the devices are not yet connected amongst themselves. As a result, heavy user interaction is often required, which sometimes is unintuitive and hard to understand. The following sections will introduce the reader to currently available technologies and explain if they can already be used for an extensive customer base.

1.2.1 Environment Interaction

Environment Interaction focuses on the way today's devices interact with their physical environment. This section first details the sensing of their environment

and then explains how they manipulate it.

1.2.1.1 Sensors

Sensors play an integral role in the Internet of Things by gathering information through environmental triggers. This may include, but is not limited to, changes in heat, motion, sound, weather, and chemical compositions. Information can be sent to other devices or users by identifying these changes. One example of sensors in an AAL application would be fall detectors that use a combination of accelerators and tilt sensors to identify a person's fall and send out a signal for help [4, p. 1003]. The person is required to wear the device at all times. There are also fire alarms that automatically send an emergency call if a fire is detected. Within many current mobile products such as the iPhone there are sensors that provide a more interactive experience for the user. These include accelerometers, magnetometers, gyroscopes, noise, proximity, temperature, and ambient light sensors [30].

Radio-frequency identification (RFID) stores data in an RFID tag that can be retrieved through an RFID reader through electromagnetic transmission. RFID is often used as a location-sensing device and is advantageous over other devices because it can withstand extreme environmental conditions and also works at high speeds [32, p. 3]. In this case, the RFID reader is acting as a sensor for the RFID tag and broadens the information available to the Internet of Things by identifying the objects in its surroundings.

1.2.1.2 Actuators

Actuators enable the Internet of Things to translate its information and decisions into environmental impact. For example, motors that move doors, windows or air conditioning, lamps, displays and loudspeakers, but also artificial muscles [101], pacemakers and mechanized recliners fall under this category. Collected and processed information leads to decisions in systems that then use actuators to put these decisions into effect. One example of acting on given information would be an exhaust hood that adjusts its blower level according to information from a cooking plate below it [56].

While many different and useful actuators exist today, they still are mostly disconnected from the Internet of Things and are controlled manually.

1.2.2 Infrastructure

This section deals with the current state of networking and data exchange on the Internet.

1.2.2.1 Network Technologies

Network technologies are one of the key factors of the Internet of Things. While there are already many powerful and all-purpose devices on the market, the integration and communication between them still require significant improvements. This can be done mainly via network technologies, which need a common standard that is both powerful and widespread.

Fixed Line Broadband

Even though "Europe is extremely well represented among the countries with the highest levels of broadband adoption" [3, p. 19], still only 25.6% of the continent is currently covered via fixed line broadband technologies [14, p. 77]. The average connection speed ranges from 3.4 megabits per second (Mbps) in Spain to 7.5 Mbps in the Netherlands [3, p. 38].

Mobile Networks Gaining Importance

While most of these technologies were traditionally based on wires, wireless technologies are gaining importance. This is mainly due to cheaper implementation costs especially in rural areas which often have no broadband Internet connection yet.

Thanks to enhanced versions of the Universal Mobile Telecommunications System (UMTS), mobile broadband network technologies enabled up to 7.2 Mbps and had an average territorial coverage of 53% throughout Europe as well as an average national penetration of 17.9% in late 2009 [86, p. 33].

Near Field Communication

Near Field Communication (NFC) is already used for large corporations' in-house solutions but has not yet been widely integrated into mass market devices.

Overall, current networks can be used to enable some AAL-services but the adoption of newer technologies is becoming increasingly important for further development.

1.2.2.2 Inter-Service Data Exchange

Internet services provide user interfaces (UI) as a means to interchange data and information with their users. However, many services are not standalone and interact automatically with other services, therefore on top of communicating with users, there exists a need for inter-service data exchange. The term "Web Services" describes these software systems supporting machine-to-machine interaction over a network [39].

Typical Web services contain technologies that cover three distinct purposes [16]: exchanging messages, describing the Web service (in a machine-readable form), and publishing and discovering these descriptions.

Standards have emerged for serving these different purposes, many developed by the World Wide Web Consortium (W3C). For the exchange of messages, both the access protocol and methods (e.g. W3C's SOAP - Simple Object Access Protocol), and the format of the message transferred have to be defined (e.g. W3C's XML - eXtensible Markup Language [13]). W3C also defines a standard for describing web services, called the Web Services Description Language (WSDL) [18]. Universal Description, Discovery and Integration (UDDI) [19] is an example of a standard for registering and locating web services.

Some Web services put emphasis on the exchange of messages and do not implement machine-readable Web service descriptions. These Web services are deemed "lightweight" [11]. In this context, the Web service defines an Application Programming Interface (API) in a human-readable format to educate developers on how to write applications and services that access the Web service. The common access method for lightweight Web services is RESTful [11] (REpresentational State Transfer). Regarding messages, a lightweight format is often used (e.g. JSON - JavaScript Object Notation [21] or YAML - YAML Ain't Markup Language [10]), and sometimes more elaborate formats such as XML.

1.2.3 End-User Technologies

This section describes how users interact with current approaches to AAL systems. It first details traditional desktop-style and mobile, handheld interaction. An overview of the state of autonomous service robots is given as well.

1.2.3.1 Stationary Devices

Stationary devices are mainly comprised of desktop computers and television sets. Computers can be found in the majority of households in Europe and a majority of Europeans regularly use the Internet [25]. Thanks to Internet connections, computers can be used for a countless number of activities, such as working, entertainment, information and communication.

Television sets (TVs) have been around in most European households for many generations. However, there have not been revolutionary changes to TV functionalities [60, p. 1]. Due to this, most people are accustomed to using TVs and perceive them as easy-to-use everyday devices [33, p. 3-4]. However, consumers' consumption behavior changed as the Internet offers them more diverse options for information and entertainment.

Internet has recently been integrated with TVs. This can be done either indirectly via gaming consoles (e.g. Nintendo Wii [69]) and devices such as set-top boxes (e.g. Apple TV [47]), or via a direct Internet connection.

In consequence to this, TVs are now able to play an important role in the Internet of Things. Their large screens can be used for video-telephony or to display content, such as pictures or videos, that is stored on other devices (e.g. computers) or even streamed over the Internet [47].

1.2.3.2 Mobile Devices

Mobile devices (such as smartphones, tablet PCs, or laptops) play an important role within the Internet of Things. They can connect to the Internet and therefore enable users to also interact with smart objects.

As most modern mobile devices support various types of wireless networking, users are able to fulfill many tasks on the go, such as emailing, browsing the Internet or scheduling appointments. Due to these improvements in mobile computing, users are no longer bound to stationary devices to go online. Using their mobile devices, they can essentially go online anytime and anywhere [80, p. 26].

Using wireless networking standards, physical objects connected to the Internet can be addressed independent of their location. Furthermore, mobile devices can interact directly with physical objects. For example, many advertisements such as movie posters contain a matrix barcode, the so-called Quick Repsonse code (QR code). The QR code contains information like a link to a video or homepage that can be decoded by using the camera of a mobile device and a decoding application[79, p. 12]. That means that mobile devices can act as browsers or interfaces for the Internet of Things [85].

1.2.3.3 Service Robots

Intelligent service robots are intensively developed by many big corporations such as Siemens, Dyson and Sony. While current devices mainly focus on specialized tasks such as housekeeping, robots for general assistance still need to improve substantially to be attractive to mass markets.

An example of a specialized device is the iRobot Roomba, which is capable of "moving about the home and sweeping up dirt as it goes along" [31, p. 258]. Still, even those devices are in the early stages and have yet to overcome many obstacles, in this example stairs, rugs with fringes, and curtains [31, p. 262].

Robots can also assist impaired individuals, mainly to countervail the lack of vision or hearing. They can interpret the information they gather and communicate it to the user. This may be used to help blind people with their shopping for example (see [36]).

In corporate environments robots are still mainly used for repetitive work and tasks that humans cannot do or that can be easily accomplished by machines. Although a lot of research is done in more general corporate tasks - for example a "distributed autonomous gardening system with applications in urban/indoor

precision agriculture" [20, p. 219] - a widespread adoption has not yet been achieved.

1.3 Trends

Current technologies still have great potential and exhibit need for improvements. This is mainly due to more sophisticated services whose development often exceeds the speed of technological development. The following chapter provides a comprehensive look at current trends and identifies possible services and opportunities for companies and product developers.

1.3.1 Environment Interaction

This section focuses on the way devices within the Internet of Things will communicate with their physical surroundings.

First, it begins with an overview of how the Internet of Things will evolve to know about its surroundings and influence them. The section then details one aspect of environmental information, namely location, and how it will be used. Finally, it puts a focus on the way data acquired from the environment will be stored and used between devices.

1.3.1.1 Broader Application of Sensors & Actuators

As the Internet of Things expands, sensors and RFID will need to be adapted to fit a variety of user requirements. In addition, the beauty of AAL will be in the ease of use that such sensors can provide to the user.

Devices to aid the elderly are constantly being improved to meet their needs while allowing the user a feeling of greater independence. For example, current fall detectors on the market require a conscious effort from the user to put on the device or to activate the device once a fall has occurred. However, there is an upcoming detector that would track falls by monitoring the vibration patterns on the floor using a piezoelectric sensor [4, p. 3]. The fall detector will monitor the user in a nonintrusive way by not using any camera monitoring and not requiring conscious action by the user. Thus, the trend in injury prevention technology is leading towards tools that make the elderly feel protected rather than monitored. Allowing them to feel assisted rather than observed increases user comfort, which is an important aspect of Ambient Assisted Living.

Smartphones are becoming increasingly popular with shipments of cell phone sensors expected to increase five-fold from 2009 to 2014 (435.9 million to 2.2 billion units) [63]. With more smartphone users, more applications can be created that take advantage of the already existing phone sensors. This can help the spread of AAL by allowing users to employ their smartphone sensors for some of the more basic features.

As RFID tags become more common in everyday objects, they may be used for domestic purposes. One tool uses a mobile phone to help the user locate misplaced items. The mobile phone stores information on the object location when it leaves the phone sensor's range. Once the user queries for the item, the phone will forward the request to the most logical object sensors until the item has been located and then a notification will be displayed on the user's phone with the location [32]. Tools developed using these RFID tags and sensors in unconventional ways open up a large realm of possibilities for AAL and are an important trend to follow as developers stretch the previous notions of how sensors can be used by consumers.

Actuators are also becoming connected to the Internet of Things; in particular medical devices are beginning to automatically update doctors on their patient's condition. For example, in 2009, one of the first pacemakers connected to the Internet was implanted and notifies the doctor immediately if the patient experiences any irregularities [8]. These devices may allow the patient to bypass regular in office checkups while still being constantly monitored for health. The combination of actuators and sensors opens up new possibilities for existing products.

1.3.1.2 Growing Use of Location-Aware Services and Devices

Future applications will have to use location information to adapt to changes and inform their users more intelligently, so less action on the user's side is needed to achieve at least the same degree of functionality with the system.

Traditionally, civil satellite based positioning services have been limited to outdoor use with an accuracy of about ten meters (unaugmented and in urban settings) [82, p. 1]. The addition (The U.S. GPS and European Galileo signals are compatible and can be used combined to enhance accuracy [90]) of the European satellite navigation system Galileo may enable accuracies of up to four meters (unaugmented and in urban settings) [24, p. 26, see HPE, GPS+Galileo, Dual Frequency MBOC, Urban Setting] and augmented GPS services often achieve accuracies of about one meter (see Figure 1.1). This is called assisted GPS and uses additional information available to the device to accelerate the positioning process. For example, nearby Wi-Fi hotspots may be looked up on a map or the data network is used for faster download of supplemental GPS data that helps the device to more quickly get a GPS fix by relying on assumptions derived from the received data. However, satellite based navigation will likely not be the technology behind future Local Positioning Systems (LPS). The current LPS landscape is still scattered but usage will become increasingly common [43, p. 64].

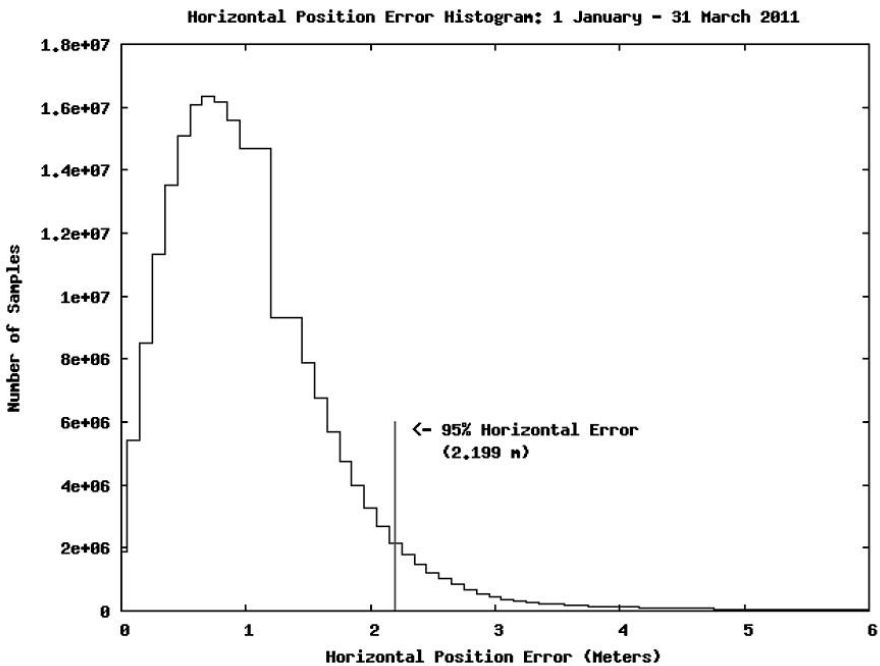

Figure 1.1: Most GPS signal achieve an accuracy of about 1m, but future LPS will likely still not use it due to it's limitation to outdoor use. Source: U.S. Government[94]

Global Positioning & Navigation

GPS will continue to have increased integration in mobile devices. By the end of 2011 about 80% of cell phones shipped are expected to incorporate GPS functionality [77] and this figure will likely reach 100% within the coming decade. In 2009, a GPS Receiver still cost about $ 2 [53], while basebands that include the GPS receiver, as a part will become the standard. (Qualcomm's MDM6600 is an example for such a baseband and is used in Apple Inc.'s iPhone 4 [30, p. 3].)

Ubiquitous availability of location information will enable future devices to go far beyond the services that current devices provide. Usage will shift from a mostly conscious usage of location information, like mapping or navigation, to also include less visible, passive assistance services. See 1.3.1.2–Relevance to AAL for examples.

Indoor Positioning & Navigation

Indoor Positioning carries a big promise, due to its manifold applications: real-time tracking, activity recognition, health care, navigation, emergency detection, and target-of-interest monitoring as well as many others [100].

However, while several different technologies already exist, all of them have specific disadvantages:

Infrared (IR) Based Systems are technologically simple and cheap, but require line-of-sight, are subject to interference, and consume extra energy [78].

Ultrasound Based Systems are cheap as well, but require laborious installation and consume additional energy [68, 59].

Radio Frequency (RF) Based Systems can be implemented with RFID (Radio Frequency Identification), WLAN (Wireless Local Area Network) or Bluetooth technology and thus can be integrated into existing devices. However, current implementations still offer poor performance [9].

Each of those positioning system technologies can be superior under given circumstances. It thus seems impossible to determine a single "winning" technology. Future indoor positioning systems will rather use a plethora of different location information sources. [99] In summary, innovative research is still needed to realize the potential of Indoor Positioning & Navigation.

Relevance to AAL

Ubiquitous availability of GPS location information to mobile devices will enable future devices to offer context sensitive services. One example of these services is illustrated by Apple Inc.:

> "[...] Say you need to remember to pick up milk during your next grocery trip. Since Reminders can be location based, you'll get an alert as soon as you pull into the supermarket parking lot." [49]

Here, the user does not have to activate a location-aware service himself; rather the device uses its knowledge about the user's location to assist him.

Indoor Positioning information could enable better emergency detection systems (by detecting an immobile user, for example) and generally add another information dimension to AAL systems. For example, if a user is immobile in his bedroom this may indicate to an AAL system that the user is sleeping.

1.3.1.3 Increase in Data Visibility & Lifespan

Up until now, data measured or otherwise acquired by devices has mostly been hidden. For example, a fridge's control mechanism knows about its internal temperature but this information cannot be used outside it, neither by the user nor by other systems. Internet connectivity will enable future devices to transmit their internal information, thus making it visible. Power Line Communication (PLC) [34] can even bring this capability to devices for which additional wired communication modules wouldn't be feasible and wireless communication is not available. This is often the case with traditional appliances such as freezers or tumble driers, which might be stored in a cellar where there is no wireless communication coverage. A prominent example is the concept of a "Smart Grid" [52], a system "encompassing [...] wide-area monitoring, two way communications and enhanced control functionalities" for the electric power system.

Also, data was volatile: a temperate reading from a fever thermometer was briefly displayed then discarded. Increasing connections between systems will enable them to communicate their data to data storing or presenting devices. Applications that are being conceptualized are measuring devices that directly communicate to an Electronic Health Record (EHR)[6] and could provide doctors with extensive historical patient information, leading to better care [38].

The increase in data visibility and lifespan will enable both systems and users to make more fact-based decisions about the world. In the context of assistive systems it gives system engineers a broader fact base on which their algorithms and systems can decide about assistive measures. Its impact on AAL is qualitative not innovative.

1.3.2 Infrastructure

The following sections deal with the implementation of how AAL services can be realized on the Internet of Things.

First, data exchange on a networking level is detailed. The second part outlines how traditional Information Technology (IT) infrastructure can be

replaced by Web services. After that is illustrated how data exchange is handled between systems on a protocol level. Finally it is shown that devices will learn how to deal with humans instead of doing it the other way around.

1.3.2.1 Increasing Network Speed & Coverage

The field of network technologies is currently moving at a very fast pace. More devices need to be connected, data traffic is rising exponentially, and network speeds need to increase to enable new services.

General advancements

The first challenge, connecting more devices, forced the development of a new Internet protocol, IPv6 (Internet Protocol version 6). Previously only 2^{32} (about four billion) devices could be addressed - which was expected to be a limitation as early as 2010 [45, p. 2]. To cope with the trend towards even more devices (see 1.3.3.1), IPv6 was designed to connect up to 2^{128} individual devices. As of 2011, the implementation of this protocol is currently in progress and expected to coexist beside IPv4 (Internet Protocol version 4) for several years to come [44, p. 1].

Fixed infrastructures and internet backbones are enhanced in other ways as well. Data transmission rates are increasing, latency times are getting shorter and overall coverage is improving. This is required due to extreme growth in network traffic, which increased eightfold between 2005 and 2010 and is expected to grow fourfold in the next five years [50, p. 1].

Mobile Technologies

In mobile networking technologies the challenges are even bigger. The worldwide mobile Internet traffic is expected to increase 26-fold between 2010 and 2015 [51, p. 2], which means that the current monthly traffic of 0.24 EB (Exabyte) will rise to 6.3 EB (see Figure 1.2).

Therefore several technologies including Long-Term-Evolution (LTE) and Worldwide Interoperability for Microwave Access (WiMAX) were developed and are now deployed. Unfortunately, the previous generation technology (UMTS, available since 2000) has yet only reached an average national penetration of 17.9% in Europe [86, p. 33] despite already covering 82% of the population [86, p. 31]. This shows that it will probably still take several more years until the new developments can be seen as widely used technologies.

Near Field Communication

NFC was developed to provide an “efficient technology for communications with short ranges” [57, p. 33]. This can be used for wireless payment solutions like

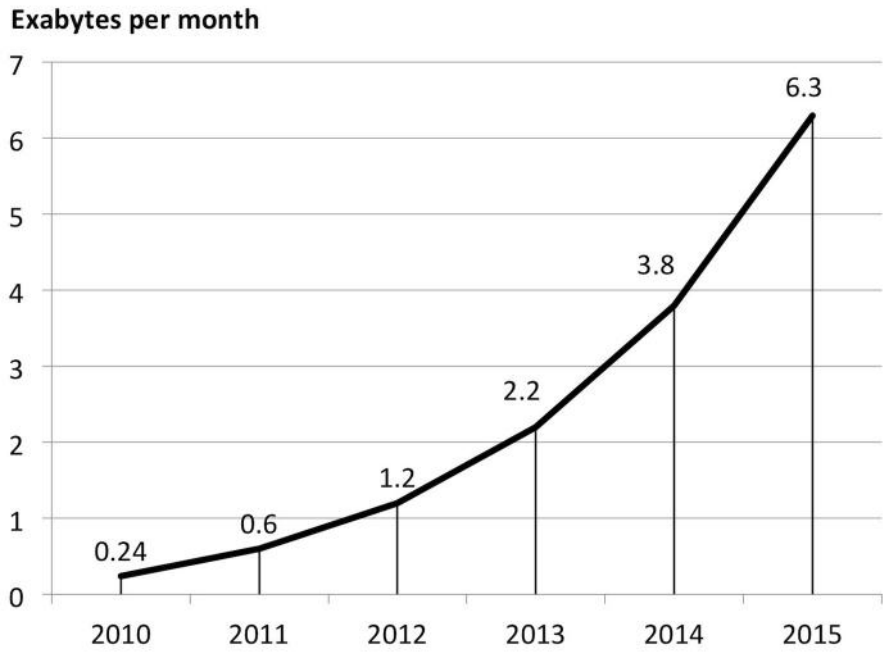

Figure 1.2: Expected mobile Internet traffic growth.
Source: Adapted from [51, p. 5]

Google Wallet (which allows for payments through Android Phones equipped with NFC), identification purposes like in digital identity cards and many other things that need quick and easy data exchange to physically close devices. While some barriers have yet to be overcome, several large corporations are doing intensive research in this area [71, p. 20].

Relevance to AAL

AAL has many developments that need both broad coverages as well as high data transfer rates. Also, developments in mobile network technologies are crucial to enable new services that need to be available everywhere.

1.3.2.2 Move Towards Cloud Computing

There is an increasingly perceived vision that computing will one day be the fifth utility [15]. Just like water, electricity, gas and telephony, it will be available to the end-user without a need for direct infrastructure investment on his part and will be billed based on usage. "Cloud Computing" is a term used to describe an implementation of this vision.

In Cloud Computing, the computing and storage resources are moved away from the end-user devices (such as a personal computer or a mobile, see 1.2.3.1 and 1.2.3.2) and into remote data centers operated by third parties, to be accessed over the network. This is also described as the Cloud becoming the Digital Hub [75].

Advantages for device manufacturers, service providers, and users are:

- For device manufacturers, as more of the computation power and storage capacity is moved away from the devices and into the Cloud, the device requirements drop and devices become cheaper, smaller, lighter, and battery life-time is extended.

- For service providers, the initial cost of setting up data centers is removed, since this is handled by the third-party Cloud Computing provider. The cost of providing processing and storage service is also lowered due to the economies of scale invoked by the co-tenancy of third party data centers [41]. Since the data centers are run by a third party, the service providers need to invest less in maintaining their infrastructure since part of the maintenance is provided by the Cloud provider. All these factors contribute to a lower barrier of entry for new businesses. Cloud Computing also eases the expansion of businesses and allows for more elasticity, due to the fast and dynamic provisioning of resources [58].

- For the user, Cloud Computing brings a fine-grained pay-for-usage pricing model (e.g. with the Software-as-a-Service model), and an overall decrease in prices (due to the lower cost along the value chain). It also means the

user's data is accessible from anywhere and from any device [35] without the hassle of explicit synchronization.

Relevance to AAL

The vision of Ambient Assisted Living includes many sensors and end-user devices, all of which need to save their data somewhere. Cloud Computing solves the issue of the home Digital Hub by saving all data in the cloud, making it accessible to all devices that need it from anywhere without explicit synchronization [27].

Using Cloud Computing in Ambient Assisted Living also cuts down on the processing power requirement of the devices and removes its redundancy; there is no need for strong hardware in every end-user device, the device can consult the Cloud when in need for a computationally intensive calculation. This also saves energy on the end-user device.

1.3.2.3 Increasing Inter-Service Data Exchange Possibilities

As service providers recognize their customers' needs for interconnections between services and the opportunities they present, more inter-service data exchange possibilities are arising. This trend can be divided into two parts: a fast trend in building and using more APIs, and a slower trend towards building the Semantic Web.

Building and Using More APIs

There is a growth in the "lightweight" approach to Web services [11]; that is, using APIs as opposed to implementing a full message exchange, service description, and publish and discovery stack (see 1.2.2.2).

This can be seen by the introduction of new APIs to services that were previously only accessible to humans (e.g. the Netflix API [42]), an extension of previous APIs to expose new underlying functionality (e.g. Google Maps Javascript API, introduced in 2005 based on strong demand [89], extended to the latest version in 2010 [37]), and a decline in the adoption of Web service standards not used in lightweight Web services (e.g. The discontinuation of the UDDI Web Services Registry Effort [81]).

There is also an increase in API usage (e.g. over the last year, 65% increase in the usage of the Google Maps API [93], 400% increase in the usage of the Facebook Graph API [91], and 800% increase in the usage of the Google Fonts API [92]). The interest from the developer community can also be seen by the creation of many community-supported API clients and different programming languages (e.g. 25 different community client implementations of the Flickr API in 16 different programming languages [29]).

Lightweight Web services do not include automatic publishing and discovery services and do not define their interfaces in machine-readable formats. This created a need for API Directories that collect information about the APIs of different Web services, catalog it, and present it to the developer. One example of such a directory is Programmable Web (http://www.programmableweb.com) which has seen an increase in cataloged APIs from about 2000 APIs last year to more than 3000 today [97].

An increase in the availability of public APIs is fueling an increase in Mashups, which are "Web applications that combine multiple services into a single application" [22]. Mashups often deliver convenience that is not present when using the incorporated services separately.

Semantic Web

The traditional markup tags used to display information on the Web do not describe what the information means, rather they describe how the page should appear [70]. There is a growing effort to extend the World Wide Web into a Semantic Web, a Web not only made of hyperlinked human-readable pages but also accompanying machine-readable metadata.

This would mean that pages would not only describe how their information is presented but also a well-defined machine-readable meaning, better enabling computers and people to work in cooperation [12]. For example, a Web page could include a date, a location, a rating, or contact information. In the Semantic Web, each of those pieces of information would have metadata attached to them indicating what they are and relations between them. This would allow the user's software to automatically extract this kind of information, relate it to other data, and answer queries about it [12].

While some of this is already possible without the Semantic Web through advancements in the field of Natural Language and Machine Learning, the approach of the Semantic Web is more robust since the metadata is explicitly provided by the publisher .

Several standards and approaches already exist to support this movement, such as Microformat. Microformat re-uses existing HTML (HyperText Markup Language) tags to convey metadata. This allows the metadata to be conveyed with current technology, benefiting users who are taking advantage of it without affecting users who are not.

Relevance to AAL

AAL involves the integration of many services transparently to the user. This gives inter-service data exchange high importance.

The fast growth of APIs will allow developers of AAL systems to integrate more services into their systems, hence making the system more attractive.

APIs also allow third parties to extend services beyond the feature-set provided by the service provider.

Integration of services allows the creation of "value chains" in which sub-assemblies of information are passed between services, adding value along the chain, to produce a final result that is more suitable to the user [12]. In this aspect the Semantic Web provides the framework to collect a large amount of data distributed across the Web and reduce it to a small amount that is more valuable to the end user [12].

1.3.2.4 Advancements in Machine Learning

Machine Learning is a branch of Artificial Intelligence concerned with creating algorithms that change their own behavior based on empirical data in such a manner that their expected future performance improves [67, p. 1]. Informally: algorithms that can "learn", thus the name.

Of Machine Learning's many subfields and applications, two are trending and relevant to AAL: Natural Language Processing and Adaptive Interfaces and Content.

Natural Language Processing

Natural Language Processing is concerned with the interactions between computers and human natural languages [17, p. 2], this covers Natural Language Understanding and Natural Language Generation.

An example of a recent application showing state-of-the-art development in Natural Language Understanding is the IBM Watson [46], an artificial intelligence computer system capable of answering questions posed in natural language. Watson competed and won on the quiz show Jeopardy! [72].

Adaptive Interfaces and Content

The idea in Adaptive Interfaces and Content is to build a model of a user's activity and interests, then modify the information or its presentation (or both) in order to better address his needs. This is made possible, in a big part, by advancements in Machine Learning.

An example of Adaptive Content is an online movie rental store that suggests movies based on your previous renting history. An example of an Adaptive Interface would be an interface that changes the order of the items based on your expected usage pattern under the current conditions [64, 66, 74].

Relevance to AAL

AAL users might not be too adapted to using technology in general. Advancements in Machine Learning can make the experience appear more natural. In

short, the machine can learn how to deal with the human using these advancements, instead of doing it the other way around.

1.3.3 End-User Technologies

In the following paragraphs, the user of the Internet of Things is considered. First, it is shown how the growing penetration of computing into the world changes how users interact with it. In the second part, several trends towards an easier user interaction are explored.

1.3.3.1 Computing Enters Everyday Devices

In the future, users will be constantly surrounded by "smart" objects, meaning that these devices are increasingly connected to the Internet. This enables all aspects of AAL to communicate with each other.

All the Time, Everywhere

The paradigm of computing will steadily shift from "anytime, anywhere" (see: 1.2.3.2) towards "all the time, everywhere" [80, p. 26]. This means that more smart objects will be connected to the Internet. The term "smart object" does not only refer to computers, smartphones, and televisions. Even everyday devices such as refrigerators, lamps, and coffee machines can become smart objects. Computer networking company Cisco claims that in 2008 the number of objects connected to the Internet had already exceeded the population on Earth and will reach 50 billion in 2020 [26]. As previously mentioned in 1.2.1, these smart objects can sense and communicate data, in other words they are able to interact with their environment. Due to their small size or inaccessible position, most of them do not have classical interfaces. Users can interact with them via wireless connections through their smartphones or laptops. For example, a user's coffee machine and alarm clock could communicate with each other. The alarm clock could notify the coffee machine before the user gets up so that he can get fresh coffee when he wakes up.

Mark Weiser, then head of the Computer Science Laboratory at Xerox Palo Alto Research Center, already predicted in 1991 that computers "will weave themselves into the fabric of everyday life until they are indistinguishable from it" [96, p. 94]. This statement implies that computers, as they are known today, will gradually disappear into the background. However, computing will be almost everywhere around the users and will be embedded in their world [61, p. 64]. The environment will become enhanced with many pieces of digital information that can be accessed at all times [80, p. 25]. Furthermore, most of it will be mobile so it follows users everywhere they go and even when they change devices [61, p. 64]. For example, temperature and brightness can be adjusted according to a user's pre-set preferences when he enters a room.

Relevance to AAL

The trend towards more ubiquitous computing is the foundation of the Internet of Things. Smart objects can interact with a user according to his preferences and needs. As they are connected to the Internet, the objects can be controlled all the time from anywhere and everywhere. Due to this, AAL can support and help people in every aspect of their lives.

For example, smart clothes with body sensors can automatically measure body signals such as blood pressure or heart rate. The data can be checked on the person's smartphone, which may then give advice on how to improve health, e.g. using nutrition or sports [28, p. 3387]. In case of any reported abnormalities in body signals, an ambulance can be called automatically. Finally, the data can also be forwarded to a doctor who reviews it without needing to meet the patient in person [62].

1.3.3.2 Towards Natural Human-Machine Interaction

In order for the Internet of Things for AAL to be accepted by its intended users, it is vital that its end-user devices are easy to use.

Skeuomorphic Graphic User Interfaces

As this also applies to interfaces, a trend towards skeuomorphic interfaces is clearly recognizable [73]. Apple Inc. states: "The more true to life your application looks and behaves, the easier it is for people to understand how it works and the more they enjoy using it." [48] A skeuomorphic Graphical User Interface (GUI) gives the user clues to its function by referring to existing mental models of the user. In figure 1.3 the shape and design resembling the look of a book and a bookmark hint to its intended use.

Natural Interaction

Another step towards more intuitive devices is achieved by enabling additional interaction methods like touch sensitivity, speech recognition, text-to-speech, and gesture recognition. Those are the traditional ways we interact with the real world and thus can be learned and understood a lot easier in technological products [84].

The ultimate goal of any user interface should be to disappear completely, and will be achieved with reality-based interaction. The user doesn't consciously interact with an interface anymore, but simply with the real world around him. By "real world", "the undigital world, including physical, social, and cultural reality outside of any form of computer interaction"[54, p. 2466] is meant. An elaborate system of sensors, processing devices, and actuators will then capture the user's action, infer his intention and assist him appropriately [54, 83].

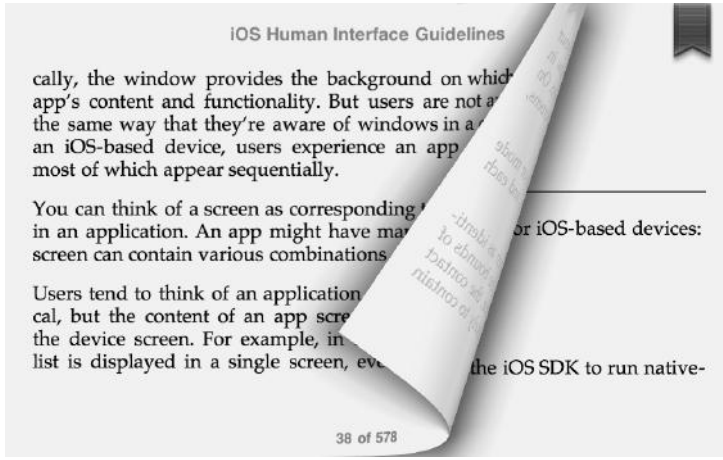

Figure 1.3: A skeumorphic book reader GUI
Source: Own illustration (Screenshot of Apple iBooks 1.3)

Relevance to AAL

New ways of Human-Machine Interaction are crucial for enhanced usability, especially if products target the elderly. It also allows products to be accessible to a broader customer base, including handicapped or mentally challenged people.

1.4 Barriers

While many technological advancements look promising, there are also some drawbacks that can potentially cause problems. Whether related to companies finding common standards, infrastructure issues, or processing and managing huge amounts of data, the following sections provide a general overview of obstacles that product developers may face.

1.4.1 Standardization

The Internet of Things is a vast network of systems working together and with this complexity arises the problem of standardization. It is important to standardize technology in order to allow communication between devices of different companies, otherwise a single Internet of Things cannot exist. Devices must be both physically and semantically compatible, which can be difficult to coordinate due to all the companies playing a role in the development. Standards can be created by government regulation through organizations

such as the International Standards Organisation or they can develop through voluntary cooperation within an industry between one or more companies [95, p. 8]. Unfortunately, voluntary cooperation can be difficult to achieve because there are incentives for each company to have its own standards. Often companies intentionally create products that are incompatible with other companies' products in order to "lock-in" the customer. There is a serious risk for a monopoly arising due to the strong network effect of Ambient Assisted Living; in other words, there is additional value added for using the same standard as the majority [87, p. 3].

1.4.2 Power Supply for Wireless Devices

With devices simultaneously becoming smaller, more mobile, and versatile, the question of energy supply inevitably arises. A large portion of those devices will not be able to be connected to a wired power grid – due to the requirement of mobility on the one hand, and due to the impracticality of wired power connections for big amounts of small units on the other hand.

Three main approaches to this problem exist: batteries, energy harvesting and wireless power supply.

Batteries

While the growth-stippling "battery gap" researchers feared in 2002 [55] could be avoided by drastically reducing power demand for modern Central processing units (CPUs), there still exists a discrepancy between the growth of capacity in batteries and the complexity of devices like smartphones [23].

Energy Harvesting

Devices can often gather small amounts of power from their environment and store it within themselves for later uses, like transmitting data. Examples include be floating sensors that gather energy from water movements [88], or TV remotes that are powered by the force the user exerts on the remote's buttons [7]. This concept is limited to low power devices; otherwise it requires some user interaction.

Wireless Power Supply

The most common form of wireless power supply is Induction Charging. Many electric toothbrushes use it in order to not have to expose contacts for charging. Its usefulness is crippled mostly by its very limited transmission distances [40].

A more recent development is Wireless Power Transfer by WiTricity[98]. It overcomes the distance limitation quite effectively, being usable over a few

meters. Current limiting factors appear to be technological maturation and antenna size [5].

An astoundingly simple and smart idea is to use solar cells in conjunction with capacitors. While this combination is highly mobile and can be relatively small, it is still limited to very low power consuming devices like smoke detectors or non-realtime sensors. This limitation is not addressable technologically, since there simply isn't that much energy to gain from the small surface of future devices under normal lighting conditions [76, p. 47, Table 1].

1.4.3 Limitations of Wireless Communication Technologies

Many of the end-user devices, sensors, and actuators in the Internet of Things are expected to communicate using wireless technologies. Collisions of packets in the wireless medium increase as the number of competing devices increases, thus lowering the overall throughput of the wireless channel.

Another issue arises regarding pairing. To allow devices to identify which devices or access points to communicate with, and to make this communication secure, the current approach is to have them paired (by providing one device with information about the other device, such as a device identifier and a key). This process is currently performed manually on each device but does not scale well as the number of devices increases.

1.4.4 Lack of Bandwidth Available in Remote Areas

For some applications of the Internet of Things a large amount of data needs to be processed [65, p. 113]. Due to this circumstance, fast connections are crucial for the development of AAL. Users would remain isolated from the Internet of Things if they did not have access to mobile 3G connections or fixed broadband connections [1, p. 7].

Digital Subscriber Line (DSL) technology is by far the most widely used broadband technology. On average, DSL coverage in the European Union plus Norway and Iceland is 94.4% (All numbers mentioned in this section are from year-end 2009). However, there is a gap between the coverage of rural and urban areas (79.9% respectively 99%) that is very slowly closing. Eastern European countries in particular have been neglected and need to catch up in order to ensure fast Internet connections to their inhabitants [86, p. 13-14, p. 34-35].

Furthermore, users need the ability to access the Internet of Things using their mobile devices from remote locations in order to enjoy all functionalities of AAL. Despite the rather low territorial coverage of UMTS, most Europeans already have access to it (see 1.2.2.1 and 1.3.2.1).

However, some governments and network providers need to ensure that all people will have access to fast Internet connections, regardless of whether they are in urban or rural areas. On a positive note, some network providers are

making efforts to bring faster Internet options to residents of areas without broadband access. For example, in April 2011, Deutsche Telekom began providing LTE to rural areas of Germany [2]. This development will continue to increase the potential user base for AAL.

1.4.5 Processing and Managing of Generated Data

Processing and managing problems arise as more devices collect and send data. First, all of this data needs to be transmitted in a fast and secure way. This can be very challenging for infrastructure providers like Deutsche Telekom because of the constant need to increase bandwidth and network coverage. Also, once the data is transmitted, most of it needs to be reduced to relevant information. This is essential to quickly identify what the information means and its potential use. Data storage in this case needs to be centralized either in personal digital hubs or at a remote location.

This still requires many developments in the general infrastructure and inter-device communication. Also, as seen in 5.2.2.6, standardization is currently a big issue that complicates exchanging information to a high degree.

1.5 Conclusion

While currently many technologies that would be part of AAL already exist, no framework holds them tightly together. The previously mentioned trends can create fertile ground for AAL to grow.

The Internet is expanding both in its coverage and its speed. The question arises whether or not it will cover users of AAL in rural areas. Storage of data is moving to the cloud and with that questions arise about how to manage this bulk of data and how to reduce it to useful information.

Sensors and actuators are being used in new creative ways that did not exist before. Location is becoming a big part of the equation, with more location-enabled devices entering the market and more location-aware services arising.

As time progresses, more objects are becoming connected and joining the Internet of Things. That creates strains on energy and wireless infrastructure, opening up room for innovative solutions.

Machine learning is making way for machines to understand the human language better and adapt to people's needs. However, this topic still requires significant research. Interfaces are becoming more user-friendly and natural by mimicking everyday objects. This makes using them easier for the elderly and the impaired.

The Internet of Things has a network effect; as more devices join its value increases. Will companies cooperate and create relevant standards to achieve the vision of AAL?

References

[1] AALIANCE. Ambient assisted living roadmap. http://www.aaliance.eu/public/documents/aaliance-roadmap/aaliance-aal-roadmap.pdf accessed on 02.09.2011, August 2009.

[2] Deutsche Telekom AG. Telekom bringt schnelles internet aufs land. http://www.telekom.com/dtag/cms/content/dt/de/595698?archivArticleID=1014010 accessed on 02.09.2011, April 2011.

[3] Akamai. The State of the Internet - 1st Quarter, 2011 Report. www.akamai.com/stateoftheinternet accessed on 01.09.2011, April 2011.

[4] Majd Alwan, Prabhu J Rajendran, Steve Kell, David Mack, Siddarth Dalal, Matt Wolfe, and Robin Felder. A smart and passive floor-vibration based fall detector for elderly. In *Information and Communication Technologies, 2006. ICTTA '06. 2nd*, volume 1, pages 1003 –1007, 0-0 2006.

[5] Robert Moffatt J.D. Joannopoulos Peter Fisher André Kurs, Aristeidis Karalis and Marin Soljacic. Wireless Power Transfer via Strongly Coupled Magnetic Resonances. *Science*, pages 83–86, july 2007.

[6] Simona Angela Apostol, Cosmin Catu, and Corina Vernic. Electronical Health Record's Systems. Interoperability. *arXiv.org*, cs.DB:7–20, February 2009.

[7] Arveni. Push button energy harvester ar01. http://www.arveni.fr/produits/DATA_SHEET_Push_button_energy_harvester.zip accessed on 25.09.2011, June 2010.

[8] Molika Ashford. First Internet-Connected Pacemaker Successfully Implanted. http://www.popsci.com/scitech/article/2009-08/first-patient-implanted-pacemaker-communicates-wirelessly-her-doctor accessed on 05.09.2011, November 2009.

[9] P. Bahl and V. Padmanabhan. RADAR: An in-building RF based user location and tracking system. *IEEE INFOCOM*, 2:775–784, 2000.

[10] Oren Ben-Kiki, Clark Evans, and Ingy döt Net. YAML Ain't Markup Language (YAML) Version 1.1. http://yaml.org/spec/1.1/current.html accessed on 01.09.2011, January 2005.

[11] Djamal Benslimane, Schahram Dustdar, and Amit Sheth. Services Mashups: The New Generation of Web Applications. *IEEE Internet Computing*, 1:13–15, 2008.

[12] Tim Berners-Lee, James Hendler, and Ora Lassila. The Semantic Web. *Scientific American Magazine*, 2001.

[13] Tim Bray, Jean Paoli, C. M. Sperberg-McQueen, Eve Maler, and François Yergeau. Extensible Markup Language (XML) 1.0 (Fifth Edition). http://www.w3.org/TR/2008/REC-xml-20081126/ accessed on 01.09.2011, November 2008.

[14] Bundesnetzagentur. Jahresbericht 2010, February 2011.

[15] Rajkumar Buyya, Chee Shin Yeo, Srikumar Venugopal, James Broberg, and Ivona Brandic. Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. *Future Generation Computer Systems*, 1, 2009.

[16] Michael Champion, Chris Ferris, Eric Newcomer, and David Orchard. Web Services Architecture. http://www.w3.org/TR/2002/WD-ws-arch-20021114 accessed on 01.09.2011, November 2002.

[17] Eugene Charniak. *Introduction to artificial intelligence*. Addison-Wesley, 1984.

[18] Erik Christensen, Francisco Curbera, Greg Meredith, and Sanjiva Weerawarana. Web Services Description Language (WSDL) 1.1. http://www.w3.org/TR/wsdl accessed on 01.09.2011, March 2001.

[19] Luc Clement, Andrew Hately, Claus von Riegen, and Tony Rogers. UDDI Spec TC. http://uddi.org/pubs/uddi_v3.htm accessed on 01.09.2011, October 2004.

[20] Nikolaus Correll, Nikos Arechiga, Adrienne Bolger, Mario Bollini, Ben Charrow, Adam Clayton, Felipe Dominguez, Kenneth Donahue, Samuel Dyar, Luke Johnson, Huan Liu, Alexander Patrikalakis, Timothy Robertson, Jeremy Smith, Daniel Soltero, Melissa Tanner, Lauren White, and Daniela Rus. Indoor robot gardening: design and implementation. *Intelligent Service Robotics*, 1:219–232, 2010.

[21] Douglas Crockford. The application/json Media Type for JavaScript Object Notation (JSON). http://www.ietf.org/rfc/rfc4627.txt accessed on 01.09.2011, July 2006.

[22] Tech Terms Computer Dictionary. Mashup Definition. http://www.techterms.com/definition/mashup accessed on 03.09.2011, October 2007.

[23] Eric Eason. Smartphone Battery Inadequacy. http://large.stanford.edu/courses/2010/ph240/eason1/ accessed on 01.09.2011, December 2010.

[24] Working Group C EU-US Cooperation on Satellite Navigation. Combined Performance for open GALILEO/GPS Receivers. ec.europa.eu/enterprise/policies/satnav/galileo/files/combined-open-gps-galileo_en.pdf accessed on 30.08.2011, July 2010.

[25] Eurostat. Information society statistics. http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Information_society_statistics accessed on 05.09.2011, September 2010.

[26] Dave Evans. The internet of things [infographic]. http://blogs.cisco.com/news/the-internet-of-things-infographic/ accessed on 05.09.2011, July 2011.

[27] Dan Farber. The new geek chic: Data Centers. http://news.cnet.com/8301-13953_3-9977049-80.html accessed on 04.09.2011, June 2008.

[28] M. V. M. Figueredo and Joao da Silva Dias. Mobile telemedicine system for home care and patient monitoring. In *Proceedings of the 26th Annual International Conference of the IEEE EMBS*, volume 2, pages 3387 – 3390, September 2004.

[29] Flickr. The Flickr API Documentation. http://www.flickr.com/services/api/ accessed on 03.09.2011.

[30] Luke Soules for iFixIt.com. iPhone 4 Verizon Teardown. http://www.ifixit.com/Teardown/iPhone-4-Verizon-Teardown/4693/3 accessed on 01.09.2011, February 2011.

[31] Jodi Forlizzi and Carl DiSalvo. Service Robots in the Domestic Environment: A Study of the Roomba Vacuum in the Home. In *Human-Robot Interaction*, 2006.

[32] Christian Frank, Philipp Bolliger, Friedemann Mattern, and Wolfgang Kellerer. The sensor internet at work: Locating everyday items using mobile phones. *Pervasive and Mobile Computing*, 4(3):421 – 447, 2008.

[33] Jonathan Freeman and Jane Lessiter. Itc-use: Ease of use and knowledge of digital and interactive television: Results, December 2001.

[34] Stefano Galli, Anna Scaglione, and Zhifang Wang. For the Grid and Through the Grid: The Role of Power Line Communications in the Smart Grid. *arXiv.org*, cs.NI:1973, October 2010.

[35] Frank Gens. Defining "Cloud Services" and "Cloud Computing". http://blogs.idc.com/ie/?p=190 accessed on 04.09.2011, September 2008.

[36] Chaitanya Gharpure and Vladimir Kulyukin. Robot-Assisted Shopping for the Blind: Issues in Spatial Cognition and Product Selection. *Intelligent Service Robotics*, 1:237–251, 2008.

[37] Jason Gilmore. Introducing the Google Maps JavaScript API V3. http://www.developer.com/services/article.php/3906451/Introducing-the-Google-Maps-JavaScript-API-V3.htm accessed on 03.09.2011, October 2010.

[38] P C Gioia. Quality improvement in pediatric well care with an electronic record. *Proceedings of the AMIA Symposium*, page 209, 2001.

[39] Hugo Haas and Allen Brown. Web Services Glossary. http://www.w3.org/TR/ws-gloss/ accessed on 01.09.2011, February 2004.

[40] Gregor Haeberle and Heinz Haeberle. *Transformatoren und elektrische Maschinen in Anlagen der Energietechnik*. Verlag Europa Lehrmittel Haan-Gruiten, second edition, 1990.

[41] James Hamilton. Cloud-Computing Economies of Scale. http://mvdirona.com/jrh/TalksAndPapers/JamesHamilton_SMDB2009.pdf accessed on 04.09.2011, March 2009.

[42] Michael Hart. Introducing the Netflix API. http://developer.netflix.com/blog/read/Introducing_the_Netflix_API accessed on 03.09.2011, September 2008.

[43] Jeffrey Hightower and Gaetano Borriello. Location systems for ubiquitous computing. *Computer*, 34(8):57 –66, August 2001.

[44] I-Ping Hsieh and Shang-Juh Kao. Managing the Co-existing Network of IPv6 and IPv4 under Various Transition Mechanisms. In *International Conference on Information Technology and Applications*, 2005.

[45] Geoff Huston. IPv4 Exhaustion Nears, July 2007.

[46] IBM. IBM Watson. http://www-03.ibm.com/innovation/us/watson/ accessed on 04.09.2011.

[47] Apple Inc. Apple TV. http://www.apple.com/appletv/ accessed on 05.09.2011.

[48] Apple Inc. iOS Human Interface Guidelines, 2010.

[49] Apple Inc. See new features included in iOS 5. http://www.apple.com/ios/ios5/features.html accessed on 01.09.2011, 2011.

[50] Cisco Systems Inc. Cisco Visual Networking Index: Forecast and Methodology, 2010-2015, June 2011.

[51] Cisco Systems Inc. Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010-2015. White Paper, February 2011.

[52] Ali Ipakchi and Farrokh Albuyeh. Grid of the future. *IEEE Power and Energy Magazine*, 7(2):52–62, 2009.

[53] iSuppli via Katie Marsal. Cost to build iPhone 3G S estimated at 179 Dollar. http://www.appleinsider.com/articles/09/06/24/cost_to_build_apples_new_iphone_3g_s_estimated_at_179.html accessed on 31.08.2011, June 2009.

[54] Robert J. K. Jacob, Audrey Girouard, Leanne M. Hirshfield, Michael S. Horn, Orit Shaer, Erin Treacy Solovey, and Jamie Zigelbaum. Reality-based interaction: unifying the new generation of interaction styles. In *CHI '07 extended abstracts on Human factors in computing systems*, pages 2465–2470, New York, NY, USA, 2007. ACM.

[55] L Kanishka and R Anand. *Battery-driven system design. A new frontier in low power design.* Proc. ASP-DAC, 2002.

[56] Miele & Cie. KG. Miele@Home - Con@ctivity - Kommunikation zwischen Dunstabzugshaube und Kochfeld. http://www.miele.de/de/haushalt/produkte/44669_44675.htm accessed on 05.09.2011.

[57] Anurag Kumar. Near Field Communication, October 2010.

[58] Michael Kuperberg, Nikolas Herbst, Joakim von Kistowski, and Ralf Reussner. Defining and Quantifying Elasticity of Resources in Cloud Computing and Scalable Platforms. *Karlsruhe Reports in Informatics*, 2011.

[59] Cambridge University Computer Laboratory. The Bat Ultrasonic Location System. http://www.cl.cam.ac.uk/research/dtg/attarchive/bat/ accessed on 04.09.2011, 2005.

[60] Hyowon Lee, Paul Ferguson, Cathal Gurrin, Alan F. Smeaton, Noel E. O'Connor, and Heeseon Park. Balancing the power of multimedia information retrieval and usability in designing interactive tv. In *Proceeding of the 1st international conference on Designing interactive user experiences for TV and video*, UXTV '08, pages 105–114, New York, NY, USA, 2008. ACM.

[61] Kalle Lyytinen and Youngjin Yoo. Issues and challenges in ubiquitous computing. *Communications of the ACM*, 45(12):62–65, 2002.

[62] Chronic Care Management. Virtualhealthcheck.com launches software-as-a-service (saas), telehealth solution designed to improve patient/physician communication and care. http://www.prweb.com/releases/prweb2011VirtualHealthCheck/03Press/prweb5119334.htm accessed on 24.09.2011, March 2011.

[63] Ian Mansfield. Shipments of Cell Phone Motion Sensors to Rise Fivefold by 2014. http://www.cellular-news.com/story/43168.php accessed on 05.09.2011, May 2010.

[64] Alexander Marinc, Carsten Stocklöw, Anreas Braun, Carsten Limberger, Cristian Hofmann, and Arjan Kuijper. *Interactive Personalization of Ambient Assisted Living Environments*, volume 6771 of *Lecture Notes in Computer Science*. Springer Berlin Heidelberg, Berlin, Heidelberg, 2011.

[65] Friedemann Mattern and Christian Flörkemeier. Vom internet der computer zum internet der dinge. *Informatik-Spektrum*, 33:107–121, 2010.

[66] Sibylle Meyer. AAL in der alternden Gesellschaft–Anforderungen, Akzeptanz und Perspektiven–Analyse und Planungshilfen, 2010.

[67] Nils J. Nilsson. *Introduction To Machine Learning*. Department of Computer Science, Stanford University, 2010.

[68] Anit Chakraborty Nissanka Priyantha and Hari Balakrishnan. The cricket location-support system. *ACM MobiCom*, 2000.

[69] Nintendo of Europe GmbH. Nintendo wii - technische details. http://www.nintendo.de/NOE/de_DE/systems/technische_details_1072.html accessed on 05.09.2011.

[70] Wharton School of the University of Pennsylvania. What's the Next Big Thing on the Web? It May Be a Small, Simple Thing – Microformats. http://knowledge.wharton.upenn.edu/article.cfm?articleid=1247 accessed on 03.09.2011, July 2005.

[71] Sixto Ortiz Jr. Is Near-Field Communication Close to Success? *Computer*, 39:18–20, March 2006.

[72] Ian Paul. IBM Watson Wins Jeopardy, Humans Rally Back. http://www.pcworld.com/article/219900/ibm_watson_wins_jeopardy_humans_rally_back.html accessed on 04.09.2011, February 2007.

[73] John Pavlus. Synthesizer 76 iPad App Shows Delights and Pitfalls of "Skeuomorphic" UI's. http://www.fastcodesign.com/1662909/synthesizer-76-ipad-app-shows-delights-and-pitfalls-of-skeuomorphic-uis accessed on 05.09.2011, December 2010.

[74] Kevin Pfaffner and Irene Maucher. Nutzergruppenorientierte Gestaltung von AAL-Systemen. *Ambient Assisted Living-AAL*, 2011.

[75] Agence France Presse. Steve Jobs unveils iCloud digital hub. http://www.hurriyetdailynews.com/n.php?n=steve-jobs-unveils-icloud-digital-hub-2011-06-07 accessed on 04.09.2011, June 2011.

[76] Jan Rabaey, Josie Ammer, Julio da Silva, Danny Patel, and Shad Roundy. PicoRadio supports ad hoc ultra-low power wireless networking. *Computer*, 33(7):42–48, 2000.

[77] Jagdish Rebello. Four Out of Five Cell Phones to Integrate GPS by End of 2011. http://www.isuppli.com/Mobile-and-Wireless-Communications/News/Pages/Four-out-of-Five-Cell-Phones-to-Integrate-GPS-by-End-of-2011.aspx accessed on 31.08.2011, July 2010.

[78] Veronica Falcao Roy Want, Andy Hopper and Jonathan Gibbons. The Active Badge Location System. *ACM Transactions on Information Systems (TOIS)*, 10:92–102, 1992.

[79] Enrico Rukzio, Albrecht Schmidt, and Heinrich Hussmann. Physical posters as gateways to context-aware services for mobile devices. In *Mobile Computing Systems and Applications. Sixth IEEE Workshop on Mobile Computing Systems and Applications*, pages 10–19, December 2004.

[80] Debashis Saha and Amitava Mukherjee. Pervasive computing: A paradigm for the 21st century. *COMPUTER*, 36(3):25–31, 2003.

[81] SAP. Microsoft, IBM, SAP To Discontinue UDDI Web Services Registry Effort. http://soa.sys-con.com/node/164624 accessed on 03.09.2011, December 2005.

[82] Andreas Schmid. Galileo/GPS Receiver with Improved Positioning Accuracy, February 2008.

[83] Orit Shaer and Robert J. K. Jacob. A specification paradigm for the design and implementation of tangible user interfaces. *ACM Trans. Comput.-Hum. Interact.*, 16:1–39, June 2009.

[84] Orit Shaer, Robert J. K. Jacob, Mark Green, and Kris Luyten. User interface description languages for next generation user interfaces. In *CHI '08 extended abstracts on Human factors in computing systems*, pages 3949–3952, New York, NY, USA, 2008. ACM.

[85] Sven Siorpaes, Gregor Broll, Massimo Paolucci, Enrico Rukzio, John Hamard, Matthias Wagner, Albrecht Schmidt, and Docomo Eurolabs. Mobile interaction with the internet of things. In *In Adjunct Proc. of Pervasive 2006 Late Breaking Results*, 2006.

[86] European Commission Information Society. Broadband coverage in europe: Survey 2010. http://ec.europa.eu/information_society/eeurope/i2010/docs/benchmarking/broadband_coverage_in_europe_2009_final_report.pdf accessed on 02.09.2011, December 2010.

[87] Victor Stango. The Economics of Standards Wars. *Review of Network Economics*, 3(1), March 2004.

[88] Lihua Tang. Wave energy harvesting for powering buoy-based sensors. In *3rd International Maritime-Port Technology and Development Conference*, pages 486–493, Singapore, April 2011.

[89] Bret Taylor. The world is your JavaScript-enabled oyster. http://googleblog.blogspot.com/2005/06/world-is-your-javascript-enabled_29.html accessed on 03.09.2011, June 2005.

[90] United States Mission to the European Union. U.S., EU Announce Final Design for GPS-Galileo Civil Signal. http://useu.usmission.gov/072607_galileo.html accessed on 30.08.2011, July 2007.

[91] BuiltWith Trends. Facebook Graph API Usage Trends. http://trends.builtwith.com/javascript/Facebook-Graph-API accessed on 03.09.2011.

[92] BuiltWith Trends. Google Font API Usage Trends. http://trends.builtwith.com/docinfo/Google-Font-API accessed on 03.09.2011.

[93] BuiltWith Trends. Google Maps Usage Trends. http://trends.builtwith.com/mapping/Google-Maps accessed on 03.09.2011.

[94] Navigation U.S. Government National Coordination Office for Space-Based Positioning and Timing. GPS Accuracy. http://www.gps.gov/systems/gps/performance/accuracy/histogram.png accessed on 02.09.2011, March 2011.

[95] Ger van den Broek. Policy paper on standardisation requirements for aal. http://www.aaliance.eu/public/documents/standardisation/policy-paper-on-standardisation-in-aal-february-2009 accessed on 05.09.2011, December 2009.

[96] Mark Weiser. The computer for the 21st century. *Scientific American*, pages 94–104, September 1991.

[97] Alex Williams. 4 API Trends Seen in Programmable Web's Milestone Numbers. http://www.readwriteweb.com/cloud/2011/03/programmable-web-apis-popping.php accessed on 03.09.2011, March 2011.

[98] WiTricity Corporation. http://www.witricity.com/index.html accessed on 04.09.2011.

[99] Anthony Lo Yanying Gu and Ignas Niemegeers. A survey of indoor positioning systems for wireless personal networks. *Communications Surveys Tutorials, IEEE*, 11(1):13 –32, quarter 2009.

[100] Da Zhang, Feng Xia, Zhuo Yang, Lin Yao, and Wenhong Zhao. Localization Technologies for Indoor Human Tracking. *arXiv.org*, cs.NI, March 2010. To appear in The 5th International Conference on Future Information Technology (FutureTech), May 2010, Busan, Korea.

[101] Q. M. Zhang, Hengfeng Li, Martin Poh, Feng Xia, Z.-Y. Cheng, Haisheng Xu, and Cheng Huang. An all-organic composite actuator material with a high dielectric constant. *Nature*, 419(6):284–287, September 2002.

Chapter 2

2 The AAL Ecosystem

Julia Aydin, Jonas Lehmann, Marcus Lehmann, Simon Pickert, Aleksandar Shterev and Runhua Xu

Executive Summary

Today's market for AAL products and services is at an early stage, with only few products available and clearly associated with the term "Ambient Assisted Living". By looking at the different customer needs, stakeholders and technological advancements, three different sub-segments can be distinguished: Health and Fitness, Social Interaction and Safety and Comfort.

The first segment, Health and Fitness, primarily deals with personal care and tele-medicine. It shows high margins and a steady growth rate with several big players having already entered the market - e.g. Intel and Google. However, legal restrictions, as well as lack of funding and acceptance have prevented AAL products and services in the health care sector from gaining popularity among end-users, doctors and health insurance companies.

Similarly to the AAL health care solutions, products that support social interaction aim at improving personal well-being. Devices and services in this segment often serve the need for entertainment and social inclusion. Investments are rather small and companies still limit their activities to research. Several projects funded by the European project AALIANCE have developed prototypes which provide the basis for marketable products and services.

The third segment, Safety and Comfort, mainly consists of home automation solutions. Despite the variety of existing products and services, acceptance among and thus adoption by customers remains on a low level. However, there

is an emerging demand for smart home solutions, attracting new market players to this AAL subfield.

2.1 Introduction

The goal of this section is to describe the ecosystem of AAL products and services. As a further development of the biological ecosystem the business ecosystem, a term coined by James Moore, is defined by organizations and individuals involved in a market and their interactions. This economic community produces goods or services of value to customers, who are themselves members of the ecosystem [154]. A business ecosystem is fundamentally represented by the five major stakeholders - the research community, interested industry parties, political and social organizations and the consumers themselves.

This section presents first the status quo of the AAL market by taking a closer look to the stakeholders, the major market players and the market segmentation and growth (section 2.2). Furthermore, value chains and business models are described. In order to give prospects for the future, possible trends will be presented afterwards (section 4.3). Finally possible market entrance barriers are pointed out (section 4.4).

2.2 Status Quo

To describe the AAL market, industrial and research stakeholders as well as product groups are reviewed in detail. Since the AAL market is still in the development phase, universities (21 percent) and non-university research institutions (16 percent) are major stakeholders. Furthermore, service providers are very important and hold the third biggest share with 13 percent. Due to legal aspects local and regional authorities (seven percent) are involved. The providers of products or services in the field of AAL and the hardware/software/device suppliers hold as well seven percent. The remaining 36 percent are split up between non govermental organisations, consultants, medical institutions, the goverment and others. An overview of the stakeholders is given in figure 2.1 ([122], p. 27).

Since the stakeholders have pushed the AAL market in different directions, several subsegments have evolved. This is reflected in the ratio of product groups as shown in figure 2.2. Most share is held by safety and security products with 26 percent, followed by communication devices (17 percent) and medical assistive technology (15 percent). Furthermore mobility (12 percent) and telemedicine (11 percent) play important roles ([122], p. 32).

According to the distributions, three major topics covering nearly the whole market can be identified: Medical assistive technology and tele-medicine are summarized in Health and Fitness. The subfield Social Interaction contains consumer electronics and communication devices. Furthermore safety and

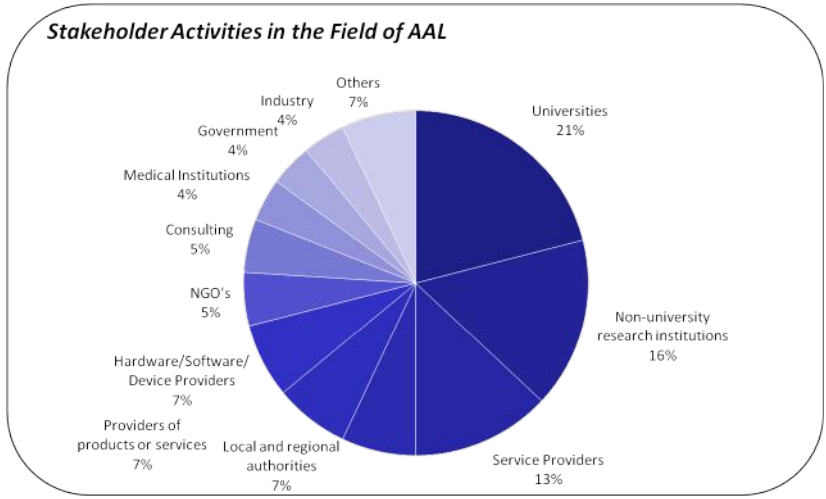

Figure 2.1: Stakeholder Activities in the Field of AAL
Source: Own illustration based on ([122], p. 27)

security, compensation of impairments and mobility are contained in Safety and Comfort.

2.2.1 Health and Fitness

> "Today's healthcare industry is reactive. It's inefficient. Preventive care is not as effective as it could be. That's because today's healthcare model is built around hospitals and clinicians waiting for sick people to come to them." [141]

Up to now Germany's health care market showed a steady growth to today's 11.6 percent of GDP and is expected to increase further in the future[157]. According to Roland Berger Strategy Consultans redundancy and inefficiency count for 25 to 40 percent of the costs in the health care sector ([166], p.8). Moreover health care systems missed to adapt to the changed requirements of today: Chronic diseases such as diabetes cause more than 60 percent of the deaths today ([166], p. 3). Modern health care consists of proactive and ambulant care. Chronic diseases can only be successfully therapied by proper long-term ambulant care. As a result an efficient exchange of patient data between health care professionals becomes indispensable.
Modern medical devices allow patients proactive and preventive care taking. The use of these devices unburdens the health care sector. The intersection of ICT and health care is called E-Health.

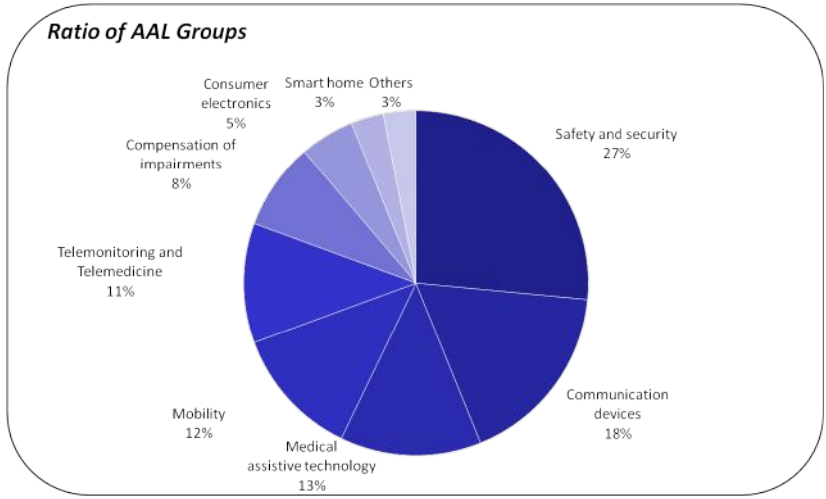

Figure 2.2: Ratio of AAL Product Groups
Source: Own illustration based on ([122], p.32)

2.2.1.1 Product Classification

AAL products are a major subsegment in the E-Health market. The present report covers all devices a patient can directly interact with, therefore clinical communication systems are not included. Figure 2.3 shows the distribution of AAL products by fields within the research topic "Health and Home Care". As shown in figure 2.4 two main categories can be distinguished:

Self Care Self care covers both preventive care at home or on the go and self care for chronically ill: Through medical devices the user receives information about his health. The user can be a sporty person who tries to get even fitter

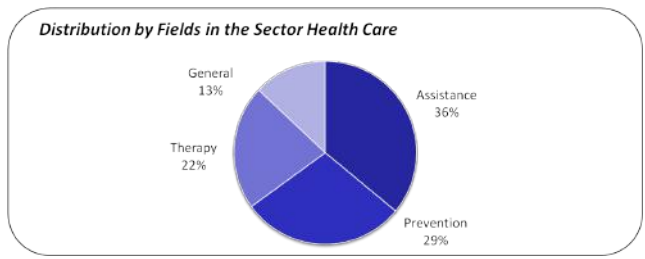

Figure 2.3: Distribution in the Sector Home and Healthcare
Source: Own illustration based on ([122], p.31)

Figure 2.4: Care Team and Self Care System
Source: [120]

and needs therefore some basic cardiographic data such as heart beat frequency, a smoker who wants to stop smoking and needs advice from the device or a diabetic who has to measure his blood sugar on a daily basis. The user is able to store his data on the device and therefore to see his personal progress over time.

Telemedicine Telemedicine describes a type of clinical health care that is done at distance. Devices in that field allow users to stay in contact with health care professionals who provide them care based on data measured by the user himself. Through the continuous transmission of vital data a more personalized care is enabled. Furthermore, if the patient shares his personal data a more precise diagnosis in case of emergency is possible through the larger available database.

2.2.1.2 Stakeholders

Today the E-Health market is influenced by five major stakeholders which will be shortly described in the following:

Health Care Device Providers They operate on the market to sell their products as profitable as possible. The Institute for Applied Telemedicine (IFAT) sells devices directly to end users suffering from heart trouble [143]. More products are described in section 2.2.1.3.

End User The end user is interested in improving his personal well-being. Health care device providers are until today mostly targeting consumers who are either chronically ill or fitness focused [126].

Health Care Professionals Health care professionals such as hospitals, physicians and home care takers are highly affected, because they are responsible for giving medical advice.

Health Insurances Since the expenses for medical treatments are mostly paid by health insurances, any improvement in terms of treatment quality or cost is of high interest to them. As discussed in 1.1, E-Health can contribute to an increase in the efficiency of the health care system.

Government As it sets the legal framework, the government is highly involved in the E-Health market. In addition, since government supports health insurances, both share the financial interest of lowering the costs.

2.2.1.3 Major Market Players

In the E-Health market specialized solutions are offered by large European-based companies that are world leaders in their field [124]. In addition an estimated 5,000 up to 6,000 small- and medium-sized enterprises, most of them with a computer engineering background, operate in various sub-sectors ([166], p. 7). The high level of specialization and heterogenity seems to support little and more agile players and meanwhile complicates a market entrance of big companies.
In 2008 Google started "Google Health", an online platform which enables patients to collect and store their personal health data, such as allergy profile or laboratory results. In addition, users can grant physicians access to their data in cases of emergencies. Since this service is mainly used by fitness oriented rather than ill persons it didn't unfold its full potential. As a consequence Google is going to shut down the servers in 2013 [135].
Another major player is Intel: The „Intel health guide" is a remote health management solution that enables patients to participate proactively in their own care by monitoring and learning about their health status. In addition clinicians were allowed to monitor patients and remotely manage their medication and enabling a more personalized care [110].
In summary, major ICT-players started to enter the E-Health market, which can be an evidence for the markets potential.

2.2.1.4 Market Share and Growth

The turnover of global medical devices was totaled $ 290 B in 2009 ([126], p.1). A distinction is made between the primary and the secondary health market.

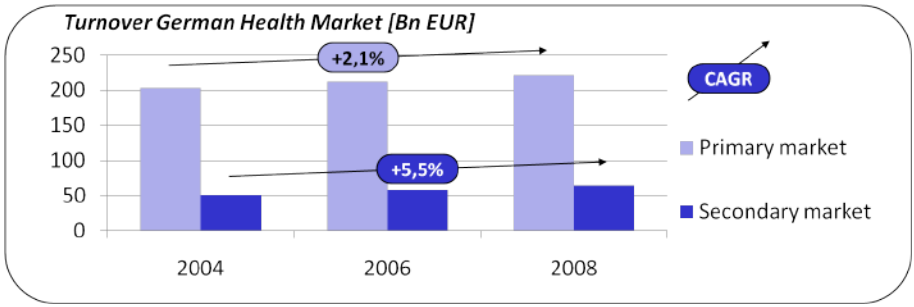

Figure 2.5: Turnover German Health Market 2004 - 2008
Source: Own illustration based on ([122], p.32)

The former is dealing with health in the classic way including hospital visits or doctor appointments. In Germany is the first segment financed by private or public health insurances and taxes only. The second segment consists of fitness and wellness products or the consumption of healthy food. It is financed only by customers themselves. As visualized in figure 2.5 both segments have shown lucrative growth rates in the past. The E-Health market is part of both, primary and secondary health market. According to a study of Roland Berger Strategy Consultants the E-Health market (including clinical communication systems) had a turnover of € 21.0 B in 2006 and € 24.6 B in 2010. This corresponds to a compound anual growth rate of four percent during this period. The forecast is € 37.6 B in 2014 and therefore a compound anual growth rate of eleven percent ([166], p. 6).

2.2.1.5 Value Chain and Business Models

Today there is no uniform business model. Due to that there is a variety of value chains: Depending on the price and functionality, products can be either sold or lent to end-users, health insurances, health care professionals or hospitals.

2.2.2 Social Interaction

This section discusses the current market situation of products and services in the subfield of AAL that support social interactions of human beings. First, a general framework for the fields of application of products is provided in order to understand which customer needs the market currently has to address. Afterwards, product categories and the respective major players are introduced. Following this bottom-up approach, the section ends with the description of the market stage. The structure applied to this section differs from the ones of the sections Health and Fitness and Safety and Comfort, due to the lack of

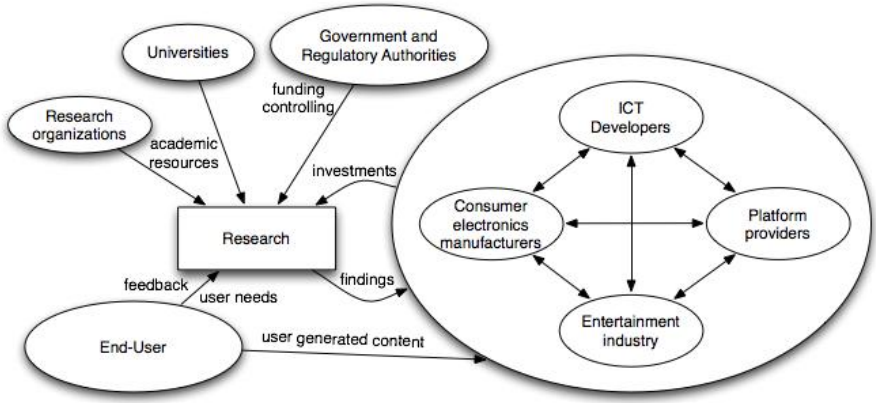

Figure 2.6: Stakeholders overview for the social interaction market segment
Source: Own illustration

reliable market data for this specific subfield of AAL.

2.2.2.1 Stakeholders

The main stakeholders of the AAL subfield social interaction are private organizations, among the ICT and Entertainment industry and the end-user. Research plays a minor role in this market segment of AAL, as end-user needs in the fields of social interaction and entertainment have not changed significantly since years. Generally speaking, innovations rather evolve from a companies own efforts than from research organizations.

2.2.2.2 Fields of Application

Social interactions are a main desire of human beings and can therefore be considered to have an important impact on the quality of life ([109], p. 31). A lack of social relationships or a low involvement in community life can lead to loneliness and isolation, often resulting in poor health, socio-economic disadvantages or even suicide ([158], p. 5). In the context of AAL the topic "Social Interaction" covers all kinds of products and services in the field of ICT which enable people to improve their well-being in their preferred living environment by realizing demands resulting from their social context. As illustrated in figure 2.7, social interactions take place in various situations, each involving a different set of actors, e.g. family, friends, neighbours or society .

However, there are personal deficiencies that prevent people from establishing and maintaining social relationships in the desired way, which AAL products

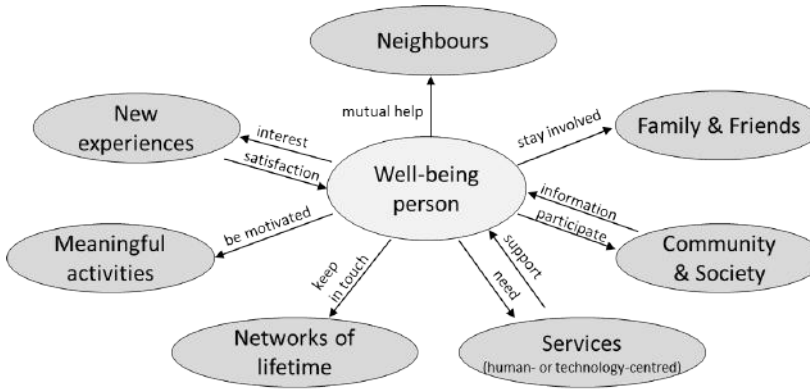

Figure 2.7: The social interaction context of the elderly
Source: Own illustration based on [158] (p. 6)

try to overcome. Especially older people face difficulties in maintaining social interactions due to age-specific losses of competencies, like physical and mental disabilities or increasing risk aversion and reticence ([131], p. 17). This loss can have serious impact on an elderly person's mental and physical health, as social relationships are the principal contributing factor to their well-being ([130], p. 679).

2.2.2.3 Existing Products and Services

Ambiently intelligent products, aiming for the support of social interactions, can be separated into two groups: The first group consists of products and services that focus on means of communication, enabling people to exchange thoughts and feelings with other human beings and thus to express and develop their personality. The second group (called "Entertainment") stimulates and enables the participation in cognitive exercises and physical activities, such as personal hobbies, which can be considered as „means of social interaction" ([109, 131]).

The current portfolio of products and services targeting the people of 50 years and above is rather small as the AAL market in Germany and Europe is quite young. In contrast, the Japanese market, facing a comparatively high average age of 48.6 years in 2020 ([113], p. 9), is further developed, as the Japenese industry has been occupying a leading position in the field of robotics and automation since the 1970s [168]. Consequently, most of the products currently available on the market are developed in Japan.

Exemplary products and services in the category Communication			
Product or service description	**Product and service example**	**Company**	**Source**
-A homepage for information about health, living in old ages, financing, with a strong regional focus recipe recommendation forum/platform	-Information providing homepage	-mediaprint infoverlag gmbh	www.sen-info.de
-Computer and video games -Board games for the generation 50+ -Foster the users health status through mental and physical exercises -Strengthen social relations.	-Silver Games	-Game engineers	http://www.game-engineers.com/
-Independent and free of charge consultation about assistance technology, education, cognitive training and therapy software, communication assisting devices - Online shop for computer aided communication	-Online shop and homepage	- LifeTool gemeinnützige GmbH	http://www.lifetool.at/
-Senior cell phone -Extra large keyboard -Easy menu -Connection to hearing aid	-Emporia Elegance	-Emporia	http://www.emporia.at/
Exemplary products and services in the category social entertainment			
-Cognitive training game on Nintendo Ds and PCs	-Dr. Kawashima	-Nintendo	www.nintendo.de
-Physical and social interactive gaming console with internet access	-Wii	-Nintendo	www.nintendo.de
-Therapeutic robot toy for old people -It allows the documented benefits of animal therapy to be administered to patients in environments such as hospitals and extended care facilities where live animals present treatment or logistical difficulties	-Paro	-AIST, PARO Robots U.S., Inc.	www.parorobots.com
-Consulting for concepts and programs for the market entrance of AAL products -Project management, communications and marketing	-Consulting specialised on products and services of the AAL	-AAL communications	http://aal-communications.de/

Table 2.1: Exemplary products and services
Source: Own illustration

2.2.2.4 Major Market Players

From the exemplary list of products and services (table 2.1) it is possible to deduce the current market players. Generally speaking these are software developers, hardware manufacturers, component suppliers of consumer electronics, large consumer electronics affiliated groups as well as small and medium sized companies, specializing in retailing or consulting.

2.2.2.5 Market Stage

From an industry perspective the market for AAL products in the subfield of social interaction can be described as "embryonic" ([140], p. 142), due to the low number of available products. Additionally, demand is currently at a low level, as the products are poorly promoted and thus not yet experiencing high publicity. This also points to the embryonic stage of the industry. In order to reach the next industry stage ("Growth") significant investments are needed. As soon as the industry's products are widely accepted, new market entrants will cause competition to rise. As soon as the number of exits exceeds the number of entries, the "Shakeout" stage will be reached. Finally growth slows down ("Mature") or even turns negative ("Decline") ([140], p. 143) .

With regards to the concept of the technology adoption curve of Rogers ([163], p. 150), it seems reasonable to consider this AAL market segment at the stage of innovators, meaning that only up to 2.5% of the total customer base have already adopted technologies in the AAL subfield "social interaction" (figure 2.9).

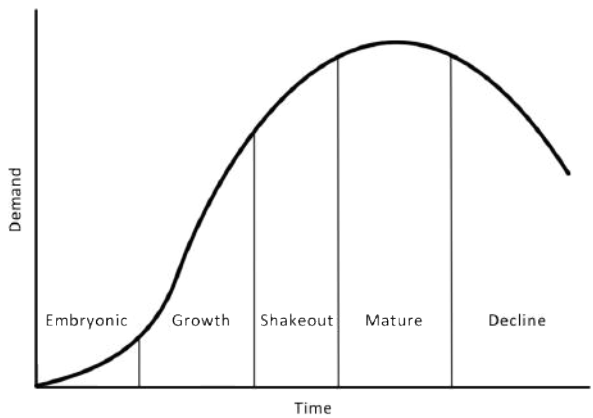

Figure 2.8: Industry lifecycle
Source: Own illustration based on [140], p. 142

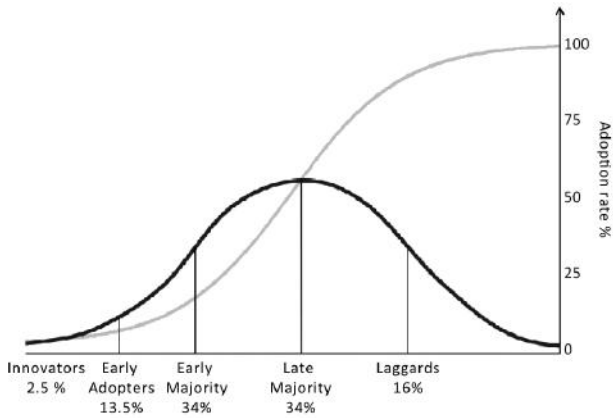

Figure 2.9: Technology adaption curve
Source: [163], p. 150

Applying the main characteristics of embryonic industries as described by Hill and Jones ([140], p. 143) onto the AAL segment Social Interaction, this segment of AAL can be described as slowly growing, inefficient in cost structures and poorly developed in terms of distribution channels. Rivalry among the major active players, i.e. Nintendo, Paro Robots U.S. and Game Engineers, is rather based on designing products, educating customers and developing successful distribution channels than on price.
Although there are already some products avaible, it is safe to say, that the majority of players has not yet moved into the market. Analyzing the members of the EU funded Coordination Action AALIANCE - The European Ambient Assisted Living Innovation Alliance also shows, that the dominant market players of consumer electronics and ICT still focus on research activities [158], p. 3).

Another very important segment is the global market for sensors in consumer electronics. Amongst all segments, image sensors command the largest share in terms of value. Communication forms the largest application market due to the high demand for mobile phones and PDAs across the globe; while entertainment applications are expected to have the highest CAGR of 16.5% from 2010 to 2015 [151].

2.2.3 Safety and Comfort

The main purpose of AAL products and services is to support people in their everyday life activities. A major part of these is aimed at enhancing comfort and productivity as well as personal safety. This section discusses the current

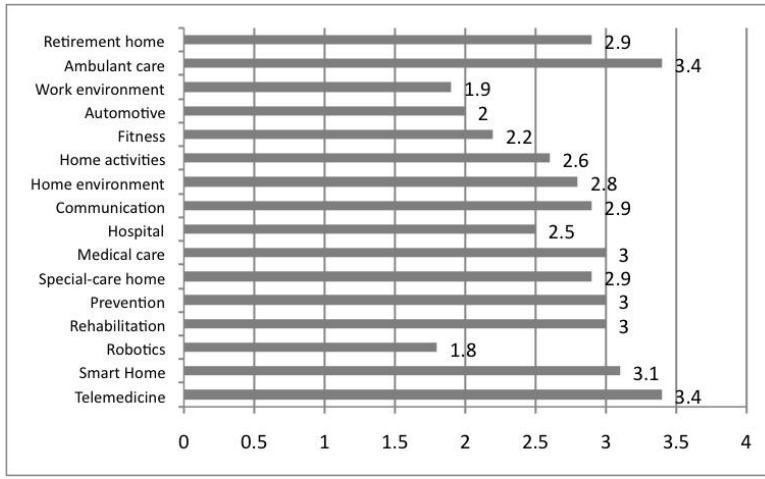

Figure 2.10: Most important application fields of AAL products and components
Source: Own illustration based on [132]

situation in this AAL subfield by giving a brief overview of the market in terms of growth, segment specific stakeholders and market representatives. Finally, a summary of the current status of the value chains and business models is presented.

2.2.3.1 Overview

Even though the market for safety and comfort is very broad, most application areas regarding comfort amenities are concentrated around indoor activities, primarily at home (Fig. 2.10), and the majority of safety products are targeted at improving the mobility of people with disabilities and at the automotive industry.

Domotics The domotics sector is a collective term for businesses targeted at providing home automation services and developing the so called "Smart homes" - resident facilities which are augmented with a wide range of digital technology products in order to enhance the everyday life of the individual - examples include alternative interfaces for remote controlling household applicances, safety sensors for preventing home accidents and others.

Mobility This market segment encompasses products and services aimed at supporting people with walking disabilities as well as at the safety aspects of the automotive industry.

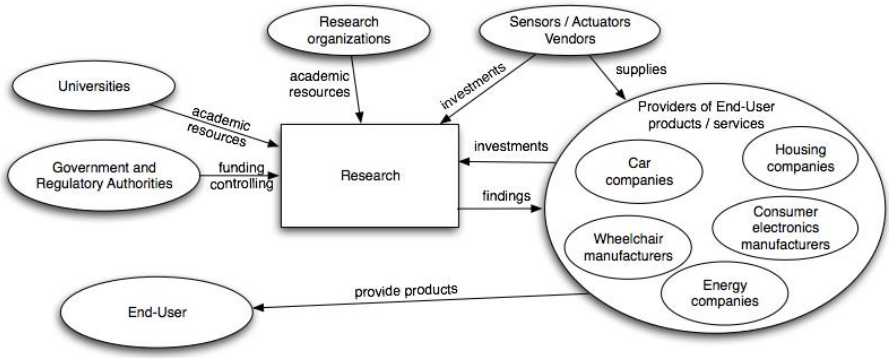

Figure 2.11: Stakeholders and their relationships in the field of Safety and Comfort

Source: Own illustration

2.2.3.2 Stakeholders

As discussed in the general stakeholders section, there are a number of stakeholders in the AAL market (section 1.2). The safety and comfort segment is the most demanding one with regard to the required research innovations, as seen on Fig 2.11. The diagram also depicts the different stakeholders and presents the relationship between them which will be discussed in the following paragraphs.

Research institutions Institutions such as universities and independent applied sciences organizations play a major role in the research part of the product lifecycle. Fig 2.12 show a separation of the research into three different aspects, as it is proposed by H. Kopetz[165, 148]). The three different stages - basic (BR), technology (TR) and product research (PR) show the gradual transition from experimental work through innovation up to commercial exploitation and new products.

Sensors and Actuators Vendors AAL solutions employ by their nature a great number of devices to monitor and interact with their environment. Hardware and software vendors responsible for the production of such devices are significantly influenced by any change in the AAL market for safety and comfort and therefore considered as a stakeholder.

Providers of End-User Services and Products This group of stakeholders contains all parties which are directly connected to the end-user. These include,

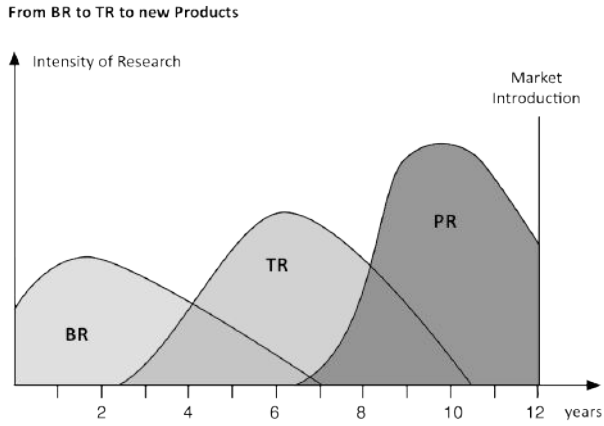

Figure 2.12: Research stages
Source: Own illustration based on [165]

but are not limited to, manufacturers of consumer electronics, communication providers, housing companies, energy companies and others.

Governmental and Regulatory Authorities In response to the demographic change, which will be discussed in detail in section 3 of this report, many governments offer funding programs to support the research of indoor AAL solutions for the elderly and for people with disabilities. There are also initiatives by the Europe Union (EU) to encourage the development of this sector.

Customers Consumers are a natural stakeholder in this market but they will be the focus of section 3 of this report.

2.2.3.3 Market Growth and Major Market Representatives

The market for Safety and Comfort products shows a high potential for growth in the next 5 years. With the main focus aimed at smart home solutions and household appliances, according to the "Global Smart Homes Market" from Electronic.ca Research Network, the market is expected to grow from $5,325 million in 2010 to $11,000 million in 2015, at an estimated Compound Annual Growth Rate (CAGR) of 15.6% from 2010 to 2015. The security application accounted for almost 26.5% of the total smart homes market in 2008 and is expected to grow at a CAGR of 13.4% from 2010 to 2015. The market for energy management is expected to grow at the fastest rate with a CAGR of 23.7% from 2010 to 2015[155].

Similarly, according to MarketsandMarkets, the European smart homes market is estimated to grow from $1,544.3 million in 2010 to $3,267 million in 2015, at an estimated CAGR of 16.2% from 2010 to 2015. Among all the smart homes applications, security market generated the highest revenue of $380.5 million in 2010 and is expected to reach $741.6 million in 2015, with a CAGR of 14.3% from 2010 to 2015. The *entertainment* and energy management market is expected to grow with a relatively high CAGR of 19.6% and 21.4% respectively from 2010 to 2015. At present, Northern Europe dominates the European smart home market; followed by Southern Europe the second largest market for smart home. These two, together, accounted for 55.5% of the total European smart home revenues in 2010. Central Europe and Western Europe are the fastest growing regions and this trend is expected to continue in the forecasted period as well[152].

Other strong segments in the Safety and Comfort market include alternative human-machine interaction technologies, mobility assistance, rehabilitation robotics and automotive safety [136]. An emerging market in this sector is the production of assistive and rehabilitation robotics. A great example is the intelligent wheelchair robots [150] - an innovation which is currently developed on a global level - NavChair (University of Michigan), Wheelesley (MIT), TinMan (KISS Institute of Practical Robotics), TAO (Applied Artificial Intelligence, Inc.), Robot wheelchair (Panasonic Boston Laboratory) and many others. Currently, there is a small number of market players in the field of robotic rehabilitation which are operating on an international level, such as the global companies Hocoma Switzerland and Interactive Motion Technologies USA. Furthermore, there is a great interest in assistive robotics and bionics as shown, for instance, by the success of Tibion Bionic Technologies, which received approximately $ 3M of venture capital in every of the funding rounds[162].

2.2.3.4 Value Chain and Business Models

Due to the importance of interaction and corporation between a lot of companies from different industries in the smart home market, the business model and value chain are quite different from other markets. In fact, the value chain is moving towards a value network.([123], p. 49) As agreed by many companies at Smart Homes 2010, a collaborative approach would be the future road[104]. For example, QEES, a global supplier of smart home solutions for homes, offices, hotels and schools, describes its business model as collaborative and interoperable. It believes that the smart home mass market can only triggered through collaboration with targeted and ambitious partners in the value chain, and such partnerships can only be developed through an open interoperable value proposition. Since there is no demand from the average end-user for smart home solutions today, the value chain needs to push a solution to the end-user in the short term. Once the fundamental smart home infrastructure platform is

deployed, a whole new and affordable value can be created for the end-users, because they will become mature and seek add-on application, products and services. This will lead to the second market stage[160].

2.3 Trends

The following section provides insights into the possible future development of the three segments - Health and Fitness, Social Interaction and Safety and Comfort.

2.3.1 Health and Fitness

It is important to figure out in which direction the health care market will develop and which health care submarkets will grow. This will answer the question whether existing or new market players will benefit from this changing situation and gain power or which will drop behind. For this purpose the following sections will shortly describe trends of the healthcare market in the context of AAL.

2.3.1.1 Shift from Stationary to Home Patient-Centered Care

Up to now the primary health care market has been experiencing a shift from stationary patient-centered care to ambulant or home care. From transformation both insurance companies and end users can benefit. The former can be disburdened as some highly-expensive stationary stays can be replaced by cheaper ambulant stays. On the other hand chronical ill can stay in their preferred familiar surrounding which can improve their healing process significantly. Linde AG developed a prototype, REMEO (Lat: I go home), which specializes in the care of long-term ventilated patients. Usually they would not be stable enough to leave ambulant care but REMEO enables them to stay at home already. Thereby it closes the gap between the usual intensive care in hospitals and the patient-centered care at home[137]. This concept fits to the upcoming trend as it manages to develop a new "ambulantized" value chain as an alternative to the stationary patient care. The traditional value chain will then just operate as the backslide solution if stationary care becomes indispensible[167].

Impact on AAL The trend for ambulant care leads to rising demand for AAL devices. The main goal of these products is to avoid the need for stationary care as long as possible while focusing on the strengths and improvements of the "own home environment".

A forecasted 19 percent compound annual growth rate as shown in Figure 2.13 illustrates the importance of telemedicine services [153]. As users of telemedical devices want to experience a complete medical care, interconnected and

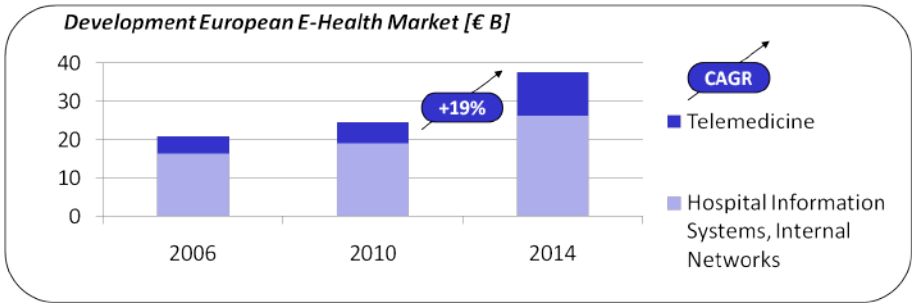

Figure 2.13: Development of European E-Health Market
Source: Own illustration base on [166]

intelligent health monitoring solutions are required. Digital health monitoring will become an accepted practice and will operate as an ideal starting point for further AAL products ([118], p. 14).

2.3.1.2 "Health-Style" Attitude Boosts Secondary Health Care Market

Up to now the market focuses mainly on the two discussed target groups: The fitness focused and the chronical ill. Besides these two, there is another group named information seekers who are neither chronically ill nor fitness focused. This group consists e.g. of smokers trying to quite or pregnant women live health-consciously (see figure 2.14). They are looking for solutions to obtain information in order to gain greater control over their physical condition. This new group of information seekers is looking for opportunities to exchange experiences. AAL devices are used for measurements and interpretation of vital data.

Impact on AAL AAL devices have to consider this new target group's set of needs. In order to enable this potential customer group to satisfy their needs, affordable devices are prerequisite. Therefore AAL devices in this more unregulated second health care market will operate as profitable go-to-market products for potential new market players. However, as market entrance barriers are low, new players will be attracted. As a consequence, market size and competition will increase [166]. Furthermore, companies are faced with sophisticated consumers and therefore have to compete more actively ([118], p. 14).

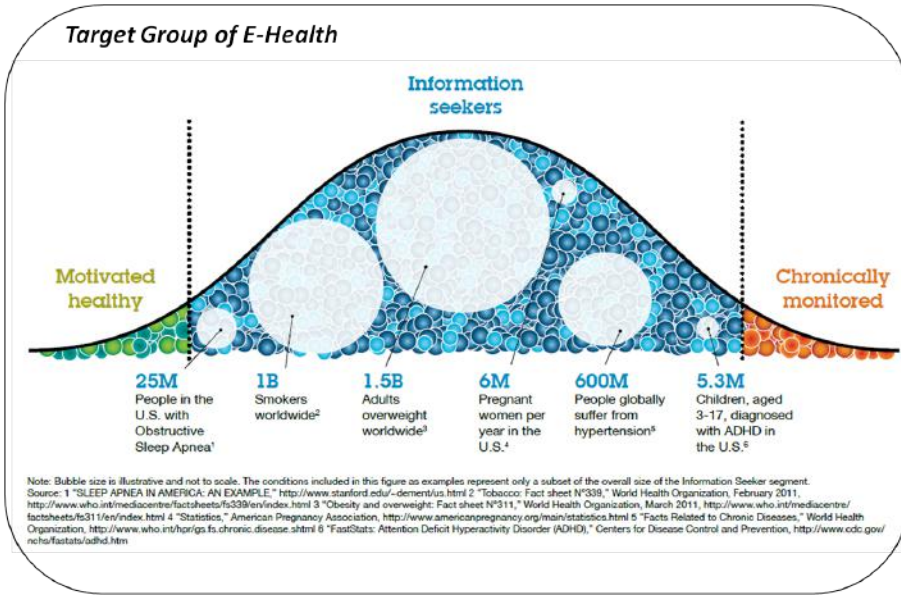

Figure 2.14: Target Group of E-Health
Source: ([126], p. 4)

2.3.1.3 Shift to Integrated Products

The development of an applicable end-user product requires the collaboration of different specialized industry sectors: e.g. the development of a T-Shirt with sensors measuring the patients' vitals requires the cooperation of the textile industry, the health care sector, the producer of the sensors and the software developer.

Impact on AAL The value add is not only caused by having an outstanding product, it is also dependend on a smooth interface-management. Only market players who follow this trend of widespread connectivity will have the chance to participate in this emerging market [167].

2.3.1.4 Increasing Concentration of Health Insurance Companies

As devices will be bought by health insurances and be leased to patients, suppliers of AAL products are to some extent dependent on insurances. As illustrated in figure 2.15 the number of insurances is decreasing and only 50 companies from today's 169 are expected to remain in 2015 ([169], p.1; ,[134] p.1)

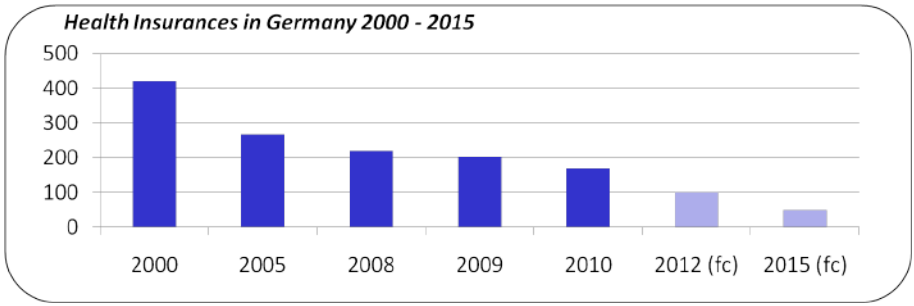

Figure 2.15: Amount of Health Insurances between 2005 - 2015
Source: ([134], p.1)

Impact on AAL This development leads to diverse advantages. This strengthened market position enables health insurances to set broader standards in the health care sector. Besides AAL product providers will also benefit from the centralization since they don't have to customize their products that often.

2.3.2 Social Interaction

The following section discusses trends in the field of communication and entertainment in the AAL market. Besides the general explaination of the trend, their impact on AAL is described.

2.3.2.1 Combination of Exercising and Entertainment

As described in the status quo (section 2.2.2), there is a connection between physical health and a person's social relationships. In view of increasing health care costs, there is a trend towards preventing illnesses and treatments by enriching the social life through ICT-based systems ([109], p. 38). In this context, combining entertainment and exercising gains importance as it aims for the sustainable change of health-related behaviour patterns through adressing a person's intrinsic motivation [109](p. 37).

Impact on AAL Products and services that simultaneously promote health and entertain are considered to play an important role for the future AAL market. In an online survey of the BMBF, about the topic 'Future Assisted Care' 326 participants from leading positions in the ICT and health care sector, ranked the importance of "Social Networks and Communication" on the second place among all services. Overall, 40% of the survey participants consider the topic as "very relevant". In comparison, "Serious Games" and "Emotional Robotics" are ranked at the very end of the list of services - only 5%, respectively 3% consider

them as "very relevant" ([129], p.11). Future AAL product development in this field will therefore require interdisciplinary teams. Furthermore, the boundaries between medical and entertaining devices will blurr.

2.3.2.2 Customer Tailored Products

Regarding the placement, pricing and promotion of new products and services, there is a growing trend towards differentiation ([109], p. 5). Companies tailor their products (as well as their marketing campaigns) to a customer's individual needs, while the product's core technology remains the same. A common example are cell phones that are specially designed for elderly people (e.g. Samsung C3060).

Impact on AAL As AAL products aim for the improvement of a person's quality of life, they have to be adaptable to specific characteristics of the person and their environment ([109], p. 10). One possible solution is a modular design of AAL products, allowing people to create their customized AAL system. Following this argument, it can also be expected that the market will be splitted into different price segments, as modularity allows customers to choose from different suppliers which in turn will try to differentiate themselves either by price or by quality.
AAL products and services are strongly pushed through project funds by the government of the European Union (EU) and the Federal Republic of Germany and mainly focus on the target group of customers in the age of 50 and above. There are 53 projects for AAL products and services funded from the AALIANCE, where about one half of the projects focuses on the health care market and the other half on social interaction [159]. These projects help to develop initial products and services, gain field test experience and customer feedback and are a base for future market activities. The core products and services primarily developed for the elderly market can also be offered to a different customer group by using customer group specific packaging and appropriate marketing strategies ([156], p.70).

2.3.2.3 Growing User-connectivity and Importance of Social Platforms

The size and profitability of a market is highly dependent on the customer acceptance. As shown above, technology supported H2H interaction will play a major role among the AAL products but the customer acceptance of these services is not yet ensured. Online social networking platforms are gaining global popularity mostly among young users. These platforms are mainly free of charge for the user. The most prominent example is Facebook, which is currently on the second place of the global alexa page ranking and has worldwide more than 750 million active users still with growth tendency [142, 102].

Impact on AAL Out of the portfolio of projects funded by the EU a trend towards social platforms in the AAL subfield "Social Interaction" can be identified [159]. Therefore, the development of suitable business models for free of charge platforms will become an important topic for AAL social platform market players.

2.3.2.4 Overlapping Value Chains

In mature industries a clear role allocation among the market players can be observed. Every player overtakes a specific part of the value chain. At the very end of every value chain the final product or service can be found, positioned on the market. However, the different value chains and activities of different industries become interconnected and tend to overlap regarding AAL products and services. The active industry players are acting in two different ways.

On the one hand, they start to overtake value steps which are not part of their core value chain. Vodafone for example, a major player in the telecommunication industry, offers Vodafone TV since February 2011. This entertainment product is typically not part of a telecommunication service provider's product portfolio [164].
Figure 2.16 illustrates this circumstance. The value chains of the telecommunication, the information technology, the entertainment and the consumer electronics are sorted parallel to each other. Steps in the value chain are symbolized by a bubble. The arrows link the different players to a step in the different value chains. For example Vodafone acts in the value chain of telecommunication as a hardware provider for infrastructure components, overtakes the role for marketing and billing and operates as a telecommunication network provider.

On the other hand, there is a trend to build a consortium for one specific product. So players from different value chains contribute a value step in which they are experienced and create together a complex product. A current example is the product "Google TV", a smart TV platform which is co-developed by Google, providing the administration, coordination as well as online and entertainment content and video telecommunication services. Also part of this cooperation are Intel and Logitech providing hardware components and Sony, which assembled the TV device "Sony Internet TV" [103]. Entertainment companies like Netflix provide further entertainment content.

Impact on AAL As the AAL industry is in the embryonic stage, no mature value chains can be figured out. Instead, companies specialize in single value chain activities and are therefore dependent on the cooperation with other companies. One attempt of creating partnerships among the companies can already be observed: The main research activities for AAL solutions are administrated by the Coordination Action AALIANCE and a consortium of industry partners like for example VDI/VDE Innovation + Technik GmbH, the

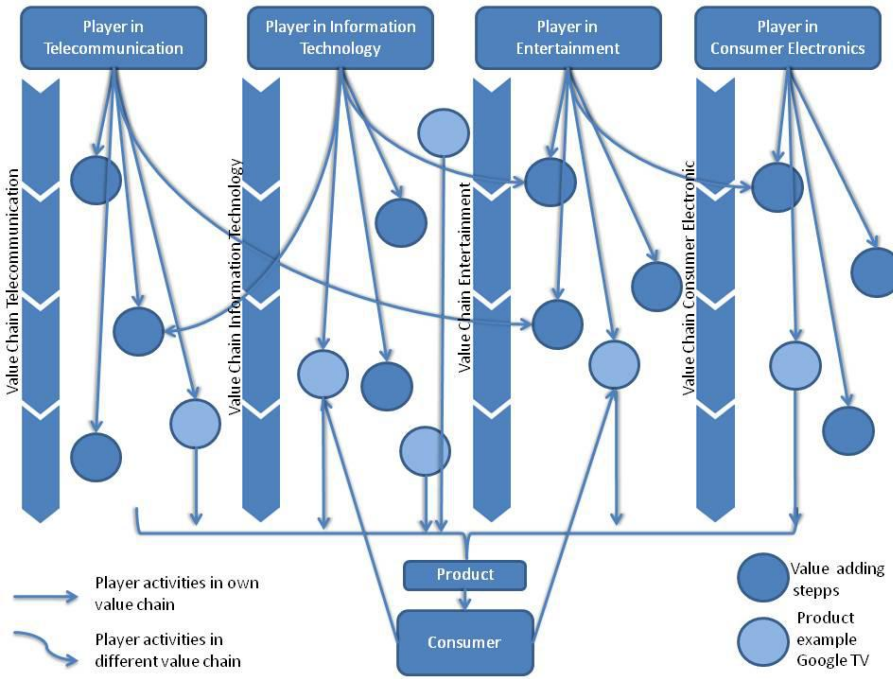

Figure 2.16: Value chain connections between major AAL companies
Source: Own illustration

AGE – the European Older People's Platform, Bosch GmbH, Deutsche Telekom Laboratories, Fraunhofer-Gesellschaft, Fundación Vodafone España, Institute for Microelectronics and Microsystems – CNR and Philips Electronics.
Furthermore this overlapping of industries creates new opportunities for start-ups, as well as for small and medium sized companies to position themselves within a niche and performing specific steps of the value chain [105, 149]. As the overlapping of industries leads to a higher number of potential rivals, competition within the different markets may increase. AAL markets will thus remain dynamic and innovative.

2.3.2.5 User Generated Content Becomes a Key Success Factor

One of the main characteristics of Web 2.0 is User-Generated Content (UGC) ([119], p. 242): Users do not only consume information but begin to create content. As social platforms gain popularity (subsec. 2.3.2.3), UGC becomes a valuable resource for companies.

Impact on AAL Business models that rely on UGC have to carefully consider the management of a company's relationship to its consumer (and thus its suppliers of content). The project "Senior channel" can serve as an example for UGC in the field of AAL. "Senior Channel" is an interactive internet protocol television channel encouraging users to participate in topical debates, entertainment services, workshops and discussion groups. Additionally, a low cost TV studio for the user is planned to create community driven broadcasts, so is a user generated content ([139], pp. 137 f). Maintaining a high level of participation among users can be considered to be a critical factor for the success of "Senior Channel".

2.3.3 Safety and Comfort

Based on active research projects and contemporary market status, it is possible to forecast upcoming product and market trends. The following sections discusses the trends in the AAL subfield of safety and comfort.

2.3.3.1 The Elderly Become Main Target Group

In view of the current demographic situation, the initiatives and support programs by political and non-political organizations in Europe ([111], [109]) it can be concluded that the elderly will be one of the main target group in terms of future research and product development in the subfield Safety and Comfort [136].

The market of assistive technologies particularly appeals to the eldery population. Most of the innovations on the smart home market are already covering the topics of automation and/or digitalizing existing products and services

as well as the introduction of alternative interaction models, such as voice or gesture based control. Companies targeting the facilitation and improvement of the lifestyle of elderly are therefore expected to gain larger shares in the AAL market.

2.3.3.2 Introduction of Larger Collaboration Models for Research and Funding

As previously stated, the subfield Safety and Comfort primarily promotes integrated solutions. One common factor for all successful innovation models is the collaboration between the involved stakeholders. These include cooperations between academia, research institutions and the industry, but also partnerships between various industry players [165]. Emerging collaboration models, such as the Initiative for Open Innovation [127] and the Generic Embedded System Platform (GENESYS) [144], designed at leveraging shared intellectual property and funding new research projects, suggest that the development in this sector will take place on a more global level.

Impact on AAL Open development platforms and shared resources can become one of the main drivers for the evolution of the AAL market. In the subfield Safety and Comfort, which relies strongly on research and innovation, this factor will play a major role in the forthcoming years. Furthermore establishing common frameworks and cooperations between industry representatives will greatly contribute to the quality and interoperability of AAL products.

2.3.3.3 More Convenient E-Commerce Model Based on Smart Devices

Currently, online shopping is accepted widely by people all over the world. It provides customers not only an easier and more convenient way to get goods, but also at lower prices. For companies, online shopping also reduces the cost for setting up physical stores. Nevertheless, this business mode is still not accepted by some elderly consumers. In June 2011, Tesco Home Plus opened a virtual grocery store in a South Korea subway station plastered subway stations with replicas of groceries that are labeled with a unique code for each product. As they pass by on their way to work, commuters can use a mobile-phone application to snap photos of desired products, then check out. Groceries are then delivered to their doorstep by the end of the work day. Home Plus reported a 130 percent increase in online sales [138].

Impact on AAL Similarly to the computer based online shopping, mobile shopping is emerging as a new E-commerce trend. Moreover, scanning a product on a leaflet and pressing a button on a smartphone is much easier than starting a computer and connecting to Internet, especially for old people and children.

The hardware platform and software applications are also easy to be integrated into other smart devices. Therefore, this more convenient E-commerce model will become more popular in the near future.

2.4 Barriers

While trends point out possible development paths, the barriers introduced in this section refer to obstacles that need to be overcome in order to enable the AAL market to grow. To some extent, the trends themselves rely on breaking market barriers. As seen in section 1.2 a high number of different stakeholders is active in the AAL market. Thus, the barriers described in this section are adressing different sets of stakeholders, leading to the need to distinguishe between general and segment-specific barriers. While the former are relevant for almost every market player, the latter mainly apply to the stakeholders of the respective AAL subfield.

2.4.1 General AAL Market Barriers

The barriers discussed in this section prevent companies from penetrating the market, as well as they hinder the market itself from growing. In order to distinguish this barriers from those discussed in the consumer and technology section, this section's market barriers will exist, even if customer requirements meet a product's technological design.

2.4.1.1 Lack of Visible Value Chains

The majority of market players still limits its activities to the R&D sector, leading to a lack of available products and business models ([109], p. 8). Knowledge about customer acceptance and preferences is still lacking. As there are currently no major first-movers, whose market performance could provide potential new market players with valuable information about working business models, high uncertaintity and therefore high entry barriers remain.

2.4.1.2 Heterogenous Target Groups

Customers differ significantly in their needs, purchasing power, educational and cultural background. Especially the target group of seniors (age 55+) is highly heterogenous ([121], p. 15). However, there is very limited knowledge about target groups ([109], p. 9), which leads to difficulties in tailoring AAL products, services and marketing campaigns.

2.4.1.3 Skilled Workforce Shortage

In order to develop innovative products in a high-technology sector like AAL, specialized and educated workforce is needed ([109], p. 9). Even without considering the emerging AAL market, Germany lacked a total of 76,400 engineers ([125], p. 10) in 2011. Regarding the ICT sector, 28,000 jobs could not be staffed in 2010. ([117], p. 1). To overcome this obstacle, costly trainings and qualifications will be needed.

2.4.1.4 Lack of Reimbursement of AAL Products and Services

Despite the fact that AAL products are designed to increase the well-being of a person and even to support the healing process, they are not yet acknowledged as reimbursable treatments by insurance companies, nor does the public sector provide incentives to install AAL devices at home ([109], p. 9). As long as affordability among customers remains on low level, high prices will slow down the deployment of AAL.

2.4.1.5 Separated Businesses

One of the greatest barriers is the lack of business models that stimulate cooperation between ICT developers, service providers, medical device manufacturer and housing industry ([168] S.142). As companies work the market separatedly, knowledge transfer and cost-sharing cannot take place. The inability to establish the necessary partnership relationships results in high entry barriers and growth barriers.

2.4.1.6 Lack of Knowledge About Long-term Impact of AAL Products

Little is known about the long-term cost saving effect of AAL technologies. ([106] p.12). This results in the inability to shape a convincing value proposition in the B2C and B2B market. Investments in AAL products are therefore considered as too risky.

2.4.1.7 Lack of Established Platforms

Due to the lack of global standards and established frameworks, newcomers have to invest time and effort to develop their own proprietary platform, which hinders their partnership with other companies and the integration of third party solutions. According to experts, the lack of standards is the greatest barriers for bringing AAL products to the market ([132], p.45). Furthermore, acceptance by the Social Insurance is considered to be a potential key barrier (figure 2.17).

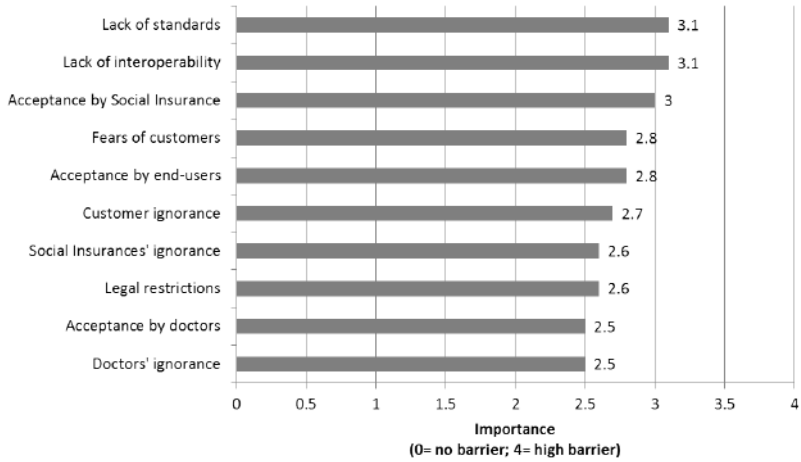

Figure 2.17: Reasons preventing AAL in Germany
Source: Own illustration based on [132] p. 45

2.4.2 Health and Fitness Barriers

Assuming that AAL solutions in the health care sector contribute to the improvement of the everyday life of the users and their relatives, increases efficiency among public institutions (e.g. hospitals, home care centers, emergency medical services) and the public health systems, the question arises why the market still lacks AAL health devices ([147], p. 1). The subsections will shed light on this matter by stating the most decisive barriers for establishing AAL products in the health care sector.

2.4.2.1 Lack of Distribution Strategy

Generally speaking, there are currently two possible approaches for distributing medical AAL devices to customers. First, the end-user obtains the device as part of a therapy. Second, the user buys the product directly without any intermediary, like it is done with calorimeters and sphygmomanometers. As there are no experience values of AAL devices' success rates, convincing the doctor or health insurance to list and promote the new devices is a difficult and time-consuming task ([161], p. 4).

2.4.2.2 Necessity For Individualized Devices Complicates the Development

As pointed out in section 1.2.1.2 there are two customers for AAL health devices: either the insurance company/doctor or the end user itself. As health insurance

companies and doctors are competing in a saturated market and therefore try to differentiate themselves from competitors ([108], p. 10), AAL devices have to be customized. But likewise the other alternative is just as difficult: the end-users' needs vary significantly. One crucial aspect is the willingness to allow private medical data to be shared. 77% of all customers presume their data to be kept private and secure. Synergy effects will be highly inhibited by responding to individual customer needs ([128], p. 7).

2.4.2.3 Rising Importance of Doctor's Role as a Mediator Between Provider and End-user

Potential customers have doubts about the benefits and usability of AAL health care devices ([132], p. 37). Moreover 71% of private people rely on their health care provider's recommendations. Given that the doctor operates as the link between the developer and many potential end users, it is indispensible to win the physicians as contributors of the products by having the possibility to highlight the surplus of E-Health in comparison to the inserted effort

2.4.2.4 Interoperability Among Branches Hinders The Product Development

The example of a sensor equipped T-Shirt which measures the user's vital signs points out the need for cooperation between industry branches in terms of development and manufacturing that have been operating separately for years, for example doctors, IT-developers and housing companies ([132], p. 44). Cooperation requires a high level of coordination. Furthermore, as soon as the distribution of chances and risks changes during the implementation phase, the innovation process of this cross-linked system may slow down or even fail, as certain partners will feel disadvantaged if they are not compensated adequately for bearing additional risk ([161], p. 4).

2.4.2.5 Disproportionally High Investment

Although AAL seems to be a reasonable investment, its implementation is accompanied by a multitude of financing problems. Comparing to other AAL products, the development costs of medical devices are significantly higher ([161], p. 4). Additionally 79% of the customers are not willing to pay more than US-$ 100 for a health device, finally resulting in a long payback period ([128], p. 6).

2.4.2.6 Severe Legal Restrictions of Germany's Health Sector Decelerate the Implementation Process

Germany's health sector has very strict restrictions regarding new medical devices. Testing and approval usually takes a lot of time, resulting in a long

period between the initial investment and the first cash inflows. Moreover, it is not clear if and when specific laws that are necessary for the implementation of AAL health products change. On a supranational level, health care and social security system are heterogeneous, which "hinders the development of common (European) business models and a common market for AAL solutions" ([106], p. 11).

2.4.3 Social Interaction Barriers

As there do not yet exist an established market for products, that are supporting social interactions and are simultaneously clearly marketed under the term AAL, understanding segment-specific barriers may give an impression on the main obstacles for the deployment of products and services whose value propositions build on user participation.

2.4.3.1 Social incompabilities

Ambiently intelligent products that support social interactions have to be adjustable to every user's social context. As the social context is dynamic, designing products that constantly meet the users' needs and requirements becomes a complex task ([115], p. 17). Furthermore, cultural differences even within Europe complicate the product development, as for example in some cultural spheres family is more important than in others and keeping in touch with one's family means keeping in touch with the relation of the third or fourth degree.

2.4.3.2 Dependency on Network Effect

Social networks are important tools in order to avoide social exclusion ([131], p. 17). However, the value of a virtual platform to access a social network depends on the number of people being accessible through this network. This effect is known under the term 'Network Externalities' ([145] p. 424). The business model of current AAL projects like "Senior channel" is based upon user networks. In view of the fact, that 76% of all German Internet-users are already member of a social network, achieving the critical mass for a new platform can be considered as a barrier ([116], p.3).

2.4.4 Safety and Comfort Barriers

The current adoption rate of AAL solutions targeting safety and comfort is very low. The following section investigates the barriers for the market growth as well as for new market entrances.

2.4.4.1 High Research and Development Costs

Although research and development costs are generally high in a technology-oriented sector such as the comfort and safety AAL market, there are a number of (supra)national initiatives for funding and supporting research projects from the European Union and Germany, in particular - e.g. the Ambient Assisted Living Joint Programme [111, 133, 109]. These programs generally do not permit the commercialization of the products, but they are considered to lower the sunk costs and therefore the risk of researching opportunities in this new market. Nevertheless, the research and development costs remain one of the highest barriers for the AAL market.

2.4.4.2 Availability Mainly on the High-End Market

Most AAL products targeting safety and comfort are not yet widely accepted by the public, despite their effectiveness in the improvement of the living standards. To a great extent this is due to the generally high prices of "smart" devices. Strategies for reducing the prices of AAL appliances in order to make them affordable to the middle class and at the same time for adopting the front-end technology are critical to the market growth in the future. The prices include the equipment, installation and ongoing maintenance and service. [146, 112]

2.5 Conclusion

The facts presented in this chapter lead to the conclusion that there is not yet an established market for AAL products and services in Germany ([132], p. 52, [114], p. 95). Experts agree, that the AAL market is at an early stage ([132], p. 52) and has significant growth potential. The major market players of each industry that is affiliated with the AAL market (e.g. ICT, housing, health care) are still focusing on research activities ([107], p. 3 f.). Although many AAL products are fully developed only few make it to market launch, mainly due to a lack of financing, resulting from poor business models. ([114], p. 95). Across all AAL segments, products are offered on a stand-alone basis, rather than as parts of integrated systems. This isolation between products and services also applies to the market players' business models. AAL products that have been developed by cooperations among scientists, IT-experts, service provider, end-users and the housing industry can be rarely found ([132], p. 52). In Germany, stand-alone telemedical and household appliances dominate the market ([114], p. 95).

To conclude, the AAL market is 'supply-side' led, meaning that a cluster of actors is focussing on developing new technologies and products while the number of product launches and customer demand still remains on a low level ([161], p. 2). From a broad perspective there is growing evidence that the

market for AAL technologies is not developing at the speed and to the scale, that has been forecast [[161], p. 2)

References

[102] Alexa Internet, Inc. URL http://www.alexa.com/topsites. accessed on 09/05/2011.

[103] Google TV. URL http://www.google.com/tv/. accessed on 09/05/2011.

[104] Smart Home 2010. Smart Home 2010, Oct 2010. URL http://bit.ly/nNLkQA. accessed on 09/05/2011.

[105] AAL4ALL. URL http://www.fraunhofer.pt/content/dam/portugal/en/documents/AAL4ALL%20Presentation.pdf. accessed on 09/05/2011.

[106] AALIANCE. Ambient Assisted Living Policy Recommendations, September 2008. URL http://www.aaliance.eu/public/documents/policy-recommendations/aal-policy-recommendations-march-2009.pdf. accessed on 09/05/2011.

[107] AALIANCE The European Ambient Assisted Living Innovation Alliance. Final Publishable Report On The AALIANCE Project, July 2010. www.aaliance.eu/public/documents/aaliance-final-report.

[108] AALIANCE The European Ambient Assisted Living Innovation Alliance. Ambient Assisted Living Strategic Research Agenda, March 2010. URL http://www.aaliance.eu/public/documents/aaliance-roadmap/aaliance-aal-strategic-research-agenda. accessed on 09/05/2011.

[109] The European Ambient Assisted Living Alliance. *Ambient Assisted Living Roadmap.* . URL http://www.aaliance.eu/. accessed on 09/05/2011.

[110] Care Innovations an Intel GE company. Intel-GE Care Innovations Guide, 2011. URL http://www.careinnovations.com/Products/HealthGuide/Default.aspx. accessed on 09/05/2011.

[111] AAL Association. Ambient Assisted Living Joint Programme. URL http://www.aal-europe.eu/. accessed on 09/01/2011.

[112] Oliver Baecker. Smart Smoke Detectors for Residential Buildings - Costs, Barriers, and Success Factors. 2007.

[113] Jens Baier, Rainer Strack, and Philipp Zimmermann. Turning the Challenge of an Older Workforce into a Managed Opportunity, August 2011. URL http://www.bcg.de/documents/file83918.pdf. accessed on 09/05/2011.

[114] Erhard Berndt, Reiner Wichert, Eva Schulze, Detlef Oesterreich, Uta Boehm, Holger Gothe, Antje Freytag, Agata Daroszewska, Philipp Storz, Sybille Meyer, and Christian Dierks. Schlussbericht - Marktpotenziale,

Entwicklungschancen, Gesellschaftliche, gesundheitliche und oekonomische Effekte der zukuenftigen Nutzung von Ambient Assisted Living (AAL)-Technologien, April 2009.

[115] Juergen Bohn, Vlad Coroama, Marc Langheinrich, Friedemann Mattern, and Michael Rohs. Social, Economic, and Ethical Implications of Ambient Intelligence and Ubiquitous Computing, 2004. URL http://www.vs.inf.ethz.ch/publ/papers/socialambient.pdf. accessed on 09/05/2011.

[116] Telekommunikation und neue Medien e. V. (BITKOM) Bundesverband Informationswirtschaft. Soziale Netzwerke - Eine repraesentative Untersuchung zur Nutzung sozialer Netzwerke im Internet, 2011.

[117] Telekommunikation und neue Medien e.V. (BITKOM) Bundesverband Informationswirtschaft. Presseinformation - Rekordbeschaeftigung in der BITKOM-Branche, October 2010. URL http://www.bitkom.org/files/documents/BITKOM_Presseinfo_Arbeitsmarkt_19_10_2010.pdf. accessed on 09/05/2011.

[118] Booz & Company. The Rise of Generation C - Implications for the World 2020, 2010.

[119] Efthymios Constantinides and Stefan J. Fountain. Web 2.0: Conceptual foundations and marketing issues. *Journal of Direct, Data and Digital Marketing Practice*, 9(3):231–244, 2008.

[120] CSC. TELEMEDICINE: An essential technology for reformed healthcare, May 2011.

[121] Verband der Elektrotechnik Elektronik Informationstechnik e.V. (VDE). VDE-Positionspapier Intelligente Assistenz-Systeme im Dienst fuer eine reife Gesellschaft, 2008.

[122] Michael Conrad Dr. Katrin Gassner. ICT enabled independent living for eldery, March 2010.

[123] K. Ducatel, M. Bogdanowicz, F. Scapolo, J. Leijten, and J-C. Burgelman. AMBIENT INTELLIGENCE IN 2010, February 2011.

[124] Enterprise European Commission and Industry. Industry innovation ehealth, October 2010. URL http://ec.europa.eu/enterprise/policies/innovation/policy/lead-market-initiative/ehealth/. accessed on 09/05/2011.

[125] Verein Deutscher Ingenieure e.V. Ingenieurmonitor - Der Arbeitsmarkt fuer Ingenieure im Juni 2011, July 2011. URL http://www.vdi.de/uploads/media/Ingenieurmonitor_2011-07.pdf. accessed on 09/05/2011.

[126] IBM Institue for Business Value. The future of connected health devices - Liberating the Information Seeker, 2011.

[127] The Initiative for Open Innovation. About The Initiative for Open Innovation. URL http://www.openinnovation.org/daisy/ioi/about.html. accessed on 09/05/2011.

[128] Heather Fraser, YangJin Kwon, and Margaret Neuer. The future of connected health devices. URL http://healthcaretechnologymagazine.com/healthcare-it-case-study-article/313-the-future-of-connected-health-devices. accessed on 09/05/2011.

[129] Bundesministerium fuer Bildung und Forschung. Ergebnisse der BMBF-Onlineumfrage zum Thema 'Assistierte Pflege von morgen', May 2011. URL http://www.aal-deutschland.de/deutschland/dokumente/Online-Fragebogen_Auswertung.pdf. accessed on 09/05/2011.

[130] Zahava Gabriel and Ann Bowling. Quality of Life From the Perspective of Older People. 24:675–691, 2004.

[131] Katrin Gassner and Michael Conrad. *ICT enabled independent living for elderly - A status-quo on products and the research landscape in the field of Ambient Assisted Living (AAL) in EU-27.* 2010.

[132] Peter Georgieff. Ambient Assisted Living - Martkpotenziale IT-unterstuetzter Pflege fuer ein selbstbestimmtes Altern. *FAZIT-Schriftenreihe*, 17, 2008.

[133] Fraunhofer Gesellschaft. Ambient Assisted Living Geschaeftsfelder. URL http://www.aal.fraunhofer.de/geschaeftsfelder.html. accessed on 09/05/2011.

[134] GKV. Anzahl der Krankenkassen im Zeitablauf, 2011.

[135] Google. An update on Google Health and Google PowerMeter, June 2011. URL http://googleblog.blogspot.com/2011/06/update-on-google-health-and-google.html. accessed on 09/05/2011.

[136] Steffi Groescho and Sabine Herrmann. AAL: New markets and future prospects through marketing communications.

[137] The Linde Group. REMEO - Linde Healthcare, 2011. URL http://www.remeo.de/de/index.shtml. accessed on 09/05/2011.

[138] Nic Halverson. Virtual Grocery Shopping In the Subway, July 2011. URL http://news.discovery.com/tech/virtual-grocery-shopping-in-the-subway-110711.html. accessed on 09/05/2011.

[139] Ana Hernandez, Francisco Ibanez, and Neftis Atallah. SENIORCHANNEL - An Interactive Digital Television Channel for Promoting Entertainment and Social Interaction amongst Elderly People. In Jose Bravo, Ramon Hervas, and Vladimir Villareal, editors, *Ambient Assisted Living*. Springer, 2011.

[140] Charles Hill and Gareth Jones. *Strategic Management - An Integrated Approach*. Cengage Learning, 2009.

[141] IBM. URL http://www.intel.com/about/companyinfo/healthcare/people/index.htm. accessed on 09/05/2011.

[142] Facebook Inc. Statistics. URL http://www.facebook.com/press/info.php?statistics. accessed on 09/05/2011.

[143] Institut fuer angewandte Telemedizin. Website, 2011. URL http://www.vitalwanderwelt.de/wandern/vitalwanderwelt/telemedizin/telemedizin-intro.php?navanchor=1010001. accessed on 09/05/2011.

[144] Vienna University of Technology Institut fuer Technische Informatik. GENESYS - GENeric Embedded SYStem Platform. URL http://www.genesys-platform.eu/. accessed on 09/04/2011.

[145] Michael L. Katz and Carl Shapiro. Network Externalities, Competition, and Compatibility. *The American Economic Review*, 75(3):424–440, June 1985.

[146] Thomas Kleinberger. Establishing the Market for Assisted Living Solutions.

[147] Thomas Kleinberger. Establishing the Market for Assisted Living Solutions, 2008. URL http://drops.dagstuhl.de/volltexte/2008/1466/pdf/07462.KleinbergerThomas.Paper.1466.pdf. accessed on 09/05/2011.

[148] Hermann Kopetz. The Impact of Research and Development on Economic Activity, 2011.

[149] Bastian Lange, Joachim Burdack, Robert Nadler, Katja Manz, Juliane Schroder, and Kornelia Ehrlich. *Urban environments and social networks in LeipzigÕs knowledge and creative industries - The managersÕ view*. 2008.

[150] Axel Lankenau and Thomas Roefer. Smart Wheelchairs - State of the Art in an Emerging Market. *Zeitschrift Kuenstliche Intelligenz*, 4, 2000.

[151] marketsandmarkets.com. World Sensors in Consumer Electronics Market (2010-2015), October 2010.

URL http://www.marketsandmarkets.com/PressReleases/world-sensors-in-consumer-electronics-market-worth-22190-million-in-2015.asp. accessed on 09/05/2011.

[152] marketsandmarkets.com. European Smart Homes and Assisted Living Market (2010 - 2015), April 2011. URL http://www.marketsandmarkets.com/Market-Reports/smart-homes-385.html. accessed on 09/05/2011.

[153] Michael Hewing Martin Gersch, Ralf Lindert. AAL-business models: Different Prospects for the Successfull Implementation of Innovative Services in the Primary and Secondary Healthcare Market, March 2010.

[154] James Moore. The death of competition: Leadership & strategy in the age of business ecosystems. *HarperBusiness*, 1996.

[155] Electronics.ca Research Network. Global Smart Homes Market (2010 Ð 2015), May 2011. URL http://www.electronics.ca/presscenter/articles/1444/1/Global-Smart-Homes-Market-To-Be-US-11000-Million-By-2015/Page1.html. accessed on 09/05/2011.

[156] Liisa Nido Nylund. Advertising's future is micromarketing and mobile phones. *Caribbean Business*, 37:70–71, March 2009.

[157] OECD. OECD Health Data 2011 - Frequently Requested Data. URL http://www.oecd.org/dataoecd/52/42/48304068.xls. accessed on 09/05/2011.

[158] Ambient Assisted Living (AAL) Joint Programme. Call for Proposals AAL-2009-2 'ICT based solutions for Advancement of Social Interaction of Elderly People', February 2009. URL http://www.aal-europe.eu/calls/Published/aal-2009-2/aal-2009-2-call-text. accessed on 09/05/2011.

[159] Ambient Assisted Living Joint Programme. Overview of Call 1 and 2. URL http://www.aal-europe.eu/projects/pdf-overview-of-call-1-and-2. accessed on 09/05/2011.

[160] QEES. QEES Business Model. URL http://qees.eu/en/business-model. accessed on 09/05/2011.

[161] Simon Roberts. A Market of Pilots: Exploring the role of consumers and design in the development of a mass market for ambient assisted living technologies. AALIANCE conference, March 2010. URL http://www.aaliance.eu/public/aaliance-conference-1/papers-and-posters/8_4_digital-health-group. accessed on 09/05/2011.

[162] Inc. Robotics Trends. Stroke Rehabilitation Market Fuels Continued Funding of Tibion. URL www.roboticsbusinessreview.com/blogs/view/

stroke-rehabilitation-market-fuels-continued-funding-of-tibion. accessed on 09/05/2011.

[163] Everett M. Rogers. *Diffusion of Innovations*. 1962.

[164] Joerg Schamberg. Vodafone TV startet: Komplettpaket fuer 39,95 Euro, February 2011. URL http://www.onlinekosten.de/news/artikel/42569/0/Vodafone-TV-startet-Komplettpaket-fuer-39-95-Euro. accessed on 09/05/2011.

[165] European Commission Information Society and Media. Orientations for EU ICT R&D & Innovation beyond 2013, July 2011.

[166] Martina Friedl Stefan David, Karsten Neumann. E-HEALTH - Wachstumsperspektiven fuer die Telekommunikationsbranche, April 2009.

[167] T-Systems. White Paper - Gesundheitswesen im Wandel., February 2010.

[168] Reiner Wichert and Birgid Eberhardt. *Ambient Assisted Living*. Springer, 2011.

[169] Ernst & Young. Fusionskarusell bei Krankenkassen gewinnt an Fahrt, 2010 .

Chapter 3

3 Changing Needs of our Society and AAL Customers

Thilo Arnold, Ferdinand von Bennigsen, Sophia Höfling, Georgi Kirev, Stephan Link, Anne Meininghaus

One can observe a discrepancy between the changing needs of the society and the ability of AAL providers to sufficiently respect them in the product development process.
Therefore, this report investigates the status quo of Germany's social environment, particularly paying closer attention to the people's needs. Societal factors such as the attitudes towards the use of technology are investigated.

Then, in order to define how the AAL customers will look like in the future, emerging trends within the society are investigated. On the one hand, AAL service providers will be confronted with an aging population, a polarization of wealth which implies a shrinking middle-class, and the increasing spread of an urban lifestyle even within rural areas. On the other hand, the ongoing changes of values, such as the shift towards immaterial values, increasing individualization and attaching greater importance on healthy living will play an important role in the design of future AAL products.

AAL service providers are too focused on pushing their technologies into the market and do not pay attention to the customer's actual needs. Barriers that, for example, emerge from the digital divide within the society or the increasing technical overstrain of users are named in order to emphasize the necessity to rather follow on a market pull strategy by listening to the voices of the users.

3.1 Introduction

The development of successful AAL products and services inducing a high market share requires an adequate use of the latest technology corresponding to the target customers' needs. Therefore, the thorough observation of technical opportunities as described in chapter 1 has to be matched with a detailed customer analysis.

In order to define how the AAL customers from now on will look like it is necessary to identify how present AAL customers are characterized and the way they behave. Furthermore, one should keep track on how the society is changing which is a good starting point to get an overall understanding for the future market situation in general.

Today the AAL industry is almost exclusively focusing on seniors. For the purpose of realizing the whole market potential, also other age and interest groups should be considered as potential target groups. Imagining a working single mother who has to cope with her job, the household and the education of her children at the same time illustrates a significant need for support and simplification in everyday life situations. Also young people, whose career forces them to live in long distance relationships due to frequent business trips for example are likewise in need of everyday assistance systems.

Even among the current target group of "the silver generation" AAL products have not yet reached a high market share. Reasons for that are among others high costs and general reluctance against technology. Another reason might be that the already mentioned combination of a technology and a market based approach is difficult to manage. Instead of concentrating on the customers' wishes the development process of many AAL products was rather technology oriented.

In order to secure a successful, customer-oriented development process, different customer segments, their goals, activities, and their acceptance of technology are identified in the following.

First a short overview of the current social situation in Europe and particularly in Germany is given, pointing out the factors which have a significant impact on AAL customers' behavior and needs. Besides age and health that includes the family status as well as the respective employment situation and the average prosperity of the population. Consequently the society is classified in lifestyle groups which indicate their relevance for AAL.

Then the most powerful social trends which are extremely important for foreshadowing future customers' demands are exposed.

In this course, social factors and the change of values are determined which will help to detect the concrete impact on AAL for each trend. Derived from that, the change of people's attitude towards technology is analyzed.

Those trends open up encouraging possibilities for the AAL industry but a well reasoned strategy also implies the consideration of possible barriers.

Therefore uprising problems which could inhibit or slower the diffusion of AAL solutions are revealed in a last step.

3.2 Status Quo

In this section the current state of the most important societal factors with impact on AAL are briefly introduced. Furthermore, some statistics on the current use of technology and the present-day customer segmentation are shortly presented. This provides the basis for understanding the social trends, which will be discussed in the next section.

3.2.1 Societal Factors

Societal factors influence people's behavior significantly. Persons of different age, family status, health condition and prosperity have different needs in their everyday life and expectations of technology. Therefore a short overview on the status quo of those factors for Germany's and EU's population is given in the following.

3.2.1.1 Age and Health

Two of the main objectives of the AAL Joint Programme are "to support maintaining health and functional capability of the elderly individuals" and "to promote a better and healthier lifestyle for individuals at risk" [173]. It is therefore imperative to analyze the current situation and the tendencies with regard to the age and the health of the population.

In the European Union the age group of people above 50 years accounts for more than 35% of the population as of 2008. Another known fact is that the life expectancy of the population is gradually increasing in the past decades ([171], p.166, 185). As a result, a 65 year old German can nowadays expect to live on average another 19 years [176]. Since elderly and handicapped rely the most on the help of others in their everyday life, the 50+ age group is currently the primary target group of AAL products. In 2009 there were 7.1M handicapped people in Germany [232] and 2.34M were in need of external care (see Figure 3.1). Almost half of them are being taken care of at home by their relatives which puts enormous strain on them.

Furthermore, a recent survey shows that 67% of the polled would like to live at home without the need of help when they reach the age of 70, while only 15% expressed the wish to live in a nursing home or another caretaking facility [181]. These facts show a deficit of enough professional caretaking personnel, as well as the desire of the individual to stay independent as long as possible. Consequently, there is a significant unexplored market potential for AAL technologies, in particular for the elderly and handicapped.

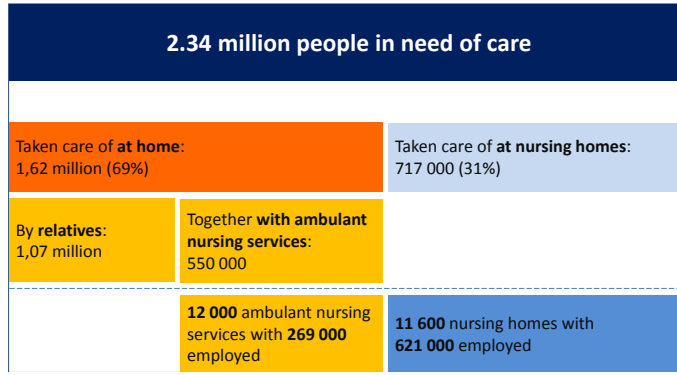

Figure 3.1: Persons in need of care in Germany as of 2009
Source: Adapted from [226]

3.2.1.2 Relationship and Family Status

The family and relationship status impact people's everyday life and needs to a great extent.
In 2010 there were 8.1 million families with 14.6 million children in Germany. Currently, the most common family form is the two-parent family with children accounting for 72% of all families. This number has, nevertheless, decreased in the last decade, giving way to alternative family forms such as families of single parents and cohabitation [232].

Single parents, which bring up one or more children, are considered to be burdened and are therefore in need of daily assistance. In comparison to married mothers, a significantly higher percentage of the single mothers state that they have financial problems, are overburdened with the family duties, and that they are dissatisfied with their accommodation [177] (see Figure 3.2). Furthermore, as of 2007 there were 1.57M single parents (accounting for 18% of all the families), who bring up 2.18M children in Germany. Out of all single parents, 90% are single mothers [177].

In 2010 about 33% of the German babies were born outside of marriage; in Iceland this figure reaches even much higher levels - around 64% [191]. At the same time the number of marriages and divorces in Germany has remained constant during the last five years at a rate of 4.6 and 2.3 per 1000 inhabitants respectively [232].

3.2.1.3 Employment, Prosperity and Residence

The percentage and type of employment of the population is an important factor to consider, since it determines the prosperity of the population and the necessity for assistance in the everyday life.

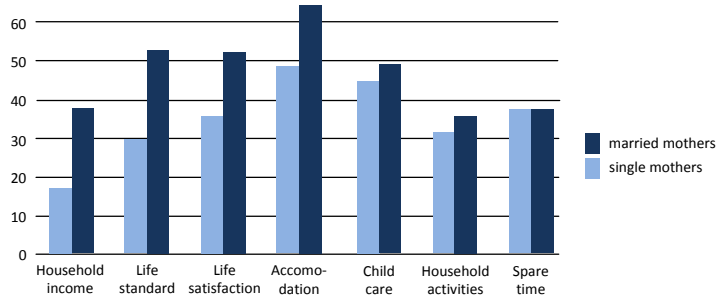

Figure 3.2: Satisfaction of mothers in different areas of life
Source: Adapted from [177]

Degree of urbanization / Country/Organization	Total	Densely-populated areas (at least 500 inhabitants/km^2)	Intermediately-populated areas (100-499 inhabitants/km^2)	Thinly-populated areas (below 100 inhabitants/km^2)	Unknown
European Union (27 countries)	494 632 000	235 035 300	130 084 800	121 730 800	7 781 100
Germany (including former GDR)	80 828 000	40 452 700	28 280 700	12 094 600	-

Table 3.1: Population of the EU and Germany in dependence of the residence (2011)
Source: Own illustration, data: [191]

As of 2010 the employment rates in the EU and Germany average to 64.2% and 71.1% respectively [191]. This relatively high figure, together with the above average (in comparison to the rest of the EU) GDP per capita of the Germans, contribute to their high level of satisfaction with their earnings (see Figure 3.3). Nevertheless, one should take into account that there are significant differences in the household incomes in dependence of the work time (part-time vs. full-time), the family structure (single or two-parent families) and the place of residence. For instance, in 2008 a German single parent earned on average €2,193 monthly, while two-parent families had an average income of €4,644 Euros.

With respect to the place of residence, the statistics for the first quarter of 2011 show no significant differences in the employment rates of the highly, intermediately, and thinly populated areas (both for EU and Germany) [191]. At the end of the first quarter of 2011 around 47.5% of EU's and 50% of Germany's population resided in the densely-populated areas (see Table 3.1) with a rising tendency.

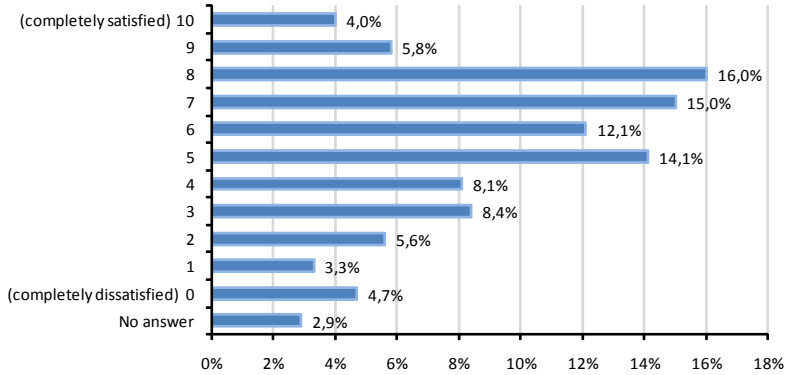

Figure 3.3: Satisfaction with the own income in percentage (Germany, 2008)
Source: Adapted from Statista's homepage [231].

3.2.2 Customers

In the following section the ratio of usage of ICT in Germany and the EU is shortly portrayed. Afterwards, one possible customer segmentation is depicted and interesting customer groups with respect to AAL are identified.

3.2.2.1 Use of Technology

The percentage of the population, which use ICT in their everyday life has constantly, risen during the last decades. The forerunners among all available are the information and communication technologies. This is true for private as well as professional usage. For instance, according to Eurostat [191], 57% of EU's and 67% of Germany's population use computers daily. Internet usage shows even higher levels - 71% and 82% with a broadband penetration rate of 25.6% and 31.3% respectively. An interesting fact which highlights the importance of ICT in everybody's life is that, as of 2010, there were 132 mobile subscriptions per 100 inhabitants in Germany [191]. Furthermore, 93% of the adolescents between 10 and 18 years of age own a mobile phone [182]. The use of ICT among the elderly is in contrast still not as high as in the lower age groups (see Table 3.2).

3.2.2.2 Customer Segmentation

People in the same objective social situation tend to show different behavior in dependence of their individual values, interests, attitude to work, family, money, and life as a whole. This is why people can be grouped with respect

Age / Computer usage / Internet usage	10-15	16-24	25-44	45-64	>65
At least once	99 / 97	99 / 99	98 / 97	87 / 81	49 / 35
Never	/ / (3)	/ /	(2) / 3	13 / 20	5 / 65
During the last 3 months	98 / 96	99 / 98	96 / 95	80 / 75	36 / 31
More than 3 months ago	/ / (2)	/ /	2 / 2	7 / 5	13 / 4

Table 3.2: Use of computers and the Internet by different age groups (Germany, 2010)
Source: Federal Statistical Office [235]

to three equally important parameters: social status, values and lifestyle, thus constructing social milieus. Social milieus represent groups of people, which are similar in their perception and way of life [180]. When speaking of customer and social segmentation, one of the most established tools are the Sinus-Milieus (see Figure 3.4). By analyzing the characteristics of the different groups in [230], the milieus in the upper right half were identified as the most promising for AAL technologies. The people in these milieus are distinguished for their urge for modernization, individualization and safety, high level of creativity, and education. An important finding is also that these groups of people have mostly a middle or higher social status and income and could therefore afford AAL technologies today if they were widely available.

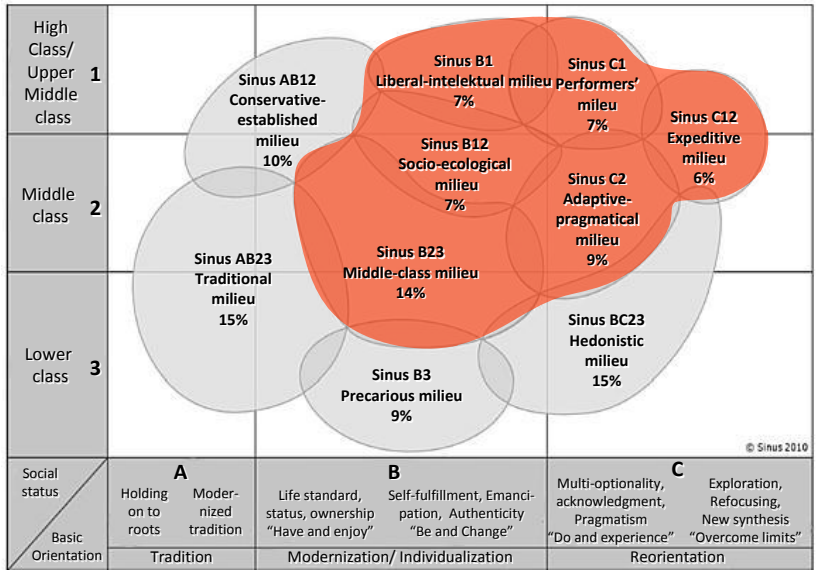

Figure 3.4: Sinus-Milieus for Germany in 2011
Source: Adapted from [230]

3.3 Trends

In the following the major trends concerning society's needs and behaviors are identified and their impact on the development of AAL products is to be described. When developing and setting the core focuses of AAL solutions the consideration of future customers' lifestyle, sytstem of values, and needs will strongly determine the success and diffusion of the products. Thus a technology push can be combined with a market pull and consequently secure that technological innovations are integrated into the products in the most appropriate way considering customer needs.

In the first place the future structure of society is to be observed concentrating on the core developments which will affect AAL. Second a closer look on the norms and values which will define the purchasing behavior of the future is taken. Last but not least, the opportunities for AAL deriving out of the trend of the greater importance of technology will be illustrated.

3.3.1 Changes in the Structure of Society

In the coming years the social structure will develop and change into certain directions which are subject of the following observation. AAL is affected in different ways by the change of the structure of society. On the one hand,

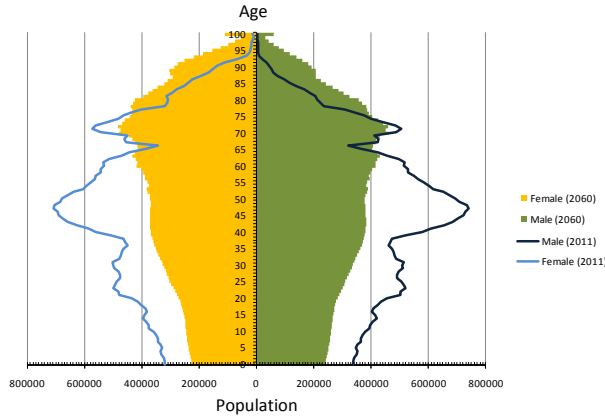

Figure 3.5: Age structure diagram of the population in Germany (projected values)
Source: Own illustration, data: [232]

factors like demographic change and migration from less prosperous to wealthier countries as well as migration from rural to urban areas influence people's lifestyle and external circumstances. On the other hand, different attitudes towards work and a distinctive self-conception of women have a huge impact on the structure of work and life processes. Each trend as well as its consequences for AAL will be exposed below.

3.3.1.1 Aging Population

Europe is facing a demographic tendency towards an aging population [195]. In particular Germany, as a frontrunner of the western countries with an aging population, will struggle with an increasing number of elderly as well as a decreasing number of younger people ([214], p.219).
As a result, by 2060 the stronger age groups will be shifted upwards whereas the younger generations will thin out as being shown in figure 1.2 ([170], pp.14-15).

The old-age dependency ratio relates the number of retired (65+) to the number of possibly gainfully employed (20 to 65 years olds). An aging population will lead to a steep increase of this number from 34% today to 67% in 2060. Not even the gradually lifting of the statutory retirement age from 65 to 67 years, nor the presumed increasing immigration rate can reverse this trend ([170], p.6).

An on average older generation will not only alter the general purchasing patterns of the largest buyer group but will also yield the necessity for more support in everyday life activities. Hence the importance of AAL solutions will steeply increase.

The main reasons for an aging population

This development can mainly be explained by the extremely low fertility rate Germany is facing in comparison to other European countries ([214], p.219). In demographics fertility is defined as the number of children a woman bears in her lifetime [175]. For about three decades the German fertility rate is stagnating at an average of about 1.4 and it is expected that this trend is about to continue. As a result, the number of deaths will gradually exceed the number of births. This implies that every new generation will decrease in size compared to the previous one and thus foster not only an aging but also a declining population from 82M in 2008 to 65-70M in 2060.

Furthermore, a growing life expectancy can be seen as another main reason for this development. The basic assumption, based on the extrapolation of recent mortality tables published by the German Federal Statistical Office, says that by 2060 the average life expectancy of a woman will have increased by 6.8 to 89.2 years and by 7.8 to 85 years for men compared to 2006/2008. This is a consequence of the ever improving medical treatment as well as the improving life circumstances which enable this trend to continue ([170], pp.29-30). Foremost the number of the aged population (80+) will grow dramatically from a share of 5% of the total population to 14% in 2060 ([170], p.5).

Related trends and societal impacts of an aging population

As a result of an aged population the average employee age will increase from 41 years in 2009 to 45.6 years in 2019 [233]. This will lead to a significant change in working life. Economy will depend on the older generation as work force and will have to adapt its structure and strategy according to its aged staff [224].

Another side effect of an aging population is the increasing number of elderly in need of care. Although the general life expectancy continuously increases people are not necessarily healthier ([213], p.15). Instead, health impairments, mental health problems and dementia become a prevalent aspect of the aging society ([172], p.4). Thus, the number of those needing care will double from 2.4M in 2010 to 4.5M in 2050 ([181], p.2).

On the other hand, the younger part of seniors will become more active, vital and better educated than before [178]. A “rejuvenation” of their values, behavior and inner attitude takes place and people between 50 and 60 experience a phase of reorientation. This could be referred to as the “time of second beginning” where people can decide again on the direction their life should move to instead of sticking to old habits only because it would not be worth to change anything due to the short lifetime left ([206], pp.5-6).

In combination with the fact that elderly will represent the largest part of society they ought to become the prevailing customer group and thus one of the target groups AAL product and service suppliers should focus on. The purchasing power will shift from the younger to the older generation ([223],

p.25). Due to the increasing number of old people the diversity of this age group will grow ([239], p.19). The heterogeneity of their ways of thinking, life concepts, expectancies and interests will determine the behavioral patterns of seniors more than in every other age group [179].

Impact on AAL

To sum up, the aging population and its needs and behavior offer a large number of opportunities for AAL solutions. On the one hand the economic necessity and the old citizens' ability to stay an active part of society and working life for a longer period of time alter the prerequisites for the working environment. On the other hand the longer time period of being a senior and the increasing number of seniors urge for a higher marketing focus on this customer group. A larger number of devices, targeted towards their needs, becomes necessary.

3.3.1.2 Growing Rich-Poor Gap

The distance between the average living standard of the less and more well-off part of the society in Germany is growing [195]. Furthermore, the number of poorer households rises and the number of rich households which become even wealthier increases. This implies a trend towards a shrinking middle class and the polarization of income ([210], p.3).

In particular, the number of elderly people living below the average subsistence level will increase due to a decline of the statutory pension [223]. Meanwhile there will be a higher number of financially stable and wealthy senior citizens ([172], p.4). But wealth is hereditary and the level of education achieved is strongly affected by the financial resources the family can provide [212]. Therefore, this development not only affects the older part of society but will have a vital impact on the younger generation as well. This increasing financial disparity of the society will arise an obstacle for AAL products as they will have to be customized to fit to each customer's financial means [212].

Increasing polarization

Germany's economic prosperity, social structure and humanitarian conventions will lead to continued immigration from economically weaker countries. Due to economic and demographic reasons, immigration of skilled employees in general would be necessary. Instead, Germany faces the problem of educated employees migrating to the United States while at the same time being flooded by unskilled workers [223]. In this context AAL products will not only face the difficulty to be suitable for people of very diverse income levels but also with quite distinctive ethical backgrounds.

Building upon this development, the barriers of obtaining a high qualification for people coming from a poor educated family still are and will exist in the

future. They consequently foster educational disadvantage and unemployment which can be seen as the main reason for the risk of poverty. On the other hand, you can find higher educated citizens which are employed for a longer time period, are healthier and have a higher life expectancy. Both phenomenons taken together, consequently, lead to a rising polarization between poor and rich [212].

Impact on AAL

Polarization leads to different consumption opportunities and lifestyles which brings about different experience worlds. Thus, social cohesion is jeopardized ([210], p.3). Developing assisting devices that fit to the needs, values and share of wallet of a large customer group will be a huge challenge for AAL and have to be considered when developing products and services. Moreover, AAL will even intensify the growing gap between the rich and the poor as they will support and simplify the users activities enabling him or her to arrange his work-life balance more efficiently.

3.3.1.3 Urbanization

Urbanization is often mentioned as one of the megatrends of the 21st century. In 2050 70% of the world citizens will live in cities [229]. In particular underdeveloped countries have a steep urbanization growth rate. Nevertheless, in the long run the growth rates are about to decline. In Europe urban growth in the following 15 years will amount for less than 0.1% per year ([193], pp.56-60).

Instead of a rural migration "urbanization of the rural areas" takes place. That means that even if the number of inhabitants of cities in general stagnates or even declines the urban culture is spread among the whole population due to technology and a more compact transport system ([206], pp.3-4). Although the majority of Germans will live in the city 19.76% will still reside in rural areas in 2020 [193].

Nevertheless, certain parts of the society are still or will increasingly be attracted by the lifestyle a city provides. In Germany this includes especially the higher educated society as well as the elderly ([206], pp.3-4).

In a survey conducted by an online housing agency the most important reason for moving into a city, mentioned by the interviewed, was the higher amount of leisure and cultural offerings. According to the survey the main advantages for seniors a city brings are shorter distances, better medical care and better accommodations that meet old people's needs [174].

Impact on AAL

Those main motives for moving into a city indicate the society's desire for community, entertainment and freedom. This, in turn, underlines the importance

and the potential of AAL as those needs will be met by new solutions facilitating the everyday life.

On the other hand, technological supported assistance will facilitate the social integration of people living in the countryside enabling them to benefit from services which are normally only available for city dwellers, like easy access to medical consultancy and care or frequent contact to others. Thus AAL will enable people to keep on living in rural areas hence fostering the "urbanization of rural areas".

Summing up AAL will be able to satisfy the needs of the major part of the society living in the city as well as the demands of the minority living in rural areas.

3.3.1.4 Increasing Career Orientation of Women

Through emancipation and free thinking the self-image of women in the society has changed over time. The new role model of young women is enlightened, active, dynamic and with a long-term life plan. It is self-evident that women want to be independent and therefore are interested in education and career ([190], pp.26-31)[205]. In almost all OECD countries there is an astonishing education revolution [206]. In 2002 60% of all general college entrances in Germany were achieved by girls with better results than boys. This resulted is a massive increase in employment of women [206]. Today 30% of the leading positions in the EU are held by women and a prognosis for the year 2030 says that every second executive will be female [197]. This development is regarded as one of the major trends of our society. One factor supporting this trend is a new set of key competences, such as team skills, capacity for dialogue, emotional intelligence and organizational talent which are all regarded as natural talents of women ([197], p.2).

Due to the shortage of skilled labor in Germany even male-dominated companies will need to accept women in leading positions [199]. Companies that successfully integrate women within teams experience a better working environment with more innovative and creative solutions. Women are proven to be a valuable company resource and former stigmas are being mitigated as companies continue to realize this fact [199]. The trend is that more women will enter the work market as shown in Figure 3.6. In addition women will be highly qualified.

However, as a result, the key question of how to combine career and children has become more important for working women [224]. In most cases women have a hard time juggling both. In Europe 60% of women with one child are employed and even fewer women with two or more children are employed [205]. They can take a maternity leave and it is also becoming more accepted that the fathers as well take time off to take care of the children. But mothers still have to accept slower progress in their career as if they were childless. In

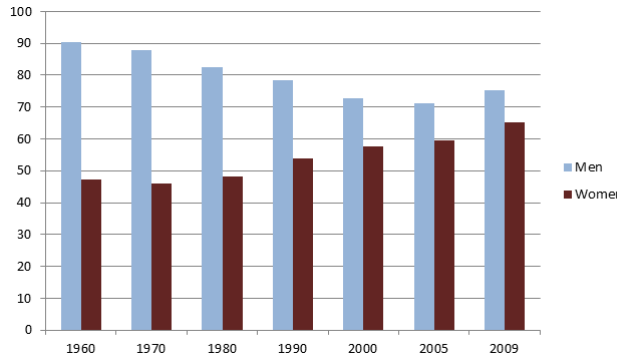

Figure 3.6: Employment rate (in percent)
Source: Bundeszentrale für politische Bildung, 2010, www.bpb.de[184]

many companies there are already institutions installed such as day care centers that help mothers continue to work. However, in many cases the plan to have children is postponed in order to achieve the personal goals in their career ([190], pp.26-31).

Impact on AAL

Women want to be able to have children and a career. Due to the increasing career orientation of women fathers need to participate in care taking process as well. Therefore, both need a flexible work schedule which can be achieved for instance by a home office solution. In addition AAL could offer everyday life assistance and even child care assistance.

3.3.1.5 Transition to a Flexible Employment

The uprising trend "New Work" is a more flexible shaping of the work structure and a rather arithmetical time-input ([205], p.24). In addition, the borders between leisure time and work will become blurred as family and work move closer together.

There are two developments responsible for the change in work environment. Firstly one can witness a shift from the former three-phase life model to a five-phase life model. The three phase model is divided into: youth and professional training, working life and family life, and retirement. Considering the five phase model, two additional phases can be seen in between the three major phases. Between the first two an additional post-adolescence phase emerges in which one goes through a self-awareness and self-discovery process. The second new phase is the restlessness one. This phase often results in a search for new

challenges ([205], pp.21-22). Altogether there are more crossroads in the lives of the general population.

Secondly people move away from previously dominant jobs, primarily industrial work. Our culture is turning into a culture of knowledge. Therefore, less money is invested in production and the added value lies in creative work. Creative work requires team work, part-time, and project related organization. Thus work takes on a new structure ([206], p.8).

- Work will have to adapt to the volatile market conditions, therefore becoming more individual and unset. (flexibility) ([206], p.8)
- In the next ten years the self-employment proportion will rise up to 25%, 35% will work as job-hopper and only 40% will be employed in a long time contract. (precariousness) ([206], p.8)([205], pp.21-22)
- Management decisions will be dependent on a complex composition of management teams. (diversity)([206], p.8)
- Work will have a huge self-realization character and fewer options to distance oneself. Therefore, many will combine office work with home office. Consequently, family and work will grow closer together. (individualism) ([206], p.8)([205], p.24)

Impact on AAL

AAL customers will need to be mobile due to the growing flexibility of work therefore AAL needs to be flexible as well. Furthermore it can assist reaching the needed flexibility by providing information on the go and assuring spatial independence. Since more people will work at home AAL will need to consider solutions that simplify the combination of family and work at home.

3.3.2 Change of Values

A society's system of values decides about how financial resources, time and efforts are spent and divided. Hence the alteration of future populations' priorities towards immaterial values, individualization and an increasing importance of health will influence future customers' willingness to purchase AAL products and services and is therefore analyzed in the following.

3.3.2.1 Shift to Immaterial Values

The concept of sustainability that was originally associated with the ecological consumption of resources has nowadays political, as well as social dimensions [185]. The world after 9/11 and after the financial crisis changes the feeling of values into a post-materialistic direction: the necessity for sense, affiliation, and home increases while wealth and authority fall in value [196].

People are more interested in a better society and want to contribute to its progress. Therefore, family structures will be rediscovered as a source of welfare and sense of life, especially because they survive every crisis and depression. As a consequence the future understanding of prosperity can mean to own less goods but still live a better life - not in sense of a high economic status but of a higher quality of living in a strong social environment [196, 224].

New central values such as helpfulness, reliability, and humanity will create more social responsibility and a stronger feeling of togetherness in society that was overshadowed by the "ego-cult" of the past twenty years [202]. One will experience an intense willingness to support particularly friends, family, and neighbors. This solidarity and liability for each other and future generations occurs not least because the economic crisis made politicians, parties, and the state untrustworthy to the people. To sum up, this mounting skepticism among the population leads to a spirit of mutual dependence, that is, people count more on each other than on institutions. As usual for periods of crisis, more self-reliance accrues and subsequently life priorities change [216, 192].
Since people feel doubtful about their future, the value “security” will gradually become more important. Existential fears will drive people to fulfill the demands of a secure income, a reliable retirement, or a safe job. The need for protection could be even stronger than the desire for private sphere and freedom [216].

Impact on AAL

This trend fosters a higher acceptance for AAL products on the customers' side, especially for integrated video and data transfer solutions in apartments. Portable devices could help people to look after family members and people they feel responsible for even if they are not at the same place. Therewith, care and aid will become more flexible and so less burdening. Accepting the help of institutions, implicating a constant switch of persons of reference, is still a process of overcoming pride for most people, independent of their age. Hereby AAL products could help to keep familiar or amicable intimacy and support the realization of a functioning social society. Furthermore, communication tools will comply with the growing demand of social comfort.

3.3.2.2 Individualization

In former generations people grew up in a societal framework of institutions such as the church and the state; nowadays attitudes and action patterns are rather a consequence of individual decisions and depend decreasingly on birth milieus, classes and statuses ([222], p.18). This development is called individualization theory as values like self-unfolding and autonomy preponderate [211]. The individual sees itself exposed to a wide range of opportunities concerning life plans, which, on the one hand, opens new chances, on the other hand, they could also bring along new risks and destabilization ([204], p.25). It is already

pioneering that prosperity, education and mobility enlarge the selection options that awake the desire to realize one's full potential to a greater extent. For example, professions, domiciles, and especially relationships are more often switched which is a main reason for patchwork and living-apart families [206].

The emphasis on an individual way of life involves a higher variety of standards and values: discipline and moral conformity make way for flexibility, change, and tolerance. In this context it is important to understand that individualization does not lead to egoism ([222], p.153 ff.). In fact, self-development values are even positively correlated with helpfulness: 34% [202] of the population over 14 are engaged in volunteering - upward trend [216]. The people of tomorrow can be described as "active realists" characterized by a strong success orientation and self-assertion, but also competencies in sociability and communication [202]. After the disappearance of traditional clusters, alternative social forms of orientation will play a major role particularly for the young generation; get-togethers and communication with like-minded persons are highly relevant to feel associated.

The development of faith and spirituality can be seen as another example. A large variety of individual directions will be cultivated in which people combine motifs of Christianity and nature spirits with Far Eastern theories. Especially the holistic Asian medicine as well as different Buddhistic movements show a rising trend [206].

Impact on AAL

Altogether, the AAL industry can expect a higher degree of openness and acceptance towards innovations, even in the health sector. Home integrated medical devices satisfy the rising need for individual and ever-present support. At the same time, consumer expectations are harder to meet: buyers that are spoiled by a large diversity of products will demand more and more customization.

The search for new social environments and communication channels will support the AAL market, especially with regard to media use. In addition to that, interactivity will play a major role in approaching the active and communicative lifestyle of the future [217].

3.3.2.3 Health Becomes a New Lifestyle

The fitness and wellness boom of the past years announced a new "feel-good" culture in which people seek for a work balance that is as stable as possible without giving up enjoyment. In accordance to that attitude, mental health becomes the key concept for happiness and the psyche becomes a priority [201]. Humans want to take care of themselves by becoming stronger, more fit, and attractive [219].

Tomorrow's health customers are not the classic patients, but instead are individuals who try to prevent getting ill. The main reason is the growing

consciousness among people that the senior stage of their lives will be a longer one. Therefore, it makes sense to take care of one's health situation as early as possible in order to stay fit and active as long as physically possible [203]. This can be appreciated throught the growth in popularity of sports such as Yoga and Pilates, and the increased intrest in nutrition . Buying organic products has become part of the norm. Trends like self-enhancement in the form of "smart drugs", which raise the performance and the ability to concentrate, as well as "functional food" with immune strengthening or anti-aging results, have entered the market. Health itself becomes a lifestyle, a consumer product, and also a scale for the quality of living ([189], pp.105 ff).

The modern individual wants to accept responsibility for himself and his health and will therefore require more information and diagnostic transparency to keep up with the experts at eye level. In dealing with aware and resourceful patients, the classic doctor could move towards the role of a health consultant. This new consumer behavior has come to be known as "LOHAS - Lifestyle Of Health And Sustainability" which describes the attitudes and needs of the future consumer majority [192]. "LOHAS" harmonize health responsibility and pleasure, as a part of their life style . On the one hand, they are traditional by demanding values such as sustainability. On the other hand, they are modern by supporting technological progress. In their opinion, green-mindedness has nothing to do with renunciation ([189], pp.12 ff).

Impact on AAL

When considering product design, one should keep in mind that people should not be made to feel disconfort or embarasment whilst using the AAL systems. Quite the contrary: AAL products should show technical advancement and prestige. Instead of focusing exclusively on practical functionality, they are supposed to give pleasure and satisfy the increasing need of participation.

Moreover, climate change and scarcity of resources make people question their habits [180]. Customer concern about the environment affects buying behaviors even now: according to current statistics, 55% of costumers ([227], pp.1-3) would pay more for brands and products whose producers prioritize environmental protection. Consequently, companies will have to build up a trustworthy image and integrate sustainability into brand marketing and messaging in order to inform and attract such clients ([227], p.11).

3.3.3 Growing Technology Integration

Technology is becoming an increasingly important part of peoples' working and everyday life. For the mainly technological oriented AAL products and services this development raises new possibilities. Subsequently the higher acceptance of technology among the major part of society as well as the trend to be always online are stated.

3.3.3.1 Increasing Acceptance of Technology

Never before has technology had such a huge impact on society and peoples' everyday life like today ([237], p.3). As already mentioned in 3.2.2.1, computers and the Internet have entered nearly every part of working and private life ([238], p.54). By extrapolating former statistics it becomes obvious that the influence of digital technology will be growing in the future even though in a different, more integrated way. Digital life, ubiquitous intelligence and convergence of technology are among others leading trends of the future [240]. This "technologicalization" of the society gives birth to a large number of possibilities and opportunities for AAL solutions as they will fit to the needs a technology oriented and accustomed society has.

Hence, one can talk about a "technical society" ([187], p.2) where people will be trained and skilled in the handling of technology. The middle aged men and women of today who will be the seniors of tomorrow increasingly "avail themselves of private courses in further education facilities in order to equip themselves for the future "information society"."([238], p.57).

As a result, technology will even find access to areas that so far remained untouched by technology due to financial reasons and society's sceptical attitude. As an example the electrification of learning modules in the educational sector which will lead to paperless schools can be mentioned ([187], p.2).
On the other hand the high diffusion of technology implies a future where further growth and expansion of ICT technology will be limited as the market at some point will be saturated.

Therefore, the leading trend of the future will be the convergence of different technologies as people will be overloaded by too many devices and will thus request the integration of different functions into one device. The focus of customers' needs will be shifted from functionality to more comfortable and easy usability [221].

Impact on AAL

Summing up, the needs of an information society bring along further expansion of digitalization and the convergence of technology. Both aspects are necessary developments for the successful diffusion of AAL solutions. People's attitude towards digital technology will be more open-minded. They will have higher requests concerning the comfortable usage of technology which could be satisfied by integrated and intuitively to handle AAL products.

3.3.3.2 More Connected "Always On" Devices

In Germany mobile computer devices have become more and more popular within the last few years: In 2008 the volume of imports of such mobile computer devices has increased by 40% in comparison to 2007 and the trend is said to

continue [234]. In particular, the number of smartphone devices will grow rapidly. In 2012 more than 22% of the German population will possess a smartphone. That means that the number of smartphone owners will double within two years [198]. In addition to that fast mobile Internet becomes affordable and popular. In 2012 61% of the mobile users will have a 3G capable device [220].

Enabled by the rapid spread of mobile communication devices, being reachable and informed everywhere and at any time has become self-evident in today's societies. In 2011 88% of German employees stated that they were reachable for E-Mails and phone calls also outside their working hours. And almost 30% said they were even available around the clock [183].

However, being "always online" has not only become a requirement in the working life but also a need in social life, especially for younger people. New ways of communication, such as microblogging in social networks, give users the feeling of participation in their friends life, even if there is a distance of hundreds of kilometers between them. As a result 52% of young mobile phone users say that they feel disconnected from the world if they do not have their mobile phones with them. 91% of the participants of the survey apparently do not want to take that risk, thus they always keep their mobile phones less than one meter away ([228], p.6).

Impact on AAL

Future customers will be reachable at anytime of the day and in almost every situation. Furthermore, they will have a high need to be informed without a delay as well. AAL products can help to satisfy those needs. But the always on trend also causes changes in the work-life balance of people. The requirement to be reachable for the employer and colleagues even in the spare time blurs the border between work and life significantly. AAL products can give the opportunity to use the spare time more effectively for recreation by making everyday tasks easier and by keeping the border more clearly.

3.4 Barriers

After starting to compile the status quo of the society in regards to societal factor and its segmentation an emphasis was put in the investigation on trends. In the following section barriers are identified that occur not only when AAL service providers are not able to meet the attributes and needs of the customers but also when ethical principles and lifestyles are not sufficiently considered.

3.4.1 Social Barriers

The AAL service providers try to design their products and services in a way to best match the attributes and needs of their customers. But in today's fast

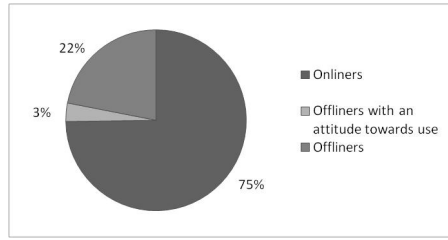

Figure 3.7: Internet use in 2011 in Germany
Source: ([208], p. 12)

moving world the needs of the society are constantly changing. In the following subsections barriers are identified that on the one hand emanate from trends within the society and on the other hand arise from the acceleration of the ongoing digitalization.

3.4.1.1 Digital Divide

Although it seems that society is already heavily involved in the digital world by writing emails, blogging or using social networks, a recent study, which was conducted by Initiative D21, shows that 22% of the German population, the so-called "Offliners", don't use the Internet at all ([208], p.12). Seventy-five percent of the population is online and represents the "digital society". But within the group of "Onliners" only twenty-five percent are using the Internet on a daily basis ([207], p.4).

The society is split into a digital and a non-digital part, Offliners and Onliners. The rather small group called "Offliners with an attitude towards use" lies in between both. It represents the people who plan to use the Internet in the foreseeable future.

The figures that investigate the Internet use of the German society are applied as an indicator whether people would or would not adopt AAL technologies and use AAL products or services. Offliners who do not use the Internet will hardly be willing to familiarize themselves with the use of digital devices. And within the group of Onliners a major share of 75% do not use the Internet on a daily basis ([207], p.4).
This could exhibit a barrier in regards to the goal of successful adaption of AAL products and services to the customer. Therefore the AAL service providers have to modify their products and have to enable intuitive use and facilitate the adaption of such technologies.

With increasing age, this barrier even gains importance within the society. As Figure 3.8 indicates, one can observe a severe shift from Onliners to Offliners. The population aged older than 70 consists of 72% Offliners, left with 25%

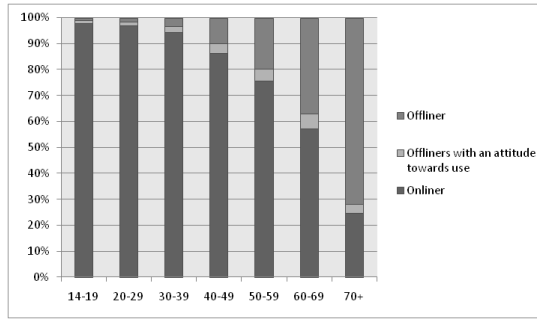

Figure 3.8: Internet use with respect to age groups (2011 in Germany)
Source: ([208], p.14)

of Onliners. But especially this market segment is highly interesting to the AAL service providers because elderly people are obviously in stronger need for assistant technologies.

Therefore, the providers have to find a way to motivate Offliners to use their products and services.

3.4.1.2 Technical Overstrain

The users' process of adapting technological innovations in terms of assistant technologies, can be compared to the five phases when dealing with a chronic affliction: denial, insurgency, negotiation, resignation, and acceptance [207]. The users need to overcome their missing affinity and refusal in order to enable the technology to prove its ability to make life more facilitating.

So far, many of the existing technologies in the AAL market do not properly satisfy the needs of the end users ([172], p.6). In most cases this is caused by wrongly designed technologies that have been developed without thinking about the actual needs and capabilities of the end users. During the development phase the producers of AAL products and services rather put an emphasis on the technological feasibility rather than focusing on the demands of the end users ([236], p.4). When using existing AAL products the customers often state that the use is counter-intuitive ([236], p.6). Therefore, users feel overstrained and are unable to familiarize with the products. A survey investigated technical problems of seniors when handling technical devices. 69% of the surveyed seniors stated that they stopped using a device due to complicated handling. To the question whether seniors decided not to buy a device due to complicated handling 59% answered with a "yes". It implies a correlation between the user-friendliness of a product and the decision making process when buying technical devices. Products which generate dissatisfaction reduce the likeliness of a successful market entry.

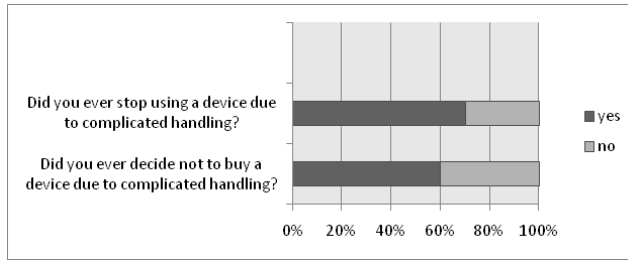

Figure 3.9: Seniors' adaption to digital devices
Source: ([236], p.6)

This potential barrier could be overcome by a more user-oriented approach where the end users, especially seniors, are integrated into the product development process at an early stage ([236], p. 5) in order to identify and take their special needs into account.

3.4.1.3 Information Overload

The increasing velocity of the creation of information has outpaced the peoples' ability to process it [215]. With the diffusion of the Internet, information is not preselected or canalized by editors but rather lashes down unfiltered onto the modern society. The task of reducing information complexity has shifted from the addresser to the recipient [215].

AAL technologies are very likely to amplify this information overload. As soon as the assistant technologies demand active participation and interaction such as decision making processes when e.g. an assistant system requires a selection from different options, they increase the complexity of reducing and processing information and rather add to the information overload.

Therefore, the AAL service providers on the one hand have to find ways to spare the end users from additional dealing and processing of information and on the other hand have to find opportunities where AAL is able to deal with the existing information overload. The key challenge is to enable people and computers to act together more intelligently ([215], p.2).

3.4.1.4 Disregard of Social Needs

A study conducted by TMS Infratest clearly shows that humans have an intense need for proximity. Among the surveyed Germans 95.5% state that proximity is very important for them and almost 50% relate physical closeness to the term proximity [218]. AAL customers might fear that using an AAL product could lead to communication via the Internet only or other indirect ways. For example, an old person in need of care might not want to talk to the care staff

over the Internet because they used to have one person that visited them on a regular basis. Another example could be an old person that used to be visited by its children because they wanted to check if their parent was alright. Now the children could know that AAL takes care of their parent and that they do not need to worry anymore.

Another need that AAL might restrict is the need of autonomy. If AAL takes over every single part of the customer's everyday life the person might feel that a part of their lives has been taken away from them. They might fear a loss of responsibility over their own life even though AAL only assists them in order to spend make time available elsewhere.

Therefore, AAL products need to be aware of these fears and handle it in a manner that allows people to see the real benefit of AAL products. It should not restrict a person in any way.

3.4.2 Ethical and Lifestyle Barriers

In the following barriers that are caused by ethical principles and individual lifestyles are identified and described. First, closer look at the reasons for skepticism against technology and why this can be a barrier for AAL products. Second, the question why individuals could refuse to use AAL products is considered.

3.4.2.1 Skepticism Against Technology

Skepticism against technology can have different reasons. On the one hand new technology will replace existing procedures in most cases. This means that there will be a familiarization phase. This presents a problem especially for older people because the willingness to learn and perception decreases in older ages [194]. For technologies that cannot be used in the worklife, also younger people might miss the willingness to work into new fields. This is because the worklife already requires to work into new fields constantly and working into new fields is exhausting for many people [186].

Distrust into new technologies

Skepticism can also be a consequence of distrust into the proper functioning of new technologies. This is particular important for technologies which can cause critical damage in case of malfunction. Due to the high level of complexity the vast majority of upcoming modern technologies is not understandable for people without profound technical expertise in the corresponding field. Those people without technical expertise have to trust on the judgment of the manufacturer. Especially technologies which are only used in very rare cases, such as emergencies, are affected by this distrust, since their users cannot convince themself by the regular use that the technology works reliably.

Global catasthrophes, like the meltdown in the nuclear power plant in Fukushima in 2011 reinforce that distrust, because they demonstrate that even systems under strict surveillance can fail [200].

3.4.2.2 Missing Awareness of the Need for Assistant Technologies

According to the Technology Acceptance Model (TAM) the attitude towards using a technology depends on the perceived usefulness and the perceived ease of use. Among other things they are influenced by changes of the user's image, that might come up with the use of the technology [188]. Assisting technologies can cause a decline of the user's image because the need for them reveals a weakness. This issue is comparable with some peoples' refusal to wear glasses even if they are necessary [209]. Not only how others see someone but also the self-perception can be affected by the use of assistance technology. This is particularly important for technologies that assists in old-age related problems. Someone who decides to use a helping technology first of all has to realize that he has a weakness. An example for an assisting technology that meets with rejection due to the missing awareness of getting old are hearing devices. A study reveals that many hearing impaired people refuse to wear hearing devices because they feel too young for them [225].

3.5 Conclusion

Although there are a lot of obstacles that AAL products and services will have to overcome, the opportunities that derive out of the trends will prevail. They will lead to benefits for the customers and open up a remunerative market to the AAL service providers.
One of the most important developments that can be observed is the demographic change Germany is facing. Therefore, the generation 50+ will be the largest customer group in the near future. Nevertheless, other interesting customer groups should not be left out. The uprising career orientation of women results in a need for assistance when they to manage with the combination of family and work successfully. Furthermore, the transition from an industrial society to a culture of knowledge leads to a change in work structure. Work life becomes more flexible and therefore family and work can move closer together, which enables a satisfaction of the urge to spend more time within the family. Another movement in the society is the increasing internalization of health and ecologic aspects, which makes people more aware of sustainability with respect to products and even to their way of production. In addition, peoples' growing open-mindedness towards technology enables the AAL industry to develop new products to facilitate the customers' lives. The simultaneously upcoming

barriers such as the earlier discussed digital divide must not be neglected in order to secure a successful integration into the modern society.

References

[170] *Bevölkerung Deutschlands bis 2060 – 12. koordinierte Bevölkerungsvorausberechnung (Begleitmaterial zur Pressekonferenz am 18. November 2009 in Berlin).* Statistisches Bundesamt, Wiesbaden; Gruppe ID, Pressestelle; Gruppe VIA, "Demografische Modellrechnungen", 2009. URL http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Presse/pk/2009/Bevoelkerung/pressebroschuere__bevoelkerungsentwicklung2009,property=file.pdf.

[171] *Europe in figures – Eurostat yearbook 2010.* European Commission, Luxembourg: Publications Office of the European Union, September 2010. URL http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-CD-10-220/EN/KS-CD-10-220-EN.PDF.

[172] AALIANCE – The European Ambient Assisted Living Innovation Alliance. Ambient Assisted Living Roadmap, August 2009.

[173] Ambient Assisted Living Joint Programme Website. URL http://www.aal-europe.eu/about-us. Accessed on 25.09.2011.

[174] Barbara Schmid. Leben in der Stadt – Leben auf dem Land (Studie zur Urbanisierung in Deutschland). URL http://presse.immowelt.de/fileadmin/Studien/Urbanisierungsstudie_2009/Urbanisierungsstudie_Gesamtbericht.pdf.

[175] Berlin-Brandenburgische Akademie der Wissenschaften. Fertilitätsdefinition der Berlin-brandenburgischen Akademie der Wissenschaften. URL http://www.bbaw.de/bbaw/Forschung/Forschungsprojekte/Fertilitaet/de/blanko.2009-07-30.3395106439. Access 01.09.2011.

[176] Statistisches Bundesamt. Gesundheit im Alter, February 2011. URL http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Publikationen/Fachveroeffentlichungen/Gesundheit/Gesundheitszustand/GesundheitimAlter5230002119004,property=file.pdf.

[177] Bundesministerium für Familie, Senioren, Frauen und Jugend. Alleinerziehende in Deutschland – Potenziale, Lebenssituationen und Unterstützungsbedarfe. In *Monitor Familienforschung. Beiträge aus Forschung, Statistik und Familienpolitik* , volume 15. December 2008. URL http://www.bmfsfj.de/RedaktionBMFSFJ/Abteilung2/Newsletter/Monitor-Familienforschung/2008-04/medien/monitor-2008-04,property=pdf,bereich=bmfsfj,sprache=de,rwb=true.pdf.

[178] Bundesministerium für Familie, Senioren, Frauen und Jugend. Startschuss für das Programm "Alter neu denken – Altersbilder", January 2011. URL http://www.bmfsfj.de/BMFSFJ/aeltere-menschen,did=166332.html. Accessed 01.09.2011.

[179] Bundesministerium für Familie, Senioren, Frauen und Jugend. Alter als Chance – demografische Entwicklung, January 2011. URL http://www.bmfsfj.de/BMFSFJ/aeltere-menschen,did=12342.html. Access 01.09.2011.

[180] Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU). Referat öffentlichkeitsarbeit. Umweltbewusstsein in Deutschland 2010. pages 10–60, 2010.

[181] BKK Bundesverband. BKK Faktenspiegel – Aktiv bleiben im Alter, Mai 2011. URL http://www.bkk.de/fileadmin/user_upload/PDF/Faktenspiegel/Aktuelle_Ausgaben/FS_1105_Aktiv_bleiben.pdf.

[182] Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e.V. Handy, Stereoanlage und MP3-Player bei Teenagern vorn. Presseinformation, May 2011. URL http://www.bitkom.org/files/documents/BITKOM_Presseinfo_Hightech_Jugendliche_11_05_2011.pdf. Accessed on 04.09.2011.

[183] Bundesverband Informationswirtschaft, Telekommunikation und neue Medien e.V. Erreichbarkeit ist für die meisten selbstverständlich. Presseinformation, 3. Juli 2011. URL http://www.bitkom.org/files/documents/BITKOM-Presseinfo_Erreichbarkeit_im_Job_03_07_2011(1).pdf. Accessed on 03.09.2011.

[184] Bundeszentrale für politische Bildung. Bundesamt für Politische Bildung-Frauen, August 2011. URL http://www.bpb.de/themen/FYH0WX,0,Frauen.html. Accessed on 29.08.2011.

[185] Centrum für angewandte Politikforschung. Zukunftsgesellschaft: Ordnungsprinzipien für das 21. Jahrhundert. pages 42 – 45, 1999. URL www.cap-info.de/triangle/download/Impulspapier.doc. Accessed on 01.09.2011.

[186] Commission of the European Communities. Adult learning: It is never too late to learn. October 2006. URL http://eur-lex.europa.eu/LexUriServ/site/en/com/2006/com2006_0614en01.pdf. Accessed on 04.09.2011.

[187] Corinna Langwieser. *Zukunftsletter*. Verlag für die Deutsche Wirtschaft AG, August 2011.

[188] F.D. Davis. Perceived usefulness, perceived ease of use, and user acceptance of information technology. In *MIS Quarterly*, volume 3-13, pages

319–339. Management Information Systems Research Center, University of Minnesota, 1989.

[189] Eike Wenzel, Anja Kirig, Christian Rauch. *Greenomics - wie der grüne Lifestyle Märkte und Konsumenten verändert*. Redline Verlag, 2009.

[190] Elisabeth Beck-Gernsheim. "Störfall Kind": Frauen in der Planungsfalle. In *Aus Politik und Zeitgeschichte*, volume 24, pages 26–32. Bundeszentrale für politische Bildung, 25/2008.

[191] Eurostat Website. URL http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/. Accessed on 04.09.2011.

[192] Dennis Spillecke Florian Baumgartner, Peter Breuer. Konsumtrends – Was Kunden von morgen wollen. In *Akzente*, volume 02. McKinsey & Company, 2010.

[193] Frank Swiaczny. *Aktuelle Aspekte des Weltbevölkerungsprozesses – Regionalisierte Ergebnisse der UN World Population Prospects 2004*. Bundesinstitut für Bevölkerungsforschung beim Statistischen Bundesamt, Wiesbaden, 2005. URL http://www.bib-demografie.de/nn_750456/SharedDocs/Publikationen/DE/Download/Materialienbaende/117, templateId=raw,property=publicationFile.pdf/117.pdf.

[194] Nicolas Gatzke. *Lebenslanges Lernen in einer alternden Gesellschaft*. Technische Universität Darmstadt Institut für Volkswirtschaftslehre Fachgebiet Finanz- und Wirtschaftspolitik, 2007. URL http://library.fes.de/pdf-files/stabsabteilung/05365.pdf. Accessed on 04.09.2011.

[195] Rainer Geißler. Armut in der Wohlstandsgesellschaft. In *Informationen zur politischen Bildung*, volume 269. Bundeszentrale für politische Bildung, December 2004. URL http://www.bpb.de/popup/popup_druckversion.html?guid=5EKME5. Accessed on 02.04.2011.

[196] Süddeutsche Zeitung GmbH. Leben in der Krise – das neue Wir-Gefühl. 2009. URL http://www.sueddeutsche.de/leben/leben-in-der-krise-das-neue-wir-gefuehl-1.442144.

[197] Goethe-Institut. Welche Megatrends die Zukunft prägen, 2008. URL www.goethe.de/markt. Accessed on 02.04.2011.

[198] Google, Otto Group, TNS Infratest, Trend Büro. GO SMART 2012: ALWAYS-IN-TOUCH. Studie zur Smartphonenutzung 2012. URL http://www.ihk-nuernberg.de/nbg/media/PDF/Kommunikation/go_smart.pdf. Accessed on 03.09.2011.

[199] Marlene Halser. Gesucht: Führungsfrauen. In *Zeit Online*. May 2011. URL http://www.zeit.de/2011/21/C-Frauen-Karriere. Accessed on 02.09.2011.

[200] Handelsblatt. Fukushima und die "German Angst", April 2011. URL http://www.handelsblatt.com/technologie/forschung-medizin/forschung-innovation/fukushima-und-die-german-angst/4029788.html?p4029788=2. Accessed on 04.09.2011.

[201] Barbara Hartmann. Gesundheitstrends 2010 – Der Healthstyle von morgen. 2008. URL http://www.barbara-hartmann-online.de/Gesundheitstrends2010.pdf. Accessed on 04.09.2011.

[202] Helmut Klages. Brauchen wir eine Rückkehr zu traditionellen Werten? In *Aus Politik und Zeitgeschichte*, volume 29, pages 7 – 12. Bundeszentrale für politische Bildung, 2001.

[203] Werner Heß. Ein Blick in die Zukunft – acht Megatrends, die Wirtschaft und Gesellschaft verändern, May 2008. URL https://www.allianz.com/static-resources/de/images/v_1214212317000/ein_blick_in_die_zukunft_acht_megatrends.pdf. Accessed on 04.09.2011.

[204] Dagmar Hoffmann. *Attraktion und Faszination Medien: jugendliche Sozialisation im Kontext von Modernisierung und Individualisierung.* Lit Verlag, May 2002.

[205] Matthias Horx. *Bayern 2020 – Megatrends und Chancen.* Bayerisches Staatsministerium für Wirtschaft, Verkehr und Technologie, 2002.

[206] Matthias Horx. Die Macht der Megatrends – Wie Globalisierung, Individualisierung und Alterung unsere Welt verändern werden. 2007. URL http://www.entega.de/fileadmin/downloads/industriekunden/megatrends_horx.pdf.

[207] Initiative D21 e.V. Die digitale Gesellschaft in Deutschland – Sechs Nutzertypen im Vergleich, March 2010. URL http://www.initiatived21.de/wp-content/uploads/2010/03/Digitale-Gesellschaft_Endfassung.pdf. Accessed on 05.09.2011.

[208] Initiative D21 e.V. (N)ONLINER Atlas 2011 Eine Topographie des digitalen Grabens durch Deutschland, 2011. URL http://www.initiatived21.de/wp-content/uploads/2011/07/NOnliner2011.pdf. Accessed on 05.09.2011.

[209] Institut für Demoskopie Allensbach. Brillenstudie 2008. March 2008. URL http://sehen.de/presse/stichwoerter/zahlen.php. Accessed 04.09.2011.

[210] Jan Goebel, Martin Gornig, Hartmut Häußermann. Polarisierung der Einkommen: Die Mittelschicht verliert. In *Wochenbericht des DIW Berlin*, volume 24. DIW Berlin, Berlin, Juni 2010. URL http://www.diw.de/documents/publikationen/73/diw_01.c.357505.de/10-24-1.pdf.

[211] Jan W. van Deth. Wertewandel im internationalen Vergleich – ein deutscher Sonderweg? In *Aus Politik und Zeitgeschichte*, volume 29, pages 23 – 30. Bundeszentrale für politische Bildung, 2001.

[212] Jutta Allmendinger, Christine Wimbauer. Deutschland, eine Klassengesellschaft?, December 2007. URL http://www.zeit.de/zeit-wissen/2006/06/Essay_Allmendinger.xml. Accessed on 31.08.2011.

[213] Katrin Gaßner, Michael Conrad. ICT enabled independent living for elderly – A status quo analysis on products and the research landscape in the field of Ambient Assisted Living (AAL) in EU27. March 2010. URL http://www.vdivde-it.de/publikationen/studien/ict-enabled-independent-living-for-elderly-a-status-quo-analysis-on-products-and-the-

[214] Juergen Kocka. *Chancen und Herausforderungen einer alternden Gesellschaft*. URL http://www.altern-in-deutschland.de/pdf/publikationen/05-HAW18-Kocka-S217-236.pdf. Accessed 01.09.2011.

[215] Peter Kruse. Digitalisierung der Gesellschaft: Und bist du nicht willig, so brauch ich Geduld, July 2010. URL http://carta.info/30238/digitalisierung-der-gesellschaft-und-bist-du-nicht-willig-so-brauch-ich-geduld. Accessed on 01.09.2011.

[216] Lohas Lifestyle. Das Zeitalter der Ichlinge geht zu Ende, 2011. URL http://www.lohas.de/index2.php?option=com_content&task=view&id=1370&pop=1&page=0&Itemid=81. Accessed on 01.09.2011.

[217] Frank Mackenroth. Deutscher Medienmarkt – zwischen Massenattraktivität und Individualisierung. Promedia-Verlag, 9 2008. URL http://www.promedia-berlin.de/fileadmin/Archiv/2008/09/promedia200809-online01.pdf. Accessed on 02.09.2011.

[218] Malteser. Weil Nähe Zählt. URL http://www.malteser.de/75.Weil_Naehe_zaehlt/75.06.NaeheStudie/studie.htm. Accessed on 04.09.2011.

[219] Marktrausch GmbH. Mehr Leistung, Schönheit, Genuss: Boom im Megamarkt Gesundheit. In *Health Trend Report*. 2008. URL http://www.marktrausch.com/docs/080403_PM_HealthTrendReport_SL_isa.pdf. Accessed on 04.09.2011.

[220] Mary Meeker, David Joseph, Anant Thaker. Internet Trends. March 2008. URL http://www.sherpalo.com/resources/InternetTrends031808.pdf. Accessed on 01.09.2011.

[221] M.K. Asthana, D.M.R. Panda. Technology Convergence. In *Delhi Business Review*, volume 3-1. January-June 2002.

[222] Nina Baur, Hermann Korte, Martina Löw, Markus Schroer. *Handbuch Soziologie*. Vs Verlag, September 2008.

[223] Horst W. Opaschowski. *Deutschland 2020. Wie wir mogen leben – Prognosen der Wissenschaft*. VS Verlag für Sozialwissenschaften, 2 edition, May 2006. URL http://books.google.com/books?id=CWS0ShLsT-QC&printsec=frontcover&hl=de&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false.

[224] Prof. Dr. Horst W. Opaschowski. Zukunftstrends. URL http://www.mctrier.de/fileadmin/mctrier/pdf/Opaschowski.pdf. Accessed on 01.09.2011.

[225] Corinna Pelz. *Das Stigma Schwerhörigkeit*. Median-Verlag von Killisch-Horn, 2007.

[226] Heiko Pfaff. *Pflegestatistik 2009 – Pflege im Rahmen der Pflegeversicherung. Deutschlandergebnisse*. Statistisches Bundesamt, Wiesbaden, February 2011. URL http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Publikationen/Fachveroeffentlichungen/Sozialleistungen/Pflege/PflegeDeutschlandergebnisse5224001099004,property=file.pdf.

[227] Richard Kauffeld, Abhishek Malhorta, Susan Higgins. *Going for Green. A CapabilitiesDriven Approach to Environmental Opportunity*, volume 10. Booz & Company, November 2009. URL http://www.booz.com/me/home/thought_leadership_strategy/reports_and_white_papers_me/ic-results_me?of_40585687=green&of_qid=49020087.

[228] Roman Friedrich, Matthew Le Merle, Michael Peterson, Alex Koster. *The Rise of Generation C: Implications for the World of 2020*. Booz & Company, 2010.

[229] Siemens AG. Urbanisierung und nachhaltige Entwicklung. In *Siemens Geschäftsbericht 2010*, page 28. 2010. URL http://www.siemens.com/annual/10/aufstellung/urbanisierung-und-nachhaltige-entwicklung.html.

[230] SINUS Markt- und Sozialforschung GmbH Website. URL http://www.sinus-institut.de/loesungen/sinus-milieus.html. Accessed on 04.09.2011.

[231] Statista GmbH Website. Zufriedenheit mit dem eigenen Einkommen, 2008. URL http://de.statista.com/statistik/daten/studie/179783/umfrage/zufriedenheit-mit-dem-eigenen-einkommen/. Accessed on 03.09.2011.

[232] Statistisches Bundesamt. URL http://www.destatis.de. Accessed on 05.09.2011.

[233] Statistisches Bundesamt Deutschland. Pressemitteilung Nr. 355, October 2010. URL http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Presse/pm/2010/10/PD10___355___12411.psml. Accessed on 31.08.2011.

[234] Statistisches Bundesamt Deutschland. Pressemitteilung Nr. 400, November 2010. URL http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Presse/pm/2010/11/PD10___400___51, templateId=renderPrint.psml. Accessed on 31.08.2011.

[235] Statistisches Bundesamt Deutschland. Wirtschaftsrechnungen 2010. Private Haushalte in der Informationsgesellschaft – Nutzung von Informations- und Kommunikationstechnologien, February 2011. URL http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Publikationen/Fachveroeffentlichungen/Informationsgesellschaft/PrivateHaushalte/PrivateHaushalteIKT2150400107004,property=file.pdf.

[236] Technische Universität Berlin Fachgebiet Arbeitswissenschaft und Produktergonomie. Nutzerabhängige Innovationsbarrieren im Bereich Altersgerechter Assistenzsysteme, 2011.

[237] Thomas Wällisch. Der Konsum von Technologie im Alltag. 2000. URL http://www.waellisch.de/home/Technolgie.pdf. Accessed on 04.09.2011.

[238] Ulrich Grainer, Wolfgang Hauschild, Susanne Schnorr-Bäcker, Irene Kahle, Ulrike Timm. *Information technology in enterprises and households 2005*. Statistisches Bundesamt, Februrary 2006. URL http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Presse/pk/2006/IKT/Pressebroschuere___IKT2005___english,property=file.pdf.

[239] Unterrichtung durch die Deutsche Bundesregierung. Sechster Bericht zur Lage der älteren Generation in der Bundesrepublik Deutschland – Altersbilder in der Gesellschaft und Stellungnahme der Bundesregierung, 2010. URL http://www.bmfsfj.de/RedaktionBMFSFJ/Abteilung3/Pdf-Anlagen/bt-drucksache-sechster-altenbericht,property=pdf, bereich=bmfsfj,sprache=de,rwb=true.pdf.

[240] Z-punkt GmbH. Megatrends. URL http://www.z-punkt.de/fileadmin/be_user/D_Publikationen/D_Arbeitspapiere/Die_20_wichtigsten_Megatrends_x.pdf. Accessed 04.09.2011.

Chapter 4

4 Political and Legal Framework

Sebastian Kobarg, Lukas Murmann, Sebastian Rehm, Conrad Schlenkhoff, Björn Verse

Facing the challenge of an ageing population, governments adopt policies that address the changing needs of elderly people seeking to stay active for longer and to live independently. Political initiatives aimed at a more efficient and individualized health care, as well as an increased social inclusion indicate that "ageing well" has become a key goal for policy makers in Europe. They recognize Ambient Assisted Living (AAL) as a promising technology path that can improve the quality of life of older people. In addition governments seek to boost the competitiveness of their information and communication technology (ICT) industries. Consequently, they try to realize a win-win-situation: shaping health and social care structures as well as enabling new business opportunities of Europe's ICT industries by promoting AAL technology. First steps include research funding on AAL and reviewing privacy regulation and standards.

However, policy and legal barriers for a successful and large-scale commercialization exist. While health care structures are insufficient to enable and successfully implement AAL, regulations on privacy and liability do not keep pace with the current technological developments. There is a gap between the current policy agenda and the legislation set in place: If AAL should become a breakthrough technology, substantial actions and efforts on an European level are required.

4.1 Introduction

Demographic change has become a widespread challenge for contemporary societies that affects all spheres of life. In order to maintain the high quality standard of living for the ageing population, policy makers are forced to identify and implement suitable measures that minimize the risks and create opportunities arising from these changes. In seeking an appropriate response to the imminent challenges, public entities are also looking at the potential of modern communication and information technology, which is embodied in Ambient Assisted Living (AAL).

As AAL and its applications are likely to impact several areas of individual and social life, the current political and legal framework might have to be adjusted accordingly. Therefore this chapter analyzes the trends of the current legal and political framework impacting AAL as well as illustrating the wide scope of these technologies and regulatory and legal issues arising from this technology. Due to the diversity of legal systems within the European Union (EU), this chapter primarily focuses on the situation in Germany, considering and including European policy developments.

First, in section 4.2.1 political stakeholders and their goals involved in the development of AAL are introduced before an overview of the current programs supporting AAL research and commercialization is provided. Section 4.2.3 analyzes the relevant fields of regulation affecting AAL and therefore reviews the current national and European regulation concerning privacy and security, accountability as well as health care.

The purpose of the subsequent section 4.3 is the identification of policy trends and the evaluation of their impacts on AAL in the close future: The trends are grouped in four categories. The first being health care, as policy reforms are increasingly visible and vital to AAL health care related applications. The second category identifies political trends in technology and economics, including the further development of the communication infrastructure as well as a unified digital market in Europe and their influence on the technological development and diffusion of AAL technology. In the third cluster the trend of social, political and economic inclusion is depicted and brought in conjunction with the potential benefits for AAL enhancement. The illustration and evaluation of current policy trends in privacy and data protection, involving the harmonization of privacy legislation across Europe, consumer protection initiatives and the development of privacy standards concludes this section.

Finally, possible remaining barriers for AAL technology are discussed in section 4.4: How high is the regulatory burden? Are the existing funding programs sufficient? Do AAL applications provide an appropriate tool in medical care? Finally, the question is raised whether the diversity of the EU's member state's national welfare and health care systems poses a barrier for a widespread adoption of AAL technology.

The conclusion summarizes the key findings of this chapter and illustrates the overall assessment of the political and legal framework of Ambient Assisted Living.

4.2 Status Quo

The current state of regulation and political measures defines the foundations for future trends. In order to outline the current political environment, the following sections describe political stakeholders, ongoing incentive measures and regulatory issues relevant to AAL.

4.2.1 Political Stakeholders and their Interests

One of the most ubiquitous stakeholders regarding AAL is the European Commission (EC). The commission tries to tackle the demographic change and must adapt the European legal framework (see 4.2.3) to the disruptive innovations caused by the advent of digital technology. National governments are facing the same challenges; they implement legislation within the boundaries defined by the EC.

Private stakeholders include industry alliances (e.g. the European Ambient Assisted Living Innovation Alliance, AALIANCE [243]). The industry's main interests include standards, a coherent and unified legal framework as well as support for research and development of AAL products (see 4.2.2). However, the success of AAL still depends on adoption of the new technology by the overall population. They form a very diverse group with various needs, capabilities and attitudes towards digital technology. Interests of consumers include safety and comfort, health and care as well as entertainment. Finally, growing privacy concerns (see section 4.2.3.1) require these needs to be addressed in a privacy-aware manner.

4.2.2 Incentives

Available funding programs for AAL differ by various characteristics: Some programs require projects to have a focus on basic research, while others are targeted explicitly at product development and commercialization. Some programs are initiated by the European Commission, others by national governments. Finally, the size of the supported entity or the multi-nationality of the project consortium may be a criterion of eligibility for a specific program.

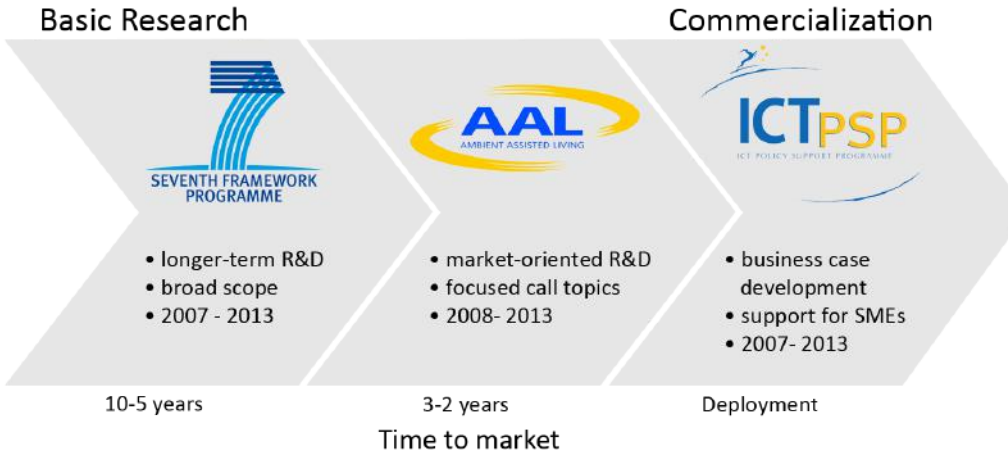

Figure 4.1: European Funding Programs for AAL
Source: Adapted from [245]

4.2.2.1 Research Funding

The 7th Framework Programme (FP7), a seven year research initiative (2007 - 2013) is the European Union's main instrument for research funding [265]. It has a total budget of € 50B, of which € 9.1B are dedicated to ICT funding [264]. The FP7's ICT Work Programme for 2011-2012 lists research on "Health, Ageing Well, Inclusion and Governance" as one key challenge to be solved [274]. Funding by the FP7 is mainly focused on basic research and research by "innovative companies" [265].

Another European funding program is the AAL Joint Programme (JP) [242]. The JP was initiated in 2008 and is set up until 2013 with a total budget of € 700M. It does not fund product development, but funded projects must have the potential time-to-market of two to three years after the end of research. Project eligibility criteria require multi-national consortia and the participation of at least one SME. Furthermore, the projects must include the complete value-chain and at least one end user organization [241]. The maximum total project budget is € 7M with a maximum of € 3M funding from the AAL Joint Programme.

The German Federal Ministry for Education and Research supports 18 projects under a program targeted at AAL research [285] with a total budget of € 45M. The eligibility criteria for project consortia are similar to those of the AAL JP, but project sizes and the funding budget are much more diverse. Project

budgets range from € 1M to € 41M with 50-60% of the budgets being funded by the federal government.

4.2.2.2 Support of Product Development

Small and medium sized entities in the field of ICT can receive funding from the European Information and Communication Technologies Policy Support Programme (ICT-PSP) under the Competitiveness and Innovation Framework Programme (CIP) by the European Commission [271]. The program does not fund basic research, but "innovations that have moved beyond the final research demonstration phase". ICT innovations in the field of "health, aging well and inclusion" are explicitly included in the five focus themes for the ICT-PSP.

National funding programs for ICT-SMEs and business-startups do also exist. Digital Germany 2015 [284] lists several funding possibilities, again with emphasis that ICT can "make a major contribution to good, effective and efficient assistance in caring for older people" [284, p.29].

4.2.3 Regulation

Whereas AAL solutions are affected by various domains of legislation, this section is limited to the presentation of three regulatory fields that bear the highest potential for impact on AAL, namely data security and privacy, liability and health care.

4.2.3.1 Data Security and Privacy

AAL systems are normally connected to the internet and often work with huge amounts of data[244, p. 1]. Different sensors may track the customers' everyday life and send their data to entities outside of their influence. Therefore, data privacy is an important aspect in AAL systems.

It is not only a German topic but also a European one. Since 2009, the right for data privacy is a part of the European Charter of Fundamental Rights [277, §8] and there is a European data protection guideline. In Germany, this right derives mainly from the right for informational self-determination and the secrecy of telecommunications [332, p. 35/36]. Moreover, AAL touches diverse fundamental rights [336] and also the Bundesdatenschutzgesetz and the Telemediengesetz [332, p. 74].

Naturally, there are numerous consequences for the implementation of AAL from these laws. The first and foremost one is that the collection and use of any private data is forbidden as long as the affected person does not give his or her informed consent [318, p. 1]. This means that there have to be written agreements informing the customer of all data collection and use [323, p. 210]. With regard to health information, the agreement has to mention them

explicitly. Additionally, the data must not be used for any purpose not given in the agreements [332, p. 40].

There are only few exceptions when this regulation is not applicable. Consent is not required if only anonymous data is collected or pseudonyms are used. However, in this case it must be ensured that connecting this anonymous data to a real person is "very difficult" and not possible through an automated approach [332, p. 41].

Furthermore, any automated decision based on the collected personal data is forbidden in most cases [249, §6a]. An entity which collects data has to grant the customer disclosure about the collected information, as well as to give him the ability to rectify mistakes or even delete the data [318].

4.2.3.2 Liability

As in most European countries, two general sources for possible liability claims can be distinguished in Germany: On the one hand claims can be based on unfulfilled contractual obligations [252, § 280]. These obligations depend on the underlying contract and are in some cases complemented by standards assumed by law or the jurisdiction. On the other hand, claims can result from liability in damages. Liability in damages is applicable in the case of injury of life, body, health, freedom, property or another right of another person [252, § 823].
In the following, an overview of liability concerns that are relevant to possible AAL applications will be given.

Liability for Privacy

As mentioned previously, the field of privacy is regulated by the Bundesdatenschutzgesetz (BDSG). Article 7 of this act grants the right for damages to persons impaired by the illegitimate use of their data [249, § 7]. However, the prevailing view does not foresee damages for intangible injuries [297, § 7 Rn. 12]. The BDSG prescribes a shift of the burden of proof: The defendant has to deliver the proof of exoneration [249, § 7]. This implies the need for high standards in data security as well as in the quality assurance and documentation of these security measures on the provider side.
Moreover, the unlawful use of data can be regarded as an injury of the personal rights, namely the right for informational self-determination. In this case, the claimant can also demand compensation for intangible injuries. Yet, successful claims regarding privacy are comparatively rare due to the fact that the defendant is usually able to deliver proof of exoneration [332, 5.2]. This might change, if Germany implements a guideline issued by the European Union, according to which a defendant would be liable for damages regardless of their own culpability [253, Art. 23].

Liability for Medical Malpractice

Due to the absence of laws dedicated to this very topic, regulation on medical malpractice is driven by the established practice of the courts. Again, claims can either be of contractual nature or stem from the law of torts. Due to the high degree of responsibility, the measure of duties used for doctors is comparatively high and aligned to the so called "medical standard" [311, § 823 Rn. 147]. This medical standard also has to be applied in evaluating all auxiliary devices used by doctors during treatment. With regards to AAL technology this implies that the doctor has to ensure the correct functioning of all devices related to the treatment on his own as well as on the patient's side. Otherwise he might be held responsible for malpractice despite proper medical treatment [332]. In order to assess whether a device fulfills the medical standard, the following characteristics have to be verified: Reliability, practicability, superiority over alternatives, cost and availability [329].

Liability for Products and Medical Devices

Technological products used in AAL solutions are subject to the Produkthaftungsgesetz. Producers of technology are liable for damages that occurred during the use of their products independently from their culpability. Generally, all contributing parties to the product are jointly and severally liable [313, § 1]. The same regulation applies to medical devices. Due to the sensible applications in medicine, medical devices have to undergo a certification process [307, § 6]. Prerequisite for a certification is the satisfaction of several standards, which are higher than those for regular products. The question whether a certain product has to be classified as a medical device is complicated. As of now, it is likely that many components of an AAL system would have to be categorized as medical devices, since they at least partly serve a medical purpose [332].

4.2.3.3 Health Care

AAL systems are particularly envisioned to be used for health care related applications. Therefore specific standards of the health care and social security law apply to those AAL systems that are specifically in use for health care purposes. They may cause the enforcement of particular legal standards that go beyond the broad privacy and accountability legal framework.

Current health care law forbids distant medical treatment [250, § 7 Abs. 3]: Physicians are not allowed to consult and treat patients only through long-distance media channels like print, telephone or internet. Therefore, health care applications of AAL systems have to be embedded within a broader personal medical therapy.

One of the central cornerstones regulating AAL systems designed for health care applications is the principle of medical confidentiality [327][247, § 9]:

Medical data and information is by law considered to be highly sensitive data that has to specially protected [297, § 9 Abs. 3]. The principle of medical confidentiality covers a broad scope of information like medical diagnosis, treatment plans as well as medical results. Hence, the principle of medical confidentiality is in conflict as AAL service providers and other third parties involved could easily access patient data [256]. While the German health care law allows patient data to be shared to a certain extent with other involved physicians and health care insurances, AAL end users still have to agree on the release of their data if third parties are involved [324, § 140].

AAL systems are further affected by the obligation for medical staff to properly record and document information originating from medical treatment [298, p.173]: Thus, AAL systems have to be designed to support proper documentation of patient data. Also data has to be deleted automatically at regular intervals.

4.3 Trends

The broad diffusion of AAL technologies will also depend on future decisions of policy makers. This chapter depicts political plans and possible future actions expected to have impact on AAL. As current policy makers envision AAL systems particularly for elderly people and other persons in need, the focus of the analysis lies first of all on the policy trends of the health care sector in the first section while other policy areas are not analyzed which might have an impact on a broader imaginable consumer field of AAL. Afterwards, the influence of politics on the economic and technological future of AAL is shown in the subsequent section. The third section discusses the attempt to include all citizens in social and working life for as long as possible. At last the expected changes in privacy and data protection laws are portrayed.

4.3.1 Health Care

The health care sector is under constant changes through political actions. However, the approximate trend of future actions is already visible. The subsequent sections cover policy's emphasis on cost efficiency, move towards preventive medical applications and establishment of new primary care infrastructures.

4.3.1.1 Enforcing Cost Efficiency and Quality Measures in the Health Care Sector

Costs for the medical treatment of elderly people currently sum up to the half of the overall public health care spending, although this age group represents just one fifth of the whole population [309]. As a result, the German health care system already faces a highly problematic revenue-cost-ratio: In comparison to other countries, Germany's spending on health care is particularly high [304].

In fact, almost all policy reforms of the last decades were aimed at stabilizing health care costs [328, p. 35 et seq.].

Policy makers are aware of the need to introduce more cost efficiency by lowering public spending on health care [320, p. 159 et seq.]. Past policy actions in this area have been assessed on their contributions to cost efficiency [258, p. 101]. The release of the Gesundheitsmodernisierungsgesetz in 2004 marked the beginning of an ongoing trend to address the rising costs of long hospitalization, slow and uncoordinated primary care in the outpatient segment and overmedication [296]. Health care insurance holders will increasingly have to individually co-finance certain medical services and appliances. Furthermore, competition and output orientation among the inpatient and outpatient health care entities will increase as hospitals and physicians have to implement new quality measures [321, p. 331 et seq.].

Impact on AAL

The current policy trend towards more cost efficiency and increased quality and competition measures is beneficial to AAL systems: They can help to optimize medical treatment by enabling faster and well-coordinated interaction between different health care entities. AAL systems also enable new opportunities to better monitor and implement quality schemes in the health care sector. Furthermore, individual patients might be able to co-finance health care applications of AAL systems, thereby lowering public spending on health care.

4.3.1.2 Promoting Prevention, Early Detection and Personal Responsibility of Patients

Health care policy makers increasingly underline the importance of prevention and early detection of diseases [321]: Especially prevention measures of widespread public diseases like adiposity and rheumatism is a key factor to lower costs that would otherwise have caused cost intensive longtime symptomatic medical treatment. Policy makers become increasingly aware of the benefit of preventive health care action that assesses individual health risk factors at an early stage [308].

In addition, current health care reforms are characterized by a shift towards more individual responsibility [300]: Patients are urged to play a more active and self-dependent role in medical therapy with emphasis on their personal health and lifestyle [331].

Impact on AAL

AAL systems are particularly designed to monitor and detect diseases at an early stage, and therefore fit into the current shift towards more prevention and

self-dependency. They can inform and coach people with regards to individual health care risk factors and minimize unhealthy lifestyle and personal behavior.

4.3.1.3 Disseminating New Integrated Primary Care Infrastructures

The increasing lack of young and skilled medical staff alerts policy makers to secure the current status quo in health care provision [321, p. 75 et seq.]: Especially problematic is the foreseeable lack of general physicians in rural areas that provide basic outpatient health care to mostly elderly and socially isolated persons [319, 326].

The legislature is in the process of creating a new integrated health care infrastructure that bridges the traditional barrier between inpatient and outpatient health care providers. With the Wettbewerbsstärkungsgesetz [338] hospitals, practitioners and pharmacies will have the opportunity to build up ambulatory health care centers that open up new ways of medical therapy, especially for those with chronic diseases demanding highly individualized care. Those new health care centers are characterized by increased communication and coordination requirements for all different and involved health care providers: For example practionners, who will take care of their chronically ill patients on a regularly basis, will have to reinsure and coordinate medical treatment plans with specialist physicians. A future integrated health care sector, which embodies cross-linked inpatient and outpatient physicians as well as pharmacies and other health care entities, will highly rely on expanded and interconnected IT and communication infrastructure.

Furthermore, the legislature aims to strengthen the role of general physicians as "gatekeeper" in the health care system: Health care insurances increasingly remunerate general physicians for giving an overview on the individual health status as well as on guiding them through the different steps of their specialized therapy [312].

Impact on AAL

Since current health care policy aims to overcome traditional boundaries between the inpatient and outpatient sector and to create new integrated and individualized ways of medical therapy, AAL systems fit into this trend: On the one hand, they can bridge time-wise and spatial distances between practitioners and patients. On the other hand, AAL systems offer new ways of interaction and communication for different players that enable general physicians in rural areas to get advice from expert physicians.

4.3.2 Economics & Technology

Political actions shape the framework for economic developments and move focus towards distinct technological trends. Next, the political willingness to

design and enforce standards is described. Thereafter, movements towards a future-proof communications infrastructure and a unified European digital market are depicted.

4.3.2.1 Enforcing Standards and Certification

Standards are often considered as barriers for innovation. That is not the case in ICT industries [278]. One of the main pillars of the Digital Agenda of the European Union is "Interoperability and Standards". The EU recognized that, in order to stay competitive, the European ICT sector has to have universally valid standards, especially for the interoperability of devices. [267]
In detail the European Commission wants to propose legislature that ensures the interoperability of ICT devices [267, Action 21]. There will not only be new European-wide standards, but also rules a standard must adhere to, to be recognized as such [267, Action 22]. Furthermore, the Commission wants to enforce compatibility and open standards in order to restrict dominant market players from locking-in customers [267, Action 25].

Impact on AAL

The envisioned AAL services often use products of different manufacturers. Therefore, interoperability standards need to be established. In the light of the Digital Agenda, the development of a closed AAL platform by a few market players is not an option for the future. Along with the rest of the European ICT sector, the emphasis will be shifted towards open standards which foster the acceptance among customers for such new products. At the same time, competition will be harder in the market as there will be the same conditions for everyone.

4.3.2.2 Improving Communications Infrastructure

Both the European Commission and national governments have committed themselves to the improvement of Europe's broadband infrastructure. In the following, political plans of action, related ICT funding programs and their impact on the AAL market are described.

The Digital Agenda for Europe is a plan of roughly 100 actions, amongst them several that specify concrete targets for broadband internet penetration. The announced actions include the "reinforcement and rationalization of high-speed broadband through EU instruments by 2014" [267, Action 43] or the demand that member states use existing structural and rural development funds in order to finance high-speed network infrastructure [267, Action 48]
The Digital Agenda sets precise goals [266] for the speed and coverage of the member state's network infrastructure: 100% basic (> 2Mbps) broadband coverage by 2013, 100% fast (> 30Mbps) broadband coverage by 2020.

But ICT is not only a European topic; there also exist German support programs for ICT, summarized by the Digital Germany 2015 roadmap [284]. Digital Germany was agreed upon by the German government in November 2010 [282]. It sets targets that are either in line or even exceed the ones set by the Digital Agenda. For example, the German government aims to make high-performance networks (> 30Mbps) "available for at least three-quarters of the population by the end 2014" [284].

In 2010, more than 75% of German households already had access to basic broadband internet [273]. In order reach the EU target of 100% basic broadband coverage by 2013, the remaining households, mostly in rural parts of Germany, must be provided broadband access as well. However, it is often not economically feasible to operate broadband networks in such areas. Affected communities can apply for support from a rural development fund [295], a funding scheme that was proposed by Action 48 [267] of the Digital Agenda.

Impact on AAL

Most AAL services require fast internet connections for both up and downstream [266, p. 5]. Fast internet for video streaming is a key requirement for entertainment, communication and health (telemedicine); E-Health technologies like Remote Examinations require fast and reliable upload of medical log data to remote health care centers. The increasing availability of basic and fast broadband connections thus helps address a severe barrier for the diffusion of AAL services.

4.3.2.3 Unifying the European Digital Market

The Digital Agenda for Europe proposes a set of actions to make the European Digital Market more homogenous, thus making it easier to provide services not only on small national markets, but under a unified legal framework for the whole European Union.

The scope of these efforts spans a variety of topics including financial transactions, e-commerce or copyright of creative works. For example, Action 9 of the Digital Agenda addresses that "E-Commerce is still insufficiently developed in the EU" [267], while Action 4 proposes a stakeholder debate on the European digital content market. It raises the question whether the member states should further integrate copyright exceptions and limitations and states that the Commission will "assess whether further measures like legislative proposals are needed" [267].

Impact on AAL

Ambient Assisted Living is not only about technology; it's about services as well. Such services may range from entertainment (games, video-on-demand)

and communication to care or telemedicine. However, Europe's fragmented legal frameworks for e-commerce and digital services still pose a severe barrier for the diffusion of such offers. The discussed actions - a key pillar of the EU Digital Agenda - address this issue and may lead to a more competitive and diverse market for digital goods.

4.3.3 Labor & Social

All European countries are facing challenges from demographic change. These fundamental, serious developments have complex consequences for European and national labor and social policies. In the following the political and legal trend of inclusion with its labor and social components as well as their impact on AAL is depicted.

4.3.3.1 Inclusion: Enabling Social Participation

In June 2011, the German Federal Ministry of Labor and Social Affairs issued the national action plan "einfach machen - Unser Weg in eine inklusive Gesellschaft" ("Make it easier - Our way to an inclusive society") with the aim to achieve an inclusive society in which from the beginning all people with or without disabilities live together and self-determined in all spheres of life. This principle of equal social, economic and political participation, regardless of disability, gender, generation, class and geography, requires the same quality and standard in each sphere for all people [290, p. 8]. In the following the policies and measures enabling the social participation of elderly and disabled people are depicted, as due to the demographic change their share within the population and thus the political awareness for them is going to rise [294].

As the creation of an age-appropriate and disability-friendly environment is of major importance in order to enable elderly as well as disabled people to socially participate, the German government promotes the development of inclusive social areas [290, p. 71]. Federal and state governments promote the (re-)construction of age-appropriate housing in form of various own or third-party projects and initiatives [293, 288, 287]. In addition to constructional aspects such as accessibility, these projects consider both the availability of technical equipment as well as of support services and networks with the goal to facilitate independent living [290, p. 71]. Furthermore, state and local authorities encourage new living and housing programs such as multi-generation houses and assisted living models to enforce participation [286].

Beside the prerequisite of new living and housing solutions for elderly and disabled people, the government is aware of the necessity of their participation in culture and leisure. Based on the legal principle of self-determination and social participation of handicapped people [325, § 9 par. 3], the above mentioned action plan declares the need to establish venues for encounter and guidance as well as support and network structures [290, p. 79].

Recognizing the necessity to include elderly and disabled people in political life, the government also initiated the eGovernment strategy and eParticipation offerings. This enables them to access information and participate in the political decision-making process [292].

Impact on AAL

The political shift towards social inclusion may have a positive impact on the development and adoption of AAL, as the purpose and applicability of AAL fits into the political agenda and is partly explicitly mentioned. On the one hand, AAL enables elderly and handicapped people to live independently and self-determined. On the other hand, it facilitates participation as well as support and network structures [244, p. 31-32]. Hence, AAL could ease the development towards an inclusive society and therefore enhance the public and private interest and willingness to invest.

4.3.3.2 Employability: Enforcing Equal Employment Opportunities

The demographic change has a significant impact not only on the society, but on the employment market as well. It is estimated that there are 40% more people in the age between 55 and 64 years and the share of 65+ year olds will rise up to 23% in the year 2020 in Germany [279, p. 1]. This demographic impact on the employment market is reinforced by the increased employment rate of elderly people and the planned raised pension age up to 67 in Germany. The new employment strategy therefore promotes active ageing in terms of an increasing participation within the labor market, working more and for additional years and on a more flexible basis [263, p. 13-19].
The European Commission goes beyond this and targets an employment rate of 75% for women and men aged 20-64 by 2020. Within the EU 2020 inclusive growth strategy the European Commission aims especially at the increasing employment of women, young, older and low-skilled people. Furthermore, the European Commission targets the improvement of educational attainment and lifelong-learning in order to enforce equal employment opportunities for all people [272].
These developments and current political targets on a European and national basis reveal the need for policies and measures in order to arrange the employment market accordingly. Apart from raising the retirement age, the government initiates programs which aim at the improvement of the employability of older workers through for example training and development programs in order to help older employees who lose their jobs to find new employment [280].
Furthermore, the government promotes the research and development of new employment and work-life-balance models, as for example the need of flexible working hour regulations [281]. However, the national labor policies do not only aim at the employability improvement of elderly people, but also at the increase

of the employment rate and the enforcement of equal employment opportunities for women, young and disabled people, partly based on the General Act on Equal Treatment [246].
Through programs fostering the return to work of mothers, the proposed female quota and part-time working models, the government wants to facilitate the compatibility of family and career [289].
Besides, the previously mentioned action plan towards an inclusive society particularly aims and promotes the work life participation of disabled people. Based on the equality act and the convention on the rights of persons with disabilities, the action plan includes measures such as government grants and employment programs for the three million disabled people in working age [290, p. 32].

Impact on AAL

In the context of improving the employability and enforcing equal employment opportunities, AAL applications and functionalities could play a fundamental role. AAL could give support for active ageing through considering the needs of elderly people at work and supporting appropriate working conditions. Furthermore, AAL facilitates working at home as well as the access to working space and stations [244, p. 51-56].
Besides, AAL enables people to participate and network. It facilitates coordination and communication and therefore could foster the compatibility between family and career, a better work-life-balance and alternative employment models. Hence, the aforementioned policies and measures may support and even include the adoption and use of AAL services and functionalities in the future.

4.3.3.3 E-Inclusion: Lowering the Digital Divide

The active use of information and communication technologies (ICT) has become partly a prerequisite in order to participate in social, economic, cultural and political life [262]. Hence, people excluded from ICTs are disadvantaged with regard to work, access to information and social relations.
Being aware of this, the European Union as well as the German government has launched numerous programs and initiatives with the aim to lower the digital divide (see 3.4.1.1). Within the Digital Agenda for Europe for example, the e-Inclusion strategy compromises programs which enhance the accessibility, adoption and use of ICT in order to help especially elderly and disabled people to participate in the digital society and gain access to services of direct interest to them such as eLearning, eGovernment and eHealth [269]. Furthermore, digital literacy, skills and inclusion are key factors to increase their employability [270].

Impact on AAL

Lowering the digital divide involves an increase of adoption and use of ICT. As AAL technologies are mostly dependent on ICT, the European and national programs partly also promote their development and implementation [262]. Additionally, they create awareness with regard to the benefits of AAL for potential customers.

4.3.4 Privacy

In today's digital society, lawmakers struggle to adjust their privacy protection laws to the reality. The following paragraphs take a closer look at impending changes in privacy laws and their respective impact on AAL. The EU tries to align the diverse privacy laws of its member states. It further wants to put emphasis on clarifying and enforcing data subject rights; an approach that is also pursued by the German government. New standards for privacy are planned.

4.3.4.1 EU Leading towards Unified Privacy Regulations

The protection of privacy has a history in the European legislature. It is part of the European Convention on Human Rights [276] and later on was clarified in two European directives. The first one was the Data Protection Directive, which was adjusted and extended by the ePrivacy Directive [303, p. 3]. As a consequence, the governments of the European countries already had to implement the ground rules which were given by these directives. However, the EU wants to further expand their directives on privacy and data protection [267, Action 12]. With the acceptance of the Lisbon Treaty, the EU Commission now has more power to enforce data protection and privacy legislation on the Member States [306].

Viviane Reding, the EU Justice Commissioner, made the amelioration of the European data protection framework her top priority [302]. She wants to present first proposals as early as the summer of 2011 [315]. In the Digital Agenda, the EU acknowledged that inconsistent data protection laws within the federation pose a threat for ICT companies. Therefore, a homogenous European law on privacy and data protection is the target. [267, Action 12, 35]

Impact on AAL

Many of the envisioned AAL services rely heavily on the collection of private data. At the same time, the services involve cooperation between two or more companies, sometimes located in different countries. This means that private data will cross borders. A common European legislation on data protection will help minimizing risks for companies by clarifying the judicial responsibility and

it may further the acceptance of AAL services by lessening privacy concerns of end-users. Moreover, a consistent legal framework eases the commercialization of AAL applications throughout the European market.

4.3.4.2 Government Strengthening Consumer Protection

The federal government and specialists alike acknowledge that the current German data protection laws are not up to the challenges of the newest technologies [322, 291]. Hence, changes to the legislature on this topic are inbound on a national as well as on a European level [337, 315]. In Germany, the Enquete Commission on Internet and Digital Society has been formed to find and formulate a plan of action on privacy laws. The laws for data protection always move in the field of tension between moral rights and freedom of speech [259, p. 1]. However, different commissions and authorized persons who counsel the legislative on this matter agree that the rights of the data subject need to be strengthened and that an expansion of the laws is necessary [302, 260].

One of the demands is to force companies to adhere to the principle of "privacy by design" [322]. This means that the different aspects of data protection already need to be considered when developing a product. Furthermore, it is proposed that a lot of regulations, which are mostly implied in the current laws, shall be clarified or even made into new laws. The right of the aggregation subject to be informed about any stored data and its purpose shall be strengthened. At last, it is recommended to increase consequences for infringement of data protection requirements. [302, 261]

Impact on AAL

On the one hand, clear and updated data protection laws will bring judicial security to AAL companies. On the other hand, the direction which the discussion takes, especially the emphasis on the rights of the data subject, will also bring more privacy regulations for AAL services and products. To avoid being blindsided by new laws, AAL services already have to incorporate "privacy by design" and the respective companies have to prepare for the implications of possible new laws. A highly regulated data privacy law also can help customers to trust new services and products.

4.3.4.3 Policy Enforcing Privacy Standards and Certification

Data privacy is a critical topic in our society and the governments acknowledge that. The German government began to reprimand companies which are too careless concerning private data [254]. However, a lot of new technologies like AAL, rely on the collection of data to provide a better service [317]. To build trust in such new technologies, politics wants to enforce the use of privacy standards and certification [283].

In cooperation with the EU, the Unabhängiges Zentrum für Datenschutz (ULD) developed a first certificate, the European Privacy Seal (EuroPriSe). This is a possibility for companies to show their compliance with European data protection rules. [248]

On a national level, Germany seeks to advance this and to implement the certification process already planned in the BDSG [249, §9a]. Nevertheless, the necessary elaboration of the certification procedure is missing and the last attempt to put the law into effect failed [255]. Currently, a trust is planned which should develop a seal of approval concerning data protection [310]. This trust will then also carry out the certification process.

Impact on AAL

Data protection scandals [337] and the large-scale data collection of companies like Google are making people more cautious in handling their private data. An AAL service needs trust of the users in its capability to protect their data. This trust could be reinforced by commonly acknowledged standards. Therefore, a well-received data privacy certificate could be crucial in the marketing of AAL services.

4.4 Barriers

Policy rarely acts preventive, but rather as reaction to social or technological changes. As political procedures are often slow, new technologies like AAL face barriers through a dated legal framework. Therefore, the next sections deal with the problems of AAL regarding regulation and facilitation. Additionally, the issue of reimbursement is described. The last section shows the role of the diverse European health care systems as hindrance for the development of AAL services.

4.4.1 High Regulatory Burden and Uncertainty

After a thorough look at the fields of law related to possible AAL applications, it becomes clear that certain legal questions have to be answered prior to a broad commercialization of the technology. Some of these issues could possibly cause an increase in cost or even lead to the delay or prohibition of isolated AAL functions. Thus, these factors have to be considered as barriers. In the following, the most severe issues regarding legal complexity and uncertainty as well as regulatory burden will be explained shortly.

Legal Complexity

Most AAL business models proposed so far are characterized by a large number of involved parties on both, the provider as well as the customer side [299, slide 9]. Hence, the overall AAL framework will include multiple contractual relationships, side by side with wide-ranging flows of information and monetary means [299, slide 9]. In order to avoid incomplete contracts, the set-up of the legal backbone for AAL systems is thus likely to cause high transaction cost for the design and enforcement of the underlying contracts [251, page 38]. Especially with regards to liability issues, the internal relationship between the suppliers and providers has to be defined clearly. Valid for other topics as well, this issue becomes quite clear upon looking at the product liability law: According to German law, everyone involved in the processes of manufacturing and trading a product is considered as a "manufacturer" in the legal sense [313, § 1] and hence liable jointly and severally [332]. The individual responsibilities can therefore only be laid out by a clear and specific, ergo complex, internal contractual relationship.
Moreover, the complexity of the topic is enhanced by the many fields of law involved. In Chapter 4 of this report several relevant areas were covered: Laws concerning product liability, medical devices, privacy, social insurance, medical codes of conduct as well as various national and European guidelines concerning inclusion, equality and commerce. In setting up future AAL solutions, all of these areas have to be considered and monitored.

Legal Uncertainty

As shown in the previous sections of this report, there are existing uncertainties with regards to the legal feasibility of certain AAL applications and the future development of several relevant fields of law.
For doctors and other medical practitioners two questions are prevalent: Firstly, to which degree will they be liable for the correct functioning of technology used in the overall AAL system as described in section 4.2.3.2? Secondly, to which extend will the "prohibition for distant treatment" [250, § 7 Section 4] interfere with their ability to offer telemedical treatment [257]?
For all parties involved, issues regarding privacy are highly important. Whereas the general status quo and trends on the field of privacy regulation are described in sections 4.2.3.1 and 4.3.4 of this report, the pending implementation of the "European Directive on the protection of individuals with regard to the processing of personal data" should be emphasized: Its implementation would cause all parties responsible for handling and processing personal data to be liable for damages, independently of their individual culpability [253, Article 23] and thus increase the risk for service providers significantly.
Moreover, the question as to the categorization of AAL components as medical devices remains unanswered. Some sources foresee a rather strict execution of

the Medizinproduktgesetz and consequently the need for most AAL components to be handled as medical devices [332, Section 5.3.2].

Regulatory Burden

Depending on the actual outcome of the above mentioned uncertainties, the regulatory burden AAL systems will have to carry could turn out to be considerably high:
The classification of most sensors and actors of the respective systems as medical devices would lead to the compulsory certification of these components. Successful certification requires the proof for achieving higher standards of reliability and availability, the implementation of dedicated organizational responsibilities [307, § 30] and possibly the compatibility to medical interfaces [307, § 8]. Moreover, the ability to advertise the respective products might also be limited [307, § 4].

4.4.2 Gap between Research Funding and Commercialization

Current European and German funding programs for research and product development have already been introduced earlier this chapter in section 4.2.2. Most of them are general ICT funding programs; few are targeted directly at AAL. As described in section 4.2.2, the eligibility criteria for the programs differ; there is no integrated AAL program that covers both research and development. This has been criticized by the industry. For example, AALIANCE [243] criticizes a "lack of coordination" of EU and national R&D funding programs [245]. They propose that "funding programmes should be considered as a sequence; from basic R&D [...] to trials".

What adds further uncertainty to research planning is the limited duration of European funding programs. Figure 4.1 highlights that most European funding programs are scheduled to end 2013. Even though there are already plans for consecutive programs [267, Action 78][242][316], scope, budget and eligibility criteria are still under discussion [305].

4.4.3 Questionable Medical Added Value and Reimbursement of AAL Applications

The German social security law sets high barriers on the financial recognition of new and innovative therapeutic appliances: Health care insurances only reimburse therapeutic appliances once their medical and economic viability has been proven [324, § 27, Abs. 1; §33]. Currently there are no large-scale scientific studies or empirical results if AAL systems are really able to significantly organize treatment and care of individuals more effectively.

Insurances have been particularly hesitant towards reimbursement of new therapeutic appliances for their insurance holders if technological innovations

are just characterized by improved usability and comfort for the end user [335]. Also, the clear classification as medical device as described in section 4.4.1, becomes difficult to define if certain health care functionalities of an AAL system are closely associated to personal comfort and safety features [314, § 45, Rn. 2]. For example AAL systems might be used for monitoring the home temperature of a patient's home in order to treat more successfully certain chronic illnesses and to increase well-being of patients. Hence AAL systems might further face poor financial reimbursement by health and foster care insurances if they just offer new comfort and usability features with questionable medical added value.

Moreover, there are currently no financial incentives for physicians to implement AAL systems as current reimbursement schemes of health care insurances do not recognize AAL systems in the area of prevention and early detection of emergencies and diseases. The German health care sector lacks compensation models for practitioners that reward early monitoring and avoiding of public diseases, instead of curing symptoms later on [330, p. 7 et seq.].

4.4.4 Diversity of Social Welfare and Health Care Systems in the EU

The impact of European integration on national policies, often referred to as 'Europeanization', can be clearly recognized in many policy areas [334, p.1]. However, welfare state policies and especially health care policies differ, as health care systems are still organized on a national basis. Although the EU promotes the coordination of national health care policies through the open method of coordination, focusing on factors such as access, quality and sustainability [268, p.4], health care policy is generally not considered as a policy area of the EU [275, Part Three, Title XIII, Article 152].

Therefore, European health care systems remain diverse and can generally be differentiated according to two key features, the predominant ownership form of health care providers and the predominant source of health care financing [333, p.17].

The health care system can be financed by taxes, social insurance, a combination of both or by a combination of private resources and social insurances. Furthermore, health care providers can either be public, private or a combination of the two (see Table 4.1).

As these differences have major implications on health care policies and system reforms [301, p.5], the diversity among the EU member countries can be seen as barrier for the development and adoption of AAL.

The alignment and development towards an integrated health care system within the EU would foster common European business models and a pan-European health care market with consequent efficiencies and economies of scale for AAL. Currently, the variety of welfare and health care systems with their respective complex legal and regulatory basis hinders the development of AAL technolo-

gies, for example through restrictions regarding their use in public health care services. [244, p.8]

4.5 Conclusion

Concluding the assessment of the prevalent policy and legal framework surrounding AAL, a gap between policy awareness and agenda on the one side and the actual legislation and policies on the other side is evident.

As illustrated in section 4.3 of this chapter, most of the trends identified within the political and legal framework benefit the development of AAL technology. AAL provides suitable solutions to further the trends towards a cost efficient health care system as well as towards an inclusive society. At the same time the technological and economic trends regarding the information and communication infrastructure establish a supportive environment to enhance ICT infrastructure for the broad diffusion of AAL. Moreover, the drift towards a more coherent and strict privacy regulation is likely to help to resolve the uncertainty related to data intensive services such as AAL.

Being aware of the potential of AAL, public entities on a national and European level consider Ambient Assisted Living and its diverse applications as a promising technological solution that enables the ageing population to stay healthy, participate actively in the society and live self-determined. This public support becomes apparent through the various research funding programs and established initiatives.

However, the current legislation and policy framework contains several uncertainties and barriers that hamper the commercialization of AAL. As shown in section 4.4, these issues arise primarily from the insufficient data and privacy framework as well as from the high hurdles in health care regulation. Additionally, the lack of common European-wide standards and certifications slows down the development of AAL applications.

In order to overcome the disparity between the political agenda and actual legislation in place, an adjustment and clarification of the above mentioned areas is required. Due to the trend of Europeanization, a joint solution within the European Union could enhance the overall regulatory environment for AAL. A first starting point is to translate long planned bills on certification and privacy into actual policies. Furthermore, the lacking reimbursement schemes for a broad financial recognition by statutory health care insurances must be addressed. Finally, in order to ensure a relevant and homogenous market for AAL products, European policy makers must intensify their efforts towards coordinated action and a unified regulatory framework for Europe.

EU member state	Form of organization	Additional payment for health care utilization	Ownership of health care providers
Finland	National health care service with contribution-based funding	Percentage additional payment	Predominantly public
France	Social insurance	Percentage additional payment	Outpatient predominantly private; inpatient predominantly public
Germany	Social insurance	Fees	Outpatient private; inpatient partly public
Greece	National health care service with contribution-based financing	Percentage additional payment	Predominantly private
Ireland	Publicly financed health care service	Fees	Predominantly private
Italy	National health care service with contribution-based financing, internal market	Percentage additional payment	Predominantly public
Portugal	National health care service with contribution-based financing	Percentage additional payment	Predominantly public
Spain	National health care service with contribution-based financing	No additional payment	Predominantly public
Sweden	National health care service, internal market	Fees	Predominantly public
The Netherlands	Social insurance and basic insurance	Percentage additional payment	Predominantly private

Table 4.1: Exemplary Organisational Forms of European Health Care Systems Source: [333, p.17]

References

[241] AAL Joint Programme. Call 4. http://www.aal-europe.eu/calls/call-4-2011 accessed 03.09.2011, 2011.

[242] AAL Joint Programme. AAL Joint Programme. http://www.aal-europe.eu accessed on 30.08.2011, 2011.

[243] AALIANCE. European Ambient Assisted Living Innovation Alliance. http://aaliance.eu accessed on 02.09.2011.

[244] AALIANCE. Ambient Assisted Living Roadmap. http://www.aaliance.eu/public/documents/aaliance-roadmap/aaliance-aal-roadmap.pdf accessed on 01.09.2011, 2009.

[245] AALIANCE. Ambient Assisted Living Policy Recommendations. http://www.aaliance.eu/public/documents/policy-recommendations/aal-policy-recommendations-march-2009.pdf accessed on 02.09.2011, 2009.

[246] Allgemeines Gleichbehandlungsgesetz. AGG, 2006.

[247] Bayerische Landesärztekammer. Berufsordnung für die Ärzte Bayerns. http://www.blaek.de/pdf_rechtliches/haupt/SD_Berufsordnung.pdf?id_ebene1=2&CFID=22770539&CFTOKEN=87911291 accessed on 02.09.2011, 2005.

[248] Kirsten Bock. EuroPriSe - Praeventiver Datenschutz. *Datenschutz und Datensicherheit*, 11:712, 2008.

[249] Bundesdatenschutzgesetz. BDSG.

[250] Bundesärtzekammer. Musterberufsordnung für die in Deutschland tätigen Ärztinnen und Ärzte. http://www.bundesaerztekammer.de/downloads/MBO_08_20111.pdf accessed on 03.09.2011, 2011.

[251] Stefan Bühler and Franz Jaeger. *Einführung in die Industrieökonomik*. Springer, 2002.

[252] Bürgerliches Gesetzbuch. BGB.

[253] Council and Parliament of the European Union. Directive 95/46/EC of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data and on the free movement of such data. http://ec.europa.eu/justice/policies/privacy/docs/95-46-ce/dir1995-46_part1_en.pdf accessed on 01.09.2011, 1995.

[254] Deutsche Presse-Agentur. Aigner legt nach. http://www.spiegel.de/netzwelt/netzpolitik/0,1518,687498,00.html accessed on 01.09.2011, 2010.

[255] Deutsche Vereinigung für Datenschutz e.V. Stellungnahme zum Bundesdatenschutzauditgesetz vom 7. September 2007. http://www.datenschutzverein.de/Themen/Stellungnahme_Bundesdatenschutzauditgesetz_DVD.pdf accessed on 01.09.2011, 2007.

[256] Christian Dierks. Gesundheits-Telematik - Rechtliche Antworten. *Datenschutz und Datensicherheit*, 3:142–147, 2006.

[257] Christian Dierks. Mehr Rechtssicherheit für die Telemedizin! http://www.aerztezeitung.de/praxis_wirtschaft/telemedizin/article/532044/rechtssicherheit-telemedizin.html accessed on 03.09.2011, 2009.

[258] Marie-Luise Dierks. Gesundheitswesen 2025 - Was erwarten Patientinnen und Patienten? In *Gesundheitswesen 2025. Implikationen, Konzepte, Visionen*. Wolfgang Niederlag, 2008.

[259] Enquete-Kommision Internet und digitale Gesellschaft. Datenschutz im nicht-öffentlichen Bereich. http://www.bundestag.de/internetenquete/dokumentation/2010/Datenschutz/index.jsp accessed on 02.09.2011, 2011.

[260] Enquete-Kommision Internet und digitale Gesellschaft. Antrag der Fraktionen CDU/CSU und FDP auf Aufnahme von weiteren Handlungsempfehlungen. http://www.bundestag.de/internetenquete/dokumentation/2010/Datenschutz/index.jsp accessed on 02.09.2011, 2011.

[261] Enquete-Kommision Internet und digitale Gesellschaft. Handlungsempfehlungen - der Fraktionen der SPD, Bündnis 90/die Grünen und der Linken. http://www.bundestag.de/internetenquete/dokumentation/2010/Datenschutz/index.jsp accessed on 02.09.2011, 2011.

[262] European Commission. e-Inclusion. http://ec.europa.eu/information_society/activities/einclusion/index_en.htm accessed on 04.09.2011, .

[263] European Commission. Joint Report from the European Commission and Council. http://europa.eu/epc/pdf/envir02_en.pdf accessed on 04.09.2011, 2002.

[264] European Commission. FP7 Factsheet. http://ec.europa.eu/research/fp7/pdf/fp7-factsheets_en.pdf accessed on 01.09.2011, 2007.

[265] European Commission. FP7 in Brief. http://ec.europa.eu/research/fp7/pdf/fp7-inbrief_en.pdf accessed on 04.09.2011, 2007.

[266] European Commission. European Broadband: Investing in Digitally Driven Growth. http://ec.europa.eu/information_society/activities/broadband/docs/bb_communication.pdf accessed on 01.09.2011, 2010.

[267] European Commission. Digital Agenda for Europe. http://ec.europa.eu/information_society/digital-agenda/index_en.htm accessed on 01.09.2011, 2010.

[268] European Commission. Joint Report on Social Protection and Social Inclusion 2010. http://www.enothe.hva.nl/copore/docs/Joint%20Report%202010_Social%20inclusion.pdf accessed on 01.09.2011, 2010.

[269] European Commission. Digital Agenda - Pillar VI: Enhancing e-skills. http://ec.europa.eu/information_society/newsroom/cf/pillar.cfm?pillar_id=48&pillar=Enhancing%20e%2Dskills accessed on 04.09.2011, 2010.

[270] European Commission. Digital Agenda for Europe: what would it do for me? http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/10/199 accessed on 04.09.2011, 2010.

[271] European Commission. ICT PSP Work Programme 2011. http://ec.europa.eu/information_society/activities/ict_psp/documents/ict_psp_wp2011_for_publication.pdf accessed on 30.08.2011, 2011.

[272] European Commission. Inclusive growth - a high-employment economy delivering economic, social and territorial cohesion. http://ec.europa.eu/europe2020/priorities/inclusive-growth/index_en.htm accessed on 03.09.2011, 2011.

[273] European Commission. Eurostat Statistics on the Information Society. http://epp.eurostat.ec.europa.eu/portal/page/portal/information_society/introduction accessed on 01.09.2011, 2011.

[274] European Commission. 7th Framework Programme ICT Work Programme 2011-2012. ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/ict-wp-2011-12_en.pdf accessed on 04.09.2011, 2011.

[275] European Community. Treaty establishing the European Community - Part Three: Community policies - Title XIII: Public health - Article 152. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:12002E152:EN:HTML accessed on 01.09.2011, 2002.

[276] European Council. Convention for the Protection of Human Rights and Fundamental Freedoms. http://conventions.coe.int/treaty/en/Treaties/Html/005.htm accessed on 01.09.2011, 2010.

[277] European Union. Charter of Fundamental Rights, 2000.

[278] Walter Fumy. Standards bringen vielfältigen Nutzen. *Datenschutz und Datensicherheit*, 1:3, 2011.

[279] German Federal Employment Agency. IAB Kurzbericht Ausgabe Nr. 21. http://doku.iab.de/kurzber/2007/kb2107.pdf accessed on 04.09.2011, 2007.

[280] German Federal Government. Neuanfang mit 50plus. http://www.erfahrung-ist-zukunft.de/SharedDocs/DE/Artikel/Arbeitswelt/Chancen-im-Beruf/20100803-neuanfang-mit-50plus.html?nn=8824 accessed on 04.09.2011, 2010.

[281] German Federal Government. Interview with Frank Micheel: Wir brauchen flexible Arbeitszeitregelungen. http://www.erfahrung-ist-zukunft.de/SharedDocs/DE/Artikel/Arbeitswelt/Weiterarbeiten-im-Rentenalter/20101007-weiterbeschaeftigung-im-rentenalter-interview.html?nn=9300 accessed on 04.09.2011, July 2010.

[282] German Federal Government. Die Bundesregierung Informiert: Deutschland Digital 2015. http://www.bundesregierung.de/Content/DE/Magazine/MagazinWirtschaftFinanzen/088/t3-ikt-branche-deutchland-digital-2015.html accessed on 30.08.2011, 2010.

[283] German Federal Government. Errichtung der Stiftung Datenschutz. http://dipbt.bundestag.de/dip21/btd/17/066/1706699.pdf accessed on 03.09.2011, 2011.

[284] German Federal Ministry of Economics and Technology. Digital Germany 2015. http://bmwi.de/English/Redaktion/Pdf/ict-strategy-digital-germany-2015 accessed on 30.08.2011, 2010.

[285] German Federal Ministry of Education and Research. Assistenzsysteme im Dienste des älteren Menschen. http://aal-deutschland.de/deutschland/dokumente/Steckbriefe_AAL_Broschure.pdf accessed on 30.08.2011, 2008.

[286] German Federal Ministry of Family Affairs, Senior Citizens, Women and Youth. Aktionsprogramm Mehrgenerationenhäuser. http://www.mehrgenerationenhaeuser.de/coremedia/mgh/de/___Downloads/Aktionsprogramm,property=File.pdf accessed on 04.09.2011.

[287] German Federal Ministry of Family Affairs, Senior Citizens, Women and Youth. Bauen und Wohnen für ältere Menschen - Programme und Fördermöglichkeiten. http://www.modellprogramm-wohnen.de/

fileadmin/dateien/veroeffentlichungen/projekte/Bauen_und_Wohnen_für_ältere_Menschen_-_Programme_und_Fördermöglichkeiten.pdf accessed on 04.09.2011, 2009.

[288] German Federal Ministry of Family Affairs, Senior Citizens, Women and Youth. Förderprogramm "Soziales Wohnen im Alter". http://www.bmfsfj.de/BMFSFJ/aeltere-menschen,did=165572.html accessed on 04.09.2011, 2011.

[289] German Federal Ministry of Family Affairs, Senior Citizens, Women and Youth. Chancengleichheit im Erwerbsleben. http://www.bmfsfj.de/BMFSFJ/Gleichstellung/frauen-und-arbeitswelt.html accessed on 04.09.2011, 2011.

[290] German Federal Ministry of Labour and Social Affairs. "einfach machen" - Unser Weg in eine inklusive Gesellschaft. http://www.bmas.de/SharedDocs/Downloads/DE/2011_06_15_nap.pdf?___blob=publicationFile accessed on 01.09.2011, 2011.

[291] German Federal Ministry of the Interior. Modernisierung des Datenschutzrechts. http://www.computerundrecht.de/media/gutachten.pdf accessed on 03.09.2011, 2001.

[292] German Federal Ministry of the Interior. E-Government 2.0 - Das Programm des Bundes. http://www.CIO.bund.de/SharedDocs/Publikationen/DE/E-Government/egov2_programm_des_bundes_download.pdf?___blob=publicationFile accessed on 04.09.2011, 2006.

[293] German Federal Ministry of Transport, Building and Urban Development. Altersgerecht Umbauen Passgenaue Bausteine für Ihr Zuhause - Erläuterungen und Praxisbeispiele zum Förderprogramm. http://www.bmvbs.de/cae/servlet/contentblob/59240/publicationFile/30957/altersgerecht-umbauen-broschuere.pdf accessed on 04.09.2011, 2010.

[294] German Federal Statistical Office. Pressemitteilung Nr.187. http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Presse/pm/2011/05/PD11___187___227,templateId=renderPrint.psml accessed on 04.09.2011, 2011.

[295] Gesetz über die Gemeinschaftsaufgabe "Verbesserung der Agrarstruktur und des Küstenschutzes". GAKG.

[296] Gesundheitsmodernisierungsgesetz. GMG.

[297] Peter Gola and Rudolf Schomerus. *BDSG Bundesdatenschutzgesetz*, volume 10. C. H. Beck, 2010.

[298] Lukas Gundermann. Datenschutz und ärztliche Schweigepflicht. In *Praxisbuch eHealth: Von der Idee zur Umsetzung*. Roland Trill, 2008.

[299] Harald Klaus. AAL Eco System and Business Models: explained and illustrated with examples from SmartSenior. Talk on AAL Eco System and Business Model, 08 2011.

[300] Rolf G. Heinze. *Rückkehr des Staates? Politische Handlungsmöglichkeiten in unsicheren Zeiten*, volume 1. VS Verlag, 2009.

[301] Tamara Hervey. The impacts of European Union law on the health care sector: Institutional overview. *Eurohealth*, 16(4):5–7, 2010.

[302] Peter Hustinx. The Strategic Context and the Role of Data Protection Authorities in the Debate on Future Privacy. http://www.edps.europa.eu/EDPSWEB/webdav/site/mySite/shared/Documents/EDPS/Publications/Speeches/2010/10-04-29_Speech_Future_Pricacy_EN.pdf accessed on 03.09.2011, 2010.

[303] Peter Hustinx. Do not track or right on track? - The privacy implications of online behavioural advertising. http://www.edps.europa.eu/EDPSWEB/webdav/site/mySite/shared/Documents/EDPS/Publications/Speeches/2011/11-07-07_Speech_Edinburgh_EN.pdf accessed on 03.09.2011, 2011.

[304] Karl W. Lauterbach. Das deutsche Gesundheitssystem im Wandel. In *Sicherheit im Wandel*. Franz Müntefering, 2001.

[305] League of European Research Universities. Towards an Effective 8th Framework Programme for Research. http://www.leru.org/files/publications/LERU_Advice_paper_FP8_final.pdf accessed on 03.09.2011, 2010.

[306] Sabine Leutheusser-Schnarrenberger. Grundrechtsschutz im Europa des Lissaboner Vertrags. *Datenschutz und Datensicherheit*, 8:519–522, 2010.

[307] Medizinproduktgesetz. MPG.

[308] Gerhard Nägele. Alter und Gesundheit - zu einigen Anknüpfungspunkten für Prävention, Gesundheitsförderung und darauf bezogene Gesundheitswirtschaft. In *Gesundheitswirtschaft in Deutschland - Die Zukunftsbranche*. Andreas J. W. Goldschmidt and Josef Hilbert, 2009.

[309] Manuela Nöthen and Karin Böhm. *Gesundheitsberichterstattung des Bundes, Krankheitskosten*. Robert-Koch-Institut, 2010.

[310] Jost Onstein. Diskussionspapier des BfDI für eine Konzeption der Stiftung Datenschutz. *Datenschutz und Datensicherheit*, 4:234, 2011.

[311] Otto Palandt. *Kommentar zum Bürgerlichen Gesetzbuch.* Beck Juristischer Verlag, 2010.

[312] Wolfgang Portratz. Die niedergelassenen Ärzte. Das Abschiednehmen der Einzelkämpfer. In *Gesundheitswirtschaft in Deutschland. Die Zukunftsbranche.* Andreas J. W. Goldschmidt and Josef Hilbert, 2009.

[313] Produkthaftungsgesetz. ProdHaftG.

[314] Michael Quaas and Rüdiger Zuck. *Medizinrecht, Öffentliches Medizinrecht, Haftpflichtrecht, Arztstrafrecht.* C. H. Beck, 2008.

[315] Viviane Reding. Your data, your rights: Safeguarding your privacy in a connected world. http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/11/183 accessed on 03.09.2011, 2011.

[316] Research, Innovation and Science Commissioner Máire Geoghegan-Quinn. New name for the future EU funding programme for research and innovation. http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/11/435, June 2011.

[317] Martin Rost. Privacy Protection in AAL Systems. https://www.european-privacy-seal.eu/results/fact-sheets/Privacy%20Protection-in-AAL-20101022-en.pdf accessed on 03.09.2011, 2010 .

[318] Martin Rost. Datenschutz bei Ambient Assist Living (AAL) durch Anwendung der Neuen Schutzziele. http://www.maroki.de/pub/privacy/DS_in_AALSystemen.pdf acccessed on 31.08.2011, 2010.

[319] Philip Rösler. Interview Westdeutsche Allgemeine Zeitung 28. April 2010. http://www.bundesgesundheitsministerium.de/ministerium/presse/interviews/aerztemangel-und-aerzteueberschuss.html accessed on 03.09.2011, 2010.

[320] Sachverständigenrat zur Begutachtung der Entwicklung im Gesundheitswesen der Bundesregierung. Kooperation und Verantwortung - Voraussetzungen einer zielorientierten Gesundheitsversorgung. http://www.svr-gesundheit.de/Gutachten/Gutacht07/Kurzfassung2007.pdf acccessed on 31.08.2011, 2007.

[321] Sachverständigenrat zur Begutachtung der Entwicklung im Gesundheitswesen der Bundesregierung. Koordination und Integration - Gesundheitsversorgung in einer Gesellschaft des längeren Lebens. http://dip21.bundestag.de/dip21/btd/16/137/1613770.pdf acccessed on 31.08.2011, 2009.

[322] Peter Schaar. Ein Datenschutzrecht für das 21. Jahrhundert. *Datenschutz und Datensicherheit*, 8:518, 2010.

[323] Matthias Christoph Schwenke. *Individiualisierung und Datenschutz*. Deutscher Universitaets-Verlag, 2006.

[324] Sozialgesetzbuch - Fünftes Buch. SGB V, 2011.

[325] Sozialgesetzbuch - Neuntes Buch. SGB IX, 2001.

[326] Elisabeth Steinhagen-Thiessen. Die zukünftige Stellung des "alten" Menschen in der Gesellschaft - Müssen wir grundsätzlich umdenken? In *Gesundheitswesen 2025: Implikationen, Konzepte, Visionen*. Wolfflgang Niederlag, 2008.

[327] Strafgesetzbuch und Nebengesetze. StGB.

[328] Petra Strodtholz. Das Solidarsystem im Umbau. Entwicklungsbedarf und Gestaltungsoptionen für die Gesundheitspolitik, 2005.

[329] Jochen Taupitz. Informationstechnologien - Haftungsschutz oder Haftungsfalle? *Deutsches Ärzteblatt*, 41:1972–1974, 2010.

[330] Clemens Tesch-Römer and Susanne Wurm. Wer sind die Alten? Theoretische Positionen zu Gesundheit und Alter. In *Gesund und Krankheit. Beiträge zur Gesundheitsberichterstattung des Bundes, Statistisches Bundesamt*. Karin Böhm, Clemens Tesch-Römer and Thomas Ziese, 2009.

[331] The Federal Ministry of Health. Ratgeber zur gesundheitlichen Prävention. https://www.bundesgesundheitsministerium.de/fileadmin/redaktion/pdf_publikationen/BMG-V-09053-Ratgeber-Zur-Gesundheitlichen-Praevention_201005.pdf accessed on 03.09.2011, 2009.

[332] Unabhängiges Landeszentrum für Datenschutz Schleswig-Holstein. Juristische Fragen im Bereich altersgerechter Assistenzsysteme. http://www.aal-deutschland.de/deutschland/dokumente/20110215-Juristische%20Fragen%20im%20Bereich%20altersgerechter%20Assistenzsysteme.pdf accessed on 30.08.2011, 2010.

[333] Hans-Jürgen Urban. Europäisierung der Gesundheitspolitik? - Zur Evolution eines Politikfeldes im europäischen Mehrebenen-System. http://bibliothek.wzb.eu/pdf/2003/i03-303.pdf accessed on 01.09.2011, 2003.

[334] Maarten Vink. What is Europeanization? and Other Questions on a New Research Agenda. http://www.essex.ac.uk/ecpr/standinggroups/yen/paper_archive/2nd_yen_rm_papers/vink2002.pdf accessed on 01.09.2011, 2002.

[335] Regine Wagner. Kommentar 69. In *Soziale Krankenversicherung, Pflegeversicherung*. Dieter Krauskopf, 2010.

[336] Thilo Weichert. Datenschutz von Daten aus Ambient Assisted Living (AAL) Umgebungen. https://www.datenschutzzentrum.de/vortraege/20100726-weichert-ambient-assisted-living-aal.html accessed on 30.08.2011, 2010.

[337] Thilo Weichert. Dauerbrenner BDSG-Novellierung. *Datenschutz und Datensicherheit*, 1:7–14, 2010.

[338] Wettbewerbsstärkungsgesetz. WSG, 2007.

Part II

Scenarios

Chapter 5

5 Scenario Planning

5.1 Introduction

Since the goal of this report is to illustrate examples of potentially successful product and service ideas, it is important to use appropriate means to evaluate the prospects of these products in the future. Given the comparatively long planning horizon for AAL applications and the significant impact on the life of possible users, this future is characterized by a high degree of uncertainty. In order to account for this, the scenario planning methodology will be used to evaluate the resulting product and business ideas.

The Scenario Planning Methodology

First used as a strategic tool for military planning, the scenario planning technique today is also used by strategic decision makers throughout different industries. Within this technique, possible future states of environment are depicted by scenarios. These scenarios are determined by the outcome of several drivers, most importantly the key drivers. Compared to traditional forecasting, scenario planning offers a high degree of flexibility and allows taking into account non-linear events such as radical shifts in value systems. Essentially, the methodology relies on the building of future scenarios, usually including plausible but unexpected situations and problems, which however already exist to a small extend in the present day. Accordingly, the purpose of this chapter is to present the devised scenarios for the year 2025 and the chain of events that leads to the respective states in each scenario.

The Approach Used In This Report

In applying the methodology during this report, the team began the scenario planning phase with a workshop. Prior to devising the actual scenarios, the team had to identify relevant drivers. In the context of scenario planning, drivers are the essential factors that will decide the nature of the future environment. After conducting several rounds of environmental analysis, the overall team collected approximately ten drivers relevant to the future environment of AAL technologies and services, coming from the political, economic, sociological, technological, legal, and environmental framework (PESTLE). Each driver was defined by its two bipolar outcomes.

In a second step, the drivers had to be analyzed with regard to their importance for future scenarios. This was done in the overall team by characterizing both, the impact of the driver on AAL, as well as the uncertainty associated with the driver. The drivers were then mapped accordingly on the Impact-Uncertainty-Matrix (see figure 1.1). The two drivers with the highest degree of impact and uncertainty were classified as the key drivers. These key drivers define the scenarios by their bipolar outcomes. Thus, this phase concluded with four scenarios rendered by the combinations of both respective outcomes

of the first and second key driver. After this definition, a dedicated team was committed to each scenario.

In the following, each team worked to provide a clear picture of the respective scenario. The teams plotted a possible way from the current point in time to the scenario in the year 2025 by providing a timeline, which included relevant events and their causal linking. By formulating possible news headlines, a vivid and understandable picture of the future state of environment was given. Engaging in discussions helped to make each scenario fully understandable to the overall team on the one hand, but also to further verify the scenarios on the other hand. Following the workshop, the scenarios were further developed and detailed, based on the results of the final workshop presentation.

Structure of this Chapter

This chapter aims at giving a wholistic description of the devised scenarios. In order to do so, section 5.2 will introduce the relevant drivers, with a focus on the highly important key drivers (5.2.1). Each driver will be defined by a general description and the specific implications of both possible outcomes. Obviously, the list of drivers is not exhaustive. Whereas many other environmental factors influence the actual environmental states in the future, the drivers depicted in this section are the ones that will have the most noticeable impact on future products and services in the field of AAL.
Following the description of the drivers, the four scenarios will be presented. Section 5.3.1 will introduce the scenario "Electronic Hearts", followed by a portrayal of the "Me, My Tech and I" scenario (5.3.2). "Back to the Roots" will be detailed in section 5.3.3. Subsequently, the chapter concludes with a presentation of the "Me, Myself and No More I" scenario (5.3.4).
For each section, the future state of environment will be illustrated by a distinct description. In order to give a meaningful presentation of life in the year 2025 in each respective scenario, several characters were devised. The scenarios are characterized through a description of their daily lives, interests, and concerns. To provide a better understanding of how the respective environmental states have evolved, a timeline will be provided and explained for each scenario, describing the course of events from 2011 to 2025.
In addition, possible signposts that indicate that a certain scenario may become true are depicted. Signposts are events and developments that may signal a heightened probability of a specific scenario. Signposts thus have a high practical relevance for strategic planning and the evaluation of product and service concepts.

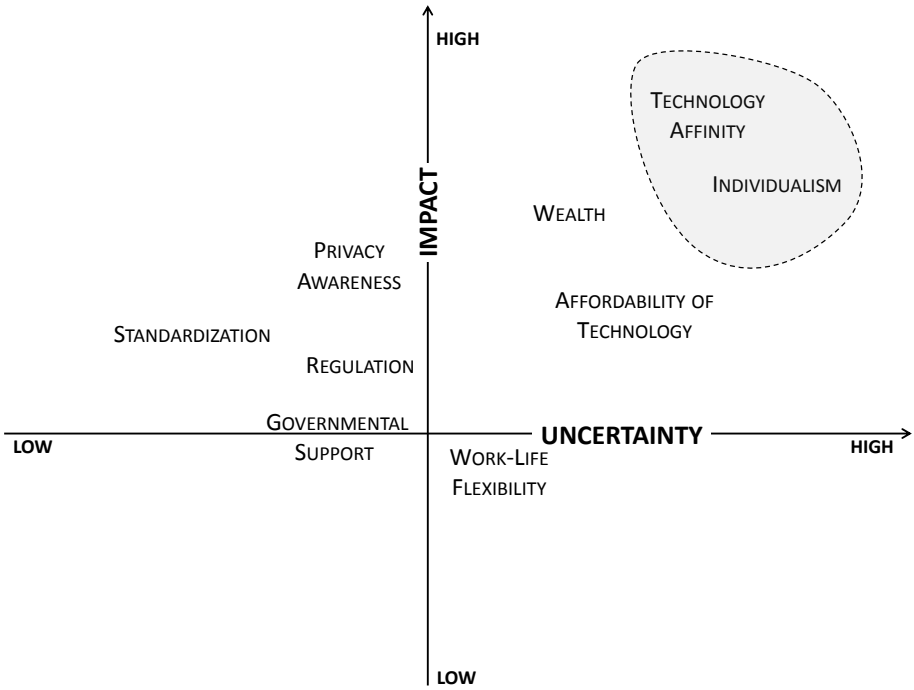

Figure 5.1: Uncertainty and Impact of Drivers for AAL.
Source: own illustration.

5.2 Driver Analysis

In order to envision the development of the world and all important aspects for AAL systems within the coming 15 years, one needs an understanding of the driving forces behind changes. These are forces which shape the future and have an especially high impact on the development of AAL. Every driver can usually develop into one of two possible directions in the future. The likeliness of one or the other outcome does not need to be equal, but in general is hardly predictable. Environmental, social and political events can be responsible for the drift of the future into one direction. Additionally, not all of the drivers are completely independent from each other. The evolution of one driver can influence another driver and push it into one of its directions.

For the development of AAL nine drivers were identified (see Figure 5.1) and ranked by their importance and uncertainty. Individualism and the technology affinity were chosen as key drivers. They have the highest impact on AAL and their future development is very uncertain. The combination of these two and their bi-directional outcomes leads to four entirely different futures.

To further flesh out these four scenarios, defined by the key drivers' possible developments, additional drivers provide the necessary background. Their influence on AAL is lower than the influence of the two key drivers. However, the directions they take still shape the future.

5.2.1 Key Drivers

In the following sections the two key drivers are described in detail. First individualism and its possible outcomes are depicted. Subsequently the development and impact of technology affinity is shown.

5.2.1.1 Individualism

Individualism is one of the two key drivers that has a very high impact on the possible development and diffusion of assisting technologies in future markets. Individualism describes the extent to which individuals promote their personal goals, interests, and desires. Thus, individualization depicts the implicit process of individualism in which people place greater value on her or his own personal interests while they rarely take into account the interests of others in the society.

Individualism is a complex social phenomenon with several aspects that have been discussed in the social sciences for decades. There are many different and contradictory definitions of individualism. We define a highly individualistic person as someone who "enters into society to further his or her own interests, or at least demands the right to serve his or her own interests, without taking the interests of society into consideration" [356]. As a result, in our definition individualism refers to both independence and self-reliance. Individualistic persons try to avoid external interference from family, friends, society, or any other social group or institution upon their individual goals and interests. They are self-reliant rather than dependent on others. Therefore they do not rely on their communities or other social structures and instead prefer to take care of themselves. For individualistic persons the value of family and friendship is not as central as for less individualistic persons.

Furthermore, individualistic people are usually not considered to be very sociable as they are often unwilling to assist other people and to get involved in the community. While individualistic people still can engage in charity activities and volunteer, individualistic societies struggle with a purely altruistic commitment for a common or collective good. This has direct implications for welfare infrastructures in modern post-industrial societies as foster and home care, for example, highly depend on the willingness of relatives and friends to step in and help out.

Possible Developments

Individualism can be assessed as a very uncertain driver: In fact, the extent of individualistic attitudes in a society highly varies as there are always certain members of a society that are more committed towards community and social life than others. Thus individualism should be understood as a continuous process between a more collaborative or individualistic orientated society. By making reference to individualization as the implicit process of individualism, it becomes evident that post-industrial societies cannot be characterized as a fully individualistic society.

Increasing individualization does not imply a shift towards purely egoistic behavior of individuals, rather a steady decrease of willingness to help, cooperate, and get involved in family and community life and of an increased focus on one's individual well-being. Furthermore it illustrates that individualistic beliefs and self-regarding behavior dominate a person's interaction with his surrounding community. Therefore two possible outcomes should be considered, a society with dominantly individualistic attitudes or a society with a low individualistic mind setting.

High Individualism

This outcome implies that individualistic attitudes dominate a society. A society with many individualistic orientated persons will be characterized by a high pluralism of lifestyles: There will be heterogeneous ways among individuals on how to organize and lead individual lifestyles. A highly individualistic society has higher needs for interaction with other individuals and integration in social life as those societies decreasingly rely on interaction, commitment, and support by family members, friends, and other social organizations. This lack of social commitment of individuals has an implicit impact on assisting technologies which are envisaged to help people coordinating and conducting their daily life.

Interaction with others will become more difficult to manage with high individualism due to the increasing work lifestyle, high mobility of other individuals, and changing attitudes towards family whose value lose importance. Information and communication technologies as well as other technologies envisaged for assisting people in their daily life will help to ease interaction with others through new and integrated means of communication. Products and services in the field of digital technologies may satisfy the need for personal communication and attention.

While problems with current welfare and other individual support infrastructures may arise from the decreasing willingness of people in an individualistic society to get involved in community life and society, digital technologies will offer new ways of social integration as they can bridge time-wise and spatial distances. They will help to compensate the lack of real individual relationships, attention, and affection as well as most importantly real support by others.

Since individuals in need will have a hard time to find somebody to take care of their children or look after their grandparents, assisting technologies might provide additional opportunities to them to conduct more smoothly their daily life and to take care of others in society.

Low Individualism

This outcome refers to a predominantly collaborative and pro-social mind setting throughout a society. In a society of low individualism personal goals and desires will not be higher ranked than interests and needs of other individuals. Social interaction and support to other community members, namely the own family members, friends, and other social organizations, is essential to individuals and is an integral part of their personal identity. Individuals in a low individualistic society will be more willing to support society and get involved in community life.

Less individualistic persons will have a different need for social interaction as they usually could confide personally in relatives and other individuals of their community. They will hold close ties with their families and friends. Thus, there is a different approach to digital technologies envisaged to enable interaction between people in those low individualistic societies: The need for personal communication can more easily realized through direct interaction. The particular aspect of assisting people in their daily life is not as central regarding those technologies.

In addition, people value and want to participate actively in social, welfare, and charity infrastructures and enjoy helping others. Therefore a possible lack of human resources in welfare and individual support of persons in need can be more easily filled with the direct support of other individuals. Information and communication technologies, which assist and support daily life of people will have to be differently designed and adapted to the lifestyle of people since less individualistic people will be more likely to devote themselves with parenting or home care of their elderly relatives.

5.2.1.2 Technology Affinity

Another key driver that impacts the development of AAL services and products in the future is people's affinity to technology. It describes the level of people's preference or rejection to information and communication technologies.

Nowadays, people are surrounded by different kinds of technologies. It seems to be impossible for a person to live without the support of them in modern society. Driven by the development of technology, people can work faster, easier and more efficiently. Besides, life styles and living standards are also changing significantly. As a result, people become increasingly reliant on technical services and products in their daily life.

However, discussions about the side-effects of technology never stop. People still wonder, whether advanced technical products will replace human beings in the future, whether they will destroy the environment, whether their privacy will be invaded, or whether they can do harm to people's health. Thus, many people are still quite afraid of these side-effects and hold a skeptical perspective towards technology.

Possible Developments

It is uncertain when and how people's affinity to technology will change. It is very likely that the side-effects of technology will be reduced with further technical developments in the future. People would then become more satisfied with technology and their trust in it would increase. Consequently, their affinity to technology would continue to grow in the future.

On the other hand, the possibility that people will change their views about technology completely cannot be eliminated. If this situation happens, people's affinity to technology will plummet. Therefore, both the high and low technology affinity should be considered.

High Technology Affinity

This direction refers to the gradual increase of people's affinity to technology. Nowadays, technology has already helped people do a lot of work which seems impossible to be done manually, such as large computation, global communication, and so on. It saves people a huge amount of time and energy, and accelerates the development speed of the whole society. To a lot of people, it is hard to imagine how they could work without computers as well as communicate without telephones. Using technology in daily life has already become a habit and difficult for people to get rid of. If this trend continues, people's affinity to technology will continue to grow in the future.

Moreover, the affinity is also strongly dependent on the development of technology itself and applications using it. Concerning the disadvantages of today's technical products, complexity of usage, relatively high prices and maintenance costs, as well as some reliability problems are still barriers for people's wide acceptance of technology, especially of new technology. With emphasis on solving these problems, new products may be offered with higher qualities and at lower prices, which will contribute to the increase of number of customers as well as people's affinity to technology.

If such affinity is on a high level, people's willingness to pay for and rely on technology is also high. They will spend more on technical services and products, and will also be inclined to upgrade them when new substitution enters the market. Accordingly, the market size and profit rates of companies offering those technologies will grow.

Furthermore, people will be interested in the development of technology and more young people will study in technical related majors, which leads to a larger supply in the labor market. Investments on technical related fields will also increase, which further accelerates the development speed of technology. However, as a consequence of the attractiveness of the market, more companies will enter it and the degree of competition will increase.

Low Technology Affinity

This direction refers to the gradual or even significant decrease of people's affinity to technology. Some side-effects of technologies still remain unexplored today. It is possible that new research will reveal these side-effects in the near future. This would totally overthrow people's current attitude towards technology and lead it in the opposite direction quickly.

Besides, this direction may also occur if current or new technologies are proven to be unreliable. As a possible result of functional failures and leak of privacy, people would become more and more skeptical about technology and lose their belief in it gradually. It is also possible that the price of new high-tech products remains stable at a relatively high level, which prevents a lot of people from purchasing them.

When people show less affinity to technology in the future, the world will change quite a lot compared to the current situation. Some people will throw their smartphones away, power off the laptops, and try to get used to a new life style. Other people on one hand don't want to use the technical devices, but on the other hand have to use them due to the necessity of technology in their working and living environment. However, they will avoid being exposed to technology as frequently as possible.

Moreover, it takes a long time for people to build up trust in a new technology. Another direct influence is people's willingness to buy technical products. Resulting from their low affinity to technology, people will spend much less money on corresponding products. Most of them will buy such products only when they are necessary.

To companies in high-tech industries, the business world also changes sharply. Companies still want to stay in the market have to increase their research investments for developments of new products in order to regain customers. Such products should be more reliable, less harmful, as well as eco-friendly. Those companies will also have to spend more money and time on introducing new technical products to the public, which further increases costs. On the other hand, as the market becomes less attractive, many companies will leave it gradually, which may lead to less competition.

5.2.2 Additional Drivers

In order to develop realistic and plausible scenarios the outcomes of seven other drivers were used. The next section describe these drivers and their possible developments. First the affordability of technology, governmental support and the overall wealth are depicted. Afterwards privacy awareness, standardization, regulation and work-life flexibility are characterized.

5.2.2.1 Work-Life Flexibility

In respect to the development of the AAL market in the future, the work-life balance plays a significant role as an additional driver besides the two already discussed key drivers. Regarding the working life, people face various challenges from different life domains simultaneously. They have to fulfill a number of various obligations at their workplace, at home and elsewhere in life [352]. In this context, the formulation of a work-life balance describes the situation whether working life and private life harmonize.

Possible Developments

It is mostly uncertain how and when work-life balance will change. Due to the rising equality of the division of tasks between men and women over the last decades, former classical distribution of roles with men being the breadwinner and women being the caregiver is mixing up more and more [352]. Additionally the rising demographic change leads to the challenge how to handle the care of the increasing number of elderly people. Therefore the possibility to harmonize working life and family gets more important, although it is not clear when and how this transformation will take place. Anyway it is sure, that this transformation will have an impact on the AAL market. It is an issue, whether people will work mostly from their home office or will travel to their office everyday, because this will lead to different demands for appropriate AAL devices. The additional driver work-life balance can occur in two possible variants. Either the work-life balance is very flexible meaning that the employee is mostly free in e.g. choosing his place of work or it is very strict as working at the company's office is required. Both alternatives have very different outcomes.

High flexibility of work-life balance

Child-friendliness, part-time work or job-sharing are possible outcomes of the first alternative with a high possibility to adapt working and private life. Besides more space for leisure activities and especially the combination of job and family, living partners will get more attention, children can be looked after and one can take care of older relatives. Employees will be free in their choice of working either at home or at the office. Especially parents would benefit from this situation as they could work at home, e.g. in part-time, and meanwhile take

care of their family. Thus company's awareness of the worker's family is clearly a win-win-situation.[354]

Low flexibility of work-life balance

On the other side it is also possible that there is a decreasing flexibility of the work-life balance. The real work time of employees is harder to proof for the company if they are physically absent and work at their home-office. Moreover there can be doubts if working at home is as effective as in the office, because the worker usually decides to work at home to have a better social interaction with his family. Additionally optimal communication between the company and its employees must be guaranteed first. This can be done e.g. by video-conferencing, which still cannot replace personal interaction at the office totally.

5.2.2.2 Affordability of Technology

Technical affordability is an important issue with respect to the AAL market, as the willingness to buy a product highly relies on the price for it. The evaluation of the price level in turn mostly depend on the customers' income. But only if the prices for the inserted commodities are adequate, the price for the end product can be exceeded by the promised added value. Thus, the adequate and sufficient supply of affordable units, have important consequences in a high-tech economy.

Possbile Developments

With respect to the prediction of technical affordability, the development is very uncertain. Although in theory the prices for technical devices are expected to decrease due to technical progress, the development of commodity prices is usually volatile as they depend on political or environmental changes which are often very unpredictable or even sudden. Regarding the impact on the AAL market it becomes clear, that technical affordability will have a high impact, as the prices of the different commodities are relevant for the produced products and their admeasured price on the market, which will then in turn influence the customers purchase decision.

High Technical Affordability

If technology is highly affordable in the future there will be great potential for new products that rely on the implementation of technical devices. Many products will come into the market and people will be able to purchase and use them. However, affordability is not a stand-alone precondition for the success of AAL devices as people can still be unaware of the benefit of the products and

neglect to buy them although they are affordable for them. Thus, marketing and image will also play significant roles.

Low Technical Affordability

This case refers decreasing technical affordability, e.g. due to increasing prices for technical devices and/or decreasing income. The market of AAL devices will then be much more difficult to access, as people are usually first skeptical with new products and even more skeptical if they need to pay a lot of money for them and don't see the corresponding counter value. Even if the prices are relatively appropriate, some of the AAL products could be considered as a kind of luxury goods that are the first to be replaced e.g. in times of a financial crisis.

5.2.2.3 Governmental Support

Worldwide there are industries which completely rely on governmental support and otherwise would not be profitable. Other sectors are highly competitive and politicians try to give companies a location advantage in exchange for jobs and taxes. Governments often invest in one industry not only to increase or preserve its ability to compete, but also to influence the direction the sector takes, in a technological as well as in an economic sense.

With regard to AAL, it is evident that nearly every consortium contains at least one governmental or public institution. The whole sector is pushed and shaped by the intentions of politics. (see Basic Report chapter 4)

Possible Developments

When looking into the future of the ICT industry and its relationship to policy, there are two possible outcomes. The amount of support is predictable for the next few years, as most political projects have a runtime of more than a year. However, the development in the long run depends on a multitude of factors. The composition of the cabinet, the economic situation and the public opinion all play a vital role in possible decisions. On the one hand, the current support can be continued or extended, in various imaginable manifestations. On the other hand, policy could decide to decrease or even cancel the current support for ICT.

High Governmental Support

In this case ICT and especially ICT-enabled assistance systems remain important in the eyes of national and international politicians. Moreover, the financial situation of the countries will be sufficient enough to shoulder additional burdens. As a consequence, there will still be public money and effort put into the further

development of the ICT industry. The current support for ICT can already be considered as moderate to high, but there is still space for improvement.

There are various concrete methods to aid the industry. They are applicable in different phases of a technology. Often governmental support concentrates on helping with the research of new technologies. For example, public institutions cooperate with companies to find and develop new technological opportunities. Another way is additional funding for the research department of a company. If the basic research is already done, the implementation can be endorsed by financial backing for product development. To prevent a rough start of the envisioned products, subsidies can be helpful. Those can be administered as a price cut for the actual product or as tax benefits for the user of the product. Besides financial advantages the administration can help with the expansion into new markets and by promoting this industry as a future pillar of the country.

In general all of those methods greatly simplify the development of new ICT and therefore AAL technologies. Examples for concrete actions concerning AAL services could be financial support for sensors for houses which are in construction. Another example is support for elderly people which use AAL technology instead of care services. Moreover, political actions can also aim at a greater public technology affinity and help with a more effective market entry of new products.

Low Governmental Support

In this case current funding and incentive programs expire without any or considerably less follow-up activities. Policy pays no attention to the needs of the sector. The abolishment of political help for the ICT industry could have diverse reasons. A lack of money in the public coffers often results in a cut in research expenditures and technologies which are not vital for the immediate future of the country suffer first. Moreover, due to a political change, the focus of public spending could change. Other industries could be considered as more important or more indigent. If, for example, the ICT sector flourished, additional funding would not be needed any more. In case of AAL this would mean the end of political commitment in AAL consortiums. Bad events could lead to a lack of trust into the future of ICT. As a result, companies would have to face the future challenges on their own.

5.2.2.4 Wealth

In general wealth can be divided into material and immaterial wealth. In the following the main focus will be put on the material wealth because in the greater context the main interest is the purchasing power of customers for AAL related products and services. The Gross Domestic Product (GDP) and the Gross National Product (GNP) are measures of wealth, as the economic growth is an important goal of economic policy and gives information about the

financial status of a society ([353], p. 35). The GDP refers to the market value of all end products and services, produced in a country in a given period of time. GDP per capita is often considered an indicator of a country's standard of living and can measure the difference between developing and developed countries relatively well [346].

Possible Developments

The development of this driver is influenced through various factors, as shown for example through the financial crisis which started in 2008, and the general economical development of a country. The development can either lead to a high or a low level of wealth.

High Level of Wealth

An increase of the financial wealth of a nation and its population will have a general positive impact because it enables individuals to fulfill their material needs and provides the bases for operational freedom of the government. An increase of the GDP can be correlated to the growing purchasing power of the German population. This leads to a more settled sentiment within the population and less fear about the future. Based on experience of the past, an increase of wealth will lead to a stimulation of consumption in general. Additionally, an increase in leisure activities and entertainment can be predicted. This could result in an increase of the diffusion of new technologies because of a higher purchasing power among customers. Thus, the acquisition cost for new products and services will not deter potential customers. Through higher tax rates of the nations and the possibility of the individual to fulfill his physiological and safety needs, the elements stability and security will increase. For example, more people will have technologies ensuring their safety during mobility and in their homes. Regarding economical, political and civil freedom an increase of wealth could support the increase of individualism. Furthermore, a higher purchasing power will increase the health status of a person. Due to enhanced treatments and stronger focus on prevention the average life expectancy will increase. Additionally, a faster and more stressful life with information and attraction overflow could lead to an increase of mental diseases like burn out and tinnitus. A higher degree of trust, due to high degree of security like a functioning legal system, could reduce transaction costs. An increase of wealth will lead to an increase of cultural attributes, which can be seen as rules in use and the characteristics of a society ([353], p. 98). Especially in western and industrialized countries there is a significant interdependency of cultural attributes, like long-term economic growth and an achievement oriented mindset of the society. This leads to a higher level of economic interaction, which will enlarge the AAL market size and allow higher occupational specialization.

Low Level of Wealth

A decrease of wealth can lead to economic stagnation and recession. During recessions, many macroeconomic indicators vary in a similar way. Production, employment, investment spending, capacity utilization, household incomes, business profits, and inflation all are falling, while bankruptcies and the unemployment rate are rising. This will decrease the purchasing power of the population and thus result in less diffusion and acceptance of newly introduced technologies and products based on them. Less money will be spent on healthcare and related products for prevention which could lead to more illnesses and a lower average life expectancy of the population. On a political level, the earned taxes will decrease which diminishes the operational freedom of the government and could lead to a general economical vicious circle. The imparct on AAl technologies will be low governmental support and funding for ICT&Assisted systems research projects.

5.2.2.5 Privacy Awareness

Privacy determines the non-public area wherein one can execute his right of free development of the individual [339]. Privacy is a basic right and included in nearly every democratic constitution. In Germany it derives from the general personal rights that are stated in the German Constitution. Charles Fried, a professor at the Harvard Law School, describes privacy as the power to control over information about oneself [345]. In other words, privacy determines the freedom of an individual to decide whether to share information with others or not. Privacy also enables an individual to determine with whom and to what extent one shares information.

The level of peoples' privacy awareness has had a significant impact on the global community and will continue to be a controversial issue. Therefore it is positioned high on the y-axis of the Impact-Uncertainty-Matrix (s. Figure 5.2). This is based on the fact that, so far, the increasing penetration of technology in our society is rather negatively correlated to the degree of privacy one retains when using products such as mobile phones or the Internet.

Possible Developments

Since many future products and services will be primarily based on digital technologies the level of privacy awareness could potentially rise tremendously. The contrary development, meaning a trend where privacy awareness is not that important to the society, is also pictured.

Development Towards Strong Privacy Awareness

A society may develop a strong awareness for privacy due to an increasing number of criminal cyber attacks such as the data leakage scandal of Sony

PlayStation where the personal data of more than 100 million customers was accessed by hackers. In addition, the increasing integration of digital technologies in peoples' lives will nurture the skepticism if data leakage occurs, especially with regard to more personal or even confidential data. People might turn their backs on these technologies due to distrust and fear if the technologies do not reliably protect personal privacy.

In addition, privacy is necessary in order to develop social human needs such as intimacy, friendship and trust[344]. These can only grow if people are able to enjoy privacy and feel safe in their surroundings. A threat to privacy is a threat to the integrity of the society.

Development Towards Weak Privacy Awareness

On the other hand a "Post-Privacy" movement may emerge when people don't have the need for privacy. The society will continue to develop into a transparent public where anyone who does not communicate via social network platforms such as XING, Facebook, or Twitter will not be able to take part in the modern society. People come to terms with the risk of privacy infringement that can occur when using digital technologies but learn to scale the risk by actively limiting their vulnerability. The benefits of the use of innovative technologies outbalance the fear of the burglary of their privacy. Weak privacy awareness could also be developed because people simply trust in the security of their private data.

5.2.2.6 Standardization

Standardization is the process of developing and implementing a norm or requirement for technical systems. In general, it is desirable for the customer, as it mediates network effects and prevents technical lock-in. Thus, competition is strengthened, which leads to more diversity in offers and lower prices. Companies can also benefit by reducing costs using economies of scale and by pooling expertise during the standardization process. However, some market players consider the value of customer lock-in higher than those benefits. Consequently, they periodically create proprietary standards that share none of the aforementioned benefits for customers.

Two main kinds of standards can be distinguished: de-facto standards and de-jure standards. De-facto standards are merely norms or requirements that have achieved a dominant position in the market. In contrast, de-jure standards are mandatory standards over the whole industry, whose adherence is enforced by law. [340] An illustrative example would be the PDF standard, which started out as an Adobe internal standard in 1993[347], became a de-facto standard in the next years and was finally turned into a de-jure standard in 2005 as PDF/A [349].

Standardization relevant for AAL or IoT will mainly stem from the field of data organization, data management and communication. While suitable protocols for many AAL or IoT Applications already exist, it remains to be seen whether producers will use them and to what extent, for example, data from sensor readings will be standardizable.

Possible Developments

It is possible to observe standardization processes on at least two different dimensions: Accessibility (Open ↔ Closed) and Prevalence (High ↔ Low). The observed key benefit of standardization for AAL or IoT systems is interoperability, which does not depend on how the standardization was actually achieved. Therefore, "High Standardization" mainly implies a high prevalence of standardized technologies.

High Standardization

High Standardization will occur either if companies foresee the need of interoperability between AAL/IoT devices or if regulatory bodies require it for the sake of end-users.
If a high level of standardization can be achieved, it will be easier to create integrated AAL or IoT products. Moreover, those products will provide a smoother experience for the user as they can interoperate and thus require less manual and time consuming interaction. On the other hand, standardization may let companies settle for inferior technology that can be detrimental to the user experience.

Low Standardization

Low Standardization will be the consequence of standardizing either too little, too slowly or only technologies that are not key to interoperability. On the side of producers, causes can be overly restrictive lock-in strategies, the failure to see their product as a part of a user's environment or the emerging of a dominant yet closed product line.
If low standardization occurs, it will be more difficult to produce useful AAL or IoT products. However, a closed yet dominant product line can offer unparalleled user experience even without standardization. (For example Facebook's messaging system is a closed, unstandardized system; but the close integration in the dominant platform makes it convenient enough for many users.)

5.2.2.7 Regulation

Regulation is the process of allocating liabilities and actively restricting or broadening rights. If a state decides to regulate a process, product category

or manufacturing methods it tries to alter market participant behavior in a politically desirable way. It can also serve to mitigate the consequences of a market failure. It is thus a means of administration different from both primary legislation and court judgment [351], even though it is also carried out using legal prescriptions and ordinances.

Introducing regulatory requirements for market entrance is an ambivalent step to take. On the one hand it might deter potential market entrants as it often introduces more bureaucracy and barriers; on the other hand it sometimes eases competition and helps to shape an emerging market. A main point of criticism on regulation has been the so-called "Law of unintended Consequences" [355] – regulatory interventions are believed to have "at least one and often many unintended consequences". While it might seem easy in hindsight to dismiss such an intervention, it is usually impossible to foresee their error in advance. This might be due to the concerned parties looking for ways to offset them, information asymmetry in disfavor against the regulatory body or simply circumstances changing more rapidly than regulation can.

Possible Developments

Currently the general trend of regulation is on a decline towards less regulation. The EU published an article titled "Red tape – less is more" [341], which deals with the benefits of a leaner, less regulated state. However, AAL is partly concerned with medical matters; the respective market is highly regulated and the regulation is severely criticized [342]. Therefore the result depends both on the continuation of the current deregulation trend and on whether AAL products will mainly be classified as medical products.

High Regulation

High Regulation would be the result of a conservative classification of most AAL products as medical products. Medical devices are still heavily regulated and the need for deregulation is not perceived as urgent in this market as other where. "Governments need to put in place policies that will address all elements related to medical devices [...]" [350]

This classification would lead to a high market entry barrier, leading to less competition and, arguably [343], less innovation. Since regulation often includes standardization, benefits mentioned in 5.2.2.6 on page 160 would also apply.

Low Regulation

Low Regulation would be the result of a strict continuation of the deregulation trend. Either it would have to continue even into the medical devices market, or less AAL devices would have to be classified as such.

More competition due to lower market entry barriers is only one outcome of this result; it would presumably also cause a wider product range and less interoperability between AAL devices in the beginning of their proliferation.

5.3 Scenarios

The previously detected key drivers “technology affinity” and “individualism” form the framework for possible future scenarios that should give a picturesque impression of the world in 2025.

The technology affinity as well as the individualism of the future society can either way assume a high or a low status. Thus, by respectively combining the different outcomes of each driver, as being shown in figure 5.2, four different scenarios result. Furthermore, each scenario is influenced by various other partly interrelated drivers.

In the following, the contrary impacts of these developments on society are explained. In a society where the technological acceptance is also high but the people are rather acting on behalf of the society, the scenario is named “Electronic Hearts”. A society where technology is highly accepted and where everyone is focusing on his own needs rather than on the society’s wellbeing the scenario is titled “Me, My Tech & I”. If technology is rather rejected and the interest in society is equally low, the scenario is called “Back to the Roots”. If the driver individualism is high and acceptance of technology is low the scenario is named “Me, Myself & No More i”.

5.3.1 Scenario "Electronic Hearts"

The following story will show the world in 2025 within the framework of a scenario which is characterized by a high technological affinity and a low level of individualization. These two main streams of development have influenced the priorities, values and lifestyle habits of the whole German society. So for Hermann, a 38 year old processing manager in the coffee industry, his next two days feel like any other...

5.3.1.1 Scenario Description

“P-p-p-pokerface....P-p-p-pokerface...”, sounds from the alarm clock of Hermann, who likes to get woken up with his favorite Oldie from the good old 2010s. For a short moment, he wishes back his ancient alarm clock, which he could have turned off easily by pushing a button. However, the window shades are already slowly lifting and the first sun’s rays enter his bedroom. Surprised that it is only 8 AM, Hermann has a look at the TV screen, that automatically switched on and opened his personal calendar for today. His boss has apparently postponed the daily video conference last night. The calendar forwarded the information

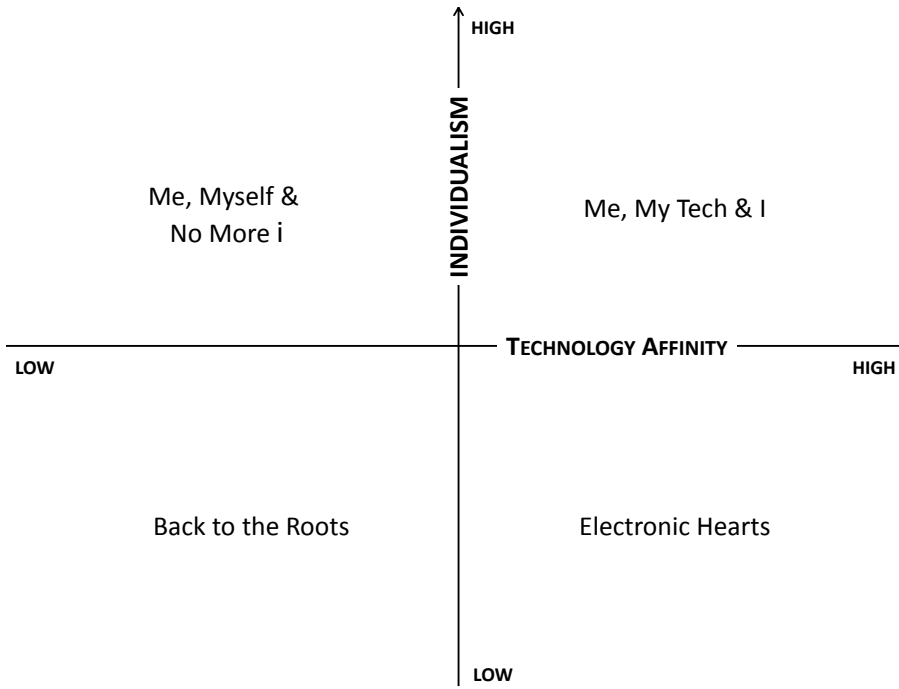

Figure 5.2: Matrix of the Four Scenarios.
Source: own illustration.

to the smart alarm clock that decided to wake Hermann up one hour earlier than usual. Fortunately his wife Angela has already been off to the office in order to conduct a job interview and therefore his loud alarm clock did not wake her up as well. She always tells him to use his vibration bracelet that wakes one up silently but as it is uncomfortable Hermann does not like to wear it at night. After having a shower and getting dressed, he enters the kitchen in order to have breakfast together with his two children. He remembers the time when getting the children out of bed has always been a fight. But these times are gone: the alarm clock in the children's room is connected to his own one and the heartless technology gets them always awake. He often feels a bit guilty, but the benefits of the system are outweighing the disadvantages as he is able to spend his time with the kids without stress. Family is the most important value for Hermann. This is also the reason why he decided to move from Hamburg to a small city near Munich where his parents live as well. Two years ago, his father became care-dependent and although Hermann's mother is still able to care for her husband on her own, Hermann does not want to be 500 kilometers away from them. Fortunately he works in the middle management for the international coffee house company CoffeeStar, a company which has always been putting particular emphasis on the sustainable work-life-balance of its employees.

He thinks over his day: after the daily video conference he will have to check that everything is in order at the three coffee shops he is responsible for. Thereafter, there will be one hour left before he has to catch the suburban train to Munich in order to take the ICE on the new high-speed line to Hamburg where a business dinner with an important investor will take place in the evening. Although the picture and sound quality of video conferences have constantly improved in recent years the management of Hermann's company emphasizes maintaining important relationships personally. Therefore Hermann is supposed to spend at least one week a month in Hamburg. Next, he remembers that he has to ask his mother to take care for the children. As he has no time to bring the kids to school, they will have to attend today's and tomorrow's lessons by using live video links. Hermann has mixed feeling about that. On one hand the tele-education lessons mean less stress for him but on the other hand his children will not be in personal contact with kids of the same age. To his relief the day after tomorrow Angela will work from home again and the kids will be back at school as usual.

Hermann looks forward to the relaxing ride with the new HighSpeed-ICE, the latest generation of the ICE. Up to now he has not found the time yet to read the news, but he will catch up on that on the way. For this purpose he takes along his tablet which automatically picks the most interesting articles regarding his individual interests out of 200 national and international newspapers and heads towards the Munich Central Station. Sitting in the ICE to

Hamburg, he reads an alarming commentary on the question why 100 cars in Berlin were set on fire last week and how the police could not come to grips with the situation. The author suggests to solve the problem by setting up CCTV cameras everywhere in deprived areas. Even though Hermann believes that such a method would be likely to reduce the number of arsons he is confident that tackling the roots of the problems can lead to a more sustainable solution. As expensive technologies have become increasingly important for participating successfully in the working life the existing rich-poor-gap was intensified. In fact, most people in Germany were able to improve their efficiency in their working and personal lives by using technologies like the ones that are implemented in Hermann's home. However, not everyone is as fortunate as Hermann having a PhD from a renowned university and an employer who subsidizes those devices. Regarding flexibility which is an important requirement in the progressively globalizing work environment, people with low income are stuck in a massively disadvantaged position. For example, the new track for the HighSpeed-ICE built by the government as kind of a prestigious object reduces the travelling time from Munich to Hamburg via Frankfurt tremendously but the ride costs four times as much as before. In addition, advanced ICT is a high priced affair: while smartphones are included in Germany's social welfare benefits, most of the equipment is outdated and therefore not reliable anymore. Consequently, a new underclass having no prospects and using violence as a way of protest is emerging. But not everything became worse in the past years. Looking out of the window Hermann sees Germany's largest onshore wind farm, providing clean energy to most parts of Northern Germany. But now it is time for Hermann to prepare the business dinner with the investor. With his tablet he accesses an automatically compiled dossier which keeps him updated about the investor's latest activities and interests. This is enabled by the carefully cultivated customer relationship management system of the company whose database is also connected to several online media platforms. With the use of individual related keywords the crawler of the software finds matching articles about past events which can be helpful to find convenient conversation topics in order to cause a stimulating atmosphere in the business meeting.

When Hermann arrives in his hotel, he still has enough time for a shower before he has to leave for dinner. Since the hotel he usually stays at is crowded he has booked a room in the new high-tech hotel "Homy's" which is located directly next to the station. Homy's is completely designed according to the needs of business people. Every room is equipped with a life management system that is compatible to the one installed in Hermann's home. In order to offer competitive prices, the number of personnel is minimized. The check-in is done automatically and the concierge is replaced by a suitcase-elevator that transports Hermann's baggage directly into his room in the 7th floor. Since the prices per square meter in the big cities have exploded in recent years it has

become necessary to use every centimeter in the most efficient way. This cost pressure can for instance be observed by taking a closer look on the proportions of the corridors that are so narrow that a medium-sized suitcase would not get through. As Hermann enters his room the life management system has already synchronized his calendar and been adjusted according to his individual preferences. A song of his favorite band sounds out of the speakers and the flat screen in front of the bed informs him about the public transport route in order to get to the restaurant where the dinner is going to take place.

Due to the uncomfortable mattress, getting up early is not difficult. The alarm clock plays "Poker Face" and after leaving a video message for his wife, which would be played as soon as she wakes up, Hermann gets ready for the day. After having breakfast, which has been prepared according to his personal taste profile and the low-carbon diet his doctor worked out for him two weeks ago, he heads towards the taxi stand. "Moin Moin", the taxi driver welcomes Hermann friendly. During the ride the taxi driver involves Hermann in a heated conversation about the traffic in Hamburg and other big cities which has increased dramatically after small city e-cars became popular. Arriving at the company's headquarter, Hermann confirms the e-payment request for the taxi ride on his smartphone. Although paying electronically simplifies and speeds up a lot of daily activities, Hermann has a queasy feeling, as he remembers his friend, whose smartphone has recently been attacked by hackers trying to manipulate the e-payment process.

In the 35th floor Hermann meets his boss Tom and ten other store managers from all over the world, most of them he hasn't met in person yet. Hermann likes that his company puts emphasis on personal meetings because in his opinion working without personal interaction causes a tensed working atmosphere in many cases. The meeting is all about the global economic situation and its impact on the coffee industry. The first topic on the meeting agenda is the job market: The unemployment rate in Germany reached a five-year high as many elderly lose their job because working conditions were not adapted to their changing physical and mental condition. Hermann and his colleagues are informed that CoffeeStar faces serious problems in finding skilled IT-engineers for developing a global tracking system for coffee beans. As the German job market lacks a total of 6.5 million qualified employees the company now tries to benefit from the revision of the immigration law allowing skilled foreigners to get employed in Germany easily. When the next agenda point about the situation of the global financial markets came up, Hermann sighs. He is fed up with all this speculator whim, greed and indecisiveness of politicians that showed up during the meltdown of the financial systems in 2008. "Regarding the regulation of the financial markets only few things changed since 2008", the analyst presenting the topic mentions. Hermann wonders, why politicians

haven't managed to agree on a global regulation framework for the financial markets yet because meanwhile, short-term profit orientation is condemned in society. "We are expecting competition in the coffee industry to increase", Tom says. "Deregulation continues to lower market entry barriers and start-ups mushroom up like never before. Innovation is on everyone's lips and the pace of change is unbelievable." He continued that he has talked to a consultant who said that adapting to technological changes has become the biggest challenge for companies across all industries. Firms therefore would have to think about how newest ICT can support their businesses. "Fortunately, the high level of standardization can simplify the integration into our existing systems", Tom concludes.

When the meeting was finished Hermann and his colleagues went to a pizzeria nearby. Sitting together with a group of people, all with different nationalities was not unusual. Companies are multinational even if they do not operate internationally, travelling has become cheap and convenient and "people are so open-minded", as his Spanish colleague always uses to say. When Hermann ordered a glass red wine, his smartphone suddenly beeps and notifies him that Ted is around, an old high-school friend to whom Hermann hasn't talked to for years. Ten minutes later Ted and Hermann indulge in reminiscence about their high school days, enjoying a good red wine and some antipasti.

The next day, Hermann travels back to his home town. This afternoon, his care-dependent father is going to have a telemedical appointment with an Austrian doctor who is specialized in the field of cognitive sciences. Hermann is a little bit late, when he entered the living room of his parents' house, where his father is already sitting in front of the TV screen, wearing a lot of cables for measuring and transmitting his vital signs. Hermann was proud of his parents: Although they haven't been growing up with all that high-technology surrounding them and pelt their son with technical questions, they are able to use these expensive devices Hermann installed in their home independently. The telemedical session went well: the doctor adjusted the medication and remotely installed an application for mental training including personalized exercises.

Looking out of the window of his parents' house, Hermann recognizes his neighbor Bob firing up the grill and Angela laying the table. He helps his father to get into the wheel chair and together with his mother, his kids as well as his neighbor's kids; he ends this sunny day in late summer with a tasty barbecue together with his loved ones.

5.3.1.2 Timeline

The 2010s have been a rollercoaster ride for the Western countries. After being in a dominant position for more than 50 years, they suddenly faced economic and financial crises, strong competition from emerging players in Asia and South America and a dramatically ageing population.
Figure 5.3 outlines the most important events that happened during that decade. The timeline begins in 2013 and ends with events of 2020. It describes a multilayered decade with social struggles of the poor, but fast innovation, increasing flexibility and technological progress for the wealthier part of the population.

In 2013 and 2014, the Western world still struggled with financial and economic crises. They had a severe impact on unemployment rates, especially among less-skilled workers. The existing gap between poor and rich increased even further. Around 2015, it became clear that those less fortunate gradually lost their trust in government and public institutions. On the other hand, the role of family and local communities was strengthened.
In order to recover from the crises, the European Commission announced a thorough revision of Europe's legal framework. In 2015 finally, legislation on digital markets, patents and privacy was revised. The changes were well received by enterprises, SMEs and young start-ups, but it would take several more years before their full impact could be observed.

But already in the early 2010s, there was progress in the ICT and home entertainment market. Smart Home solutions like the "Interactive Living Room" established new technologies that moved beyond personal devices and were used by the whole family - at least by those that could afford this shiny new technology.
The growing importance of the home was further fortified by the 2015 EU Work Flexibility Law. It granted young parents the right to spend 50% of their working time at home, allowing them to be with their children while still keeping their full-time job. Smart Home solutions expanded to the home office. However, this trend again only applied to the working population; the other significant part got caught in an increasing digital divide.

Towards the end of the decade, this gap was apparent more than ever. The incentives for research and innovation finally showed results, creating many start-up companies founded by an agile and well-informed youth. The mobile and connected consumers adopted new technology at a rapid pace; long-delayed infrastructure projects finally got realized.
However, there's a flipside. Until today, the middle of the 2020s, many feel cut-off from those benefits. They are stuck with poor education, information and future perspective. Many find hold in their families and local communities, but their inclusion still poses a huge challenge Europe has to solve in order to regain its former position.

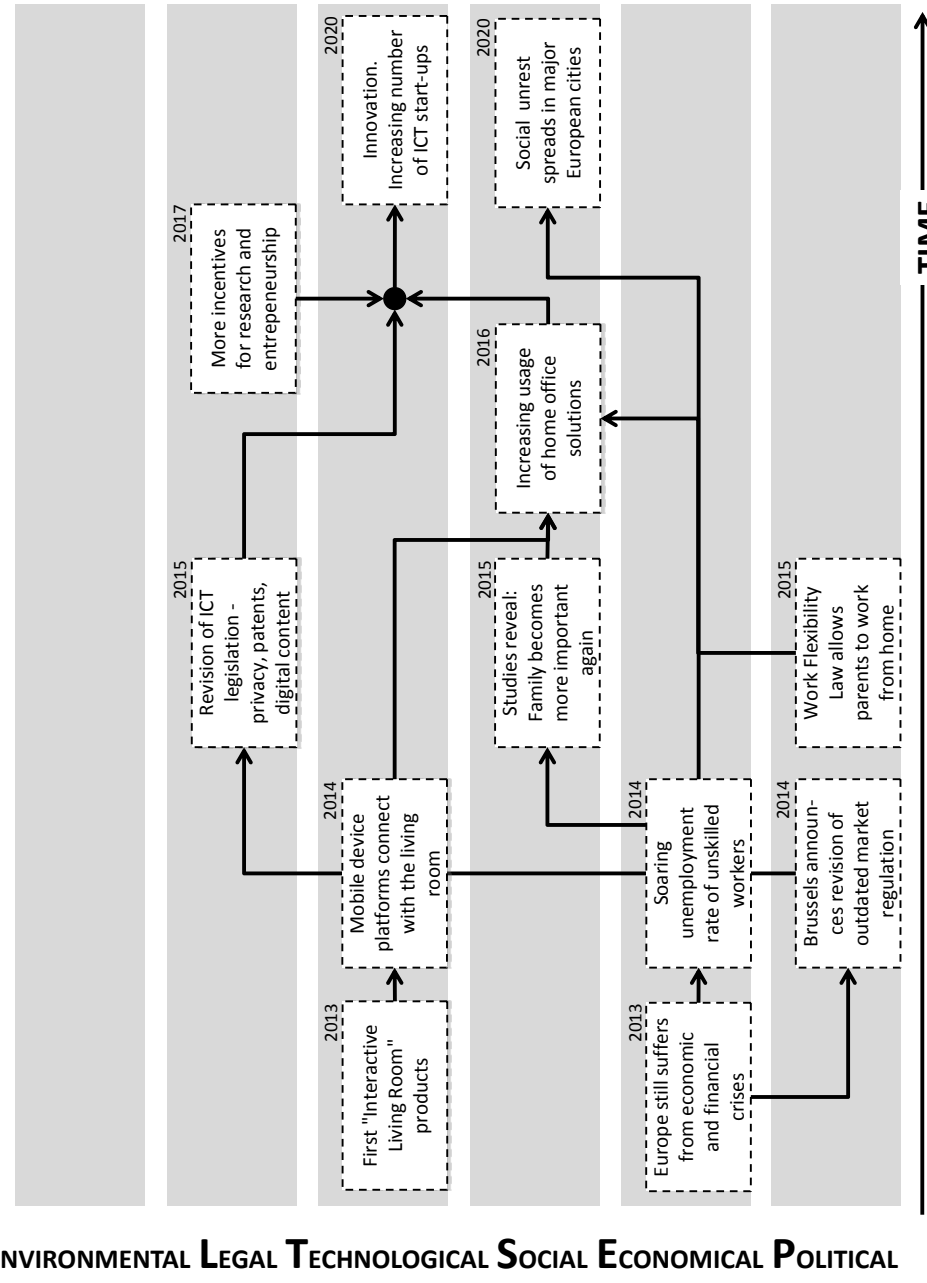

Figure 5.3: Timeline for scenario "Electronic Hearts"
Source: own illustration

5.3.1.3 Signposts

We now generalize the fictional events we described in the scenario and the timeline. These signposts may foreshadow our future becoming reality.

Growing Popularity of Home Office

As more people put value on family and spending time with their loved ones, keeping a balance between private and professional life becomes an important topic. Therefore, people demand technological solutions that enable them to work from home while keeping a high quality of work. In this context it is notable, that in the eyes of employees, the home is already ranked as the second most productive place after the office ([348], p.15). In order to be able to work efficiently without the loss of important social competences that shape the working atmosphere in every company, the opportunities home office solutions provide are crucial. For instance, once virtual conferencing becomes popular, it can replace costly and time-consuming long-distance traveling. In the developed scenario, politics support home office solutions through the "Work Flexibility Law" (see Figure 5.3). It will give parents special rights to work from home offices, so they can care for their children while still having a regular full-time job.

Less Privacy Concerns

As privacy concerns often function as a barrier for personalizing information a low level of privacy concerns can lead to a higher amount of data obtained and used by assisting technologies. The may be major breakthroughs in assistive technologies and home automation that require personal data to be gathered and processed. In the end, the value offered by those solutions may be too tempting and might outweight most privacy conerns. In the scenario described in 1.3.1.1 for example, people may question the collection and processing of personal data, but they are not willing to abandon the usage of these technologies. As a consequence of this low level of privacy concerns, new products and services that rely on data obtained by other products can easily be integrated. The network of IT-products and services covering big parts of one's life can therefore increase fast.

Increasing Sales in Smart Home Solutions

As more devices will have direct access to personal information and will synchronize wirelessly over the Internet, smart home solutions can offer valuable services to its customers. Those platforms expand from personal devices like smartphones to people's homes and work environments. Growing sales in Smart Home products and services can be an indicator for the people's acceptance to

use technologies in their daily life and even rely on their support on a permanent basis.

Increasing Economic Inequality

In this scenario, Western countries have not been able to reduce the rich-poor gap until 2025. If flexibility requirements and the usage of expensive technologies become key criteria for getting a well-paid job, the career opportunities for people who can't afford them will shrink. Thus, growing disparities in the distribution of income, indicated for example by the Gini coefficient, might be evidence for the emergemence of the scenario, in which violent outburst also take place.

Decreasing Number of Single Households

If people prefer to live together with others rather than staying alone, this indicates a lover degree of individualism. Friends, families and neighborhood thus gain importance and individuals enjoy being surrounded by people they know. In this kind of society where living alone becomes rare it is common to care for each other and thus being less dependent on social welfare benefits that try to solve problems that evolve due to loneliness.

Emerging Technologies Focus on Interoperability

New technologies can develop into two different directions: closed systems from a single company that integrate well only between themselves, or standardized systems that primarily focus on interoperability with other systems and devices. An example would be a thermometer that doesn't have its own, proprietary wireless protocol and display, but that integrates into an existing Wi-Fi infrastructure and makes its sensor readings available to other devices on this network. As devices in the scenario interact smartly, a high level of interoperability is a prerequisite for the scenario to become reality.

Growing Penetration of E-government

Establishing technologies that enable the interaction with public authorities, e.g. for voting or the annual tax declaration, can be seen as a leading indicator for the general acceptance of technology in society. The acceptance itself can be measured by the number of people using these technologies. However, the popularity of e-government solution can give an impression of how authorities consider the level of IT acceptance among citizens. Once e-government becomes the dominant or even only way for interacting with public entities, this can serve as a clear indicator for high acceptance, reliability and general trust in technology.

5.3.2 Scenario "Me, My Tech & I"

The scenario “Me, My Tech & I” describes a world that is mainly driven by a high technology affinity and a high degree of individualism. Furthermore, the society is wealthy and has low privacy awareness. The governments highly support ICT, thus fostering innovations. First, a description of the daily life in this future will be given. Next, a timeline explains the development that led to this outcome in 2025. The chapter concludes with a collection of the most important signposts which lead to a scenario like “Me, My Tech & I”.

5.3.2.1 Scenario Description

In the year 2025, Munich like many other European metropolitan areas is a very prosperous city. Businesses are flourishing, its universities are attracting a lot of students from all over the world, and many seniors are living in the city. In the following, please meet inhabitants of Munich in 2025.

Franz Kuglbauer, 75, Retired

Franz Kuglbauer is a 75-year-old senior. Until he turned 68, he was working for several ministries of the Bavarian state and is now enjoying his silver years, as he likes to call them. He was married to Marie Kuglbauer until she died in a car accident ten years ago.

Like every day, Franz starts his day with a long walk in a nearby park. He is very happy that he is able to do this again. In the same accident, when his wife died, he lost his lower leg. Therefore, he was forced to sit in a wheelchair for six months and had to use crutches for years. This struck him hard. Until then, he used to be very active and enjoyed to go hiking in the Bavarian Alps with his wife. He did not like using the crutches, so he stayed at home most of the time and became depressed. This changed after he got a state-of-the-art prosthesis in a telesurgery. It was performed by a surgeon in Berlin, while Franz stayed in a hospital in Munich. The prosthesis enabled him to live the same life as before the accident. Indeed, it felt like having a normal leg again.

Walking in the park, he recognizes many posters for the upcoming election, which is performed online. Within the last ten years the former big political parties lost many members and plenty of smaller new parties emerged that only cover a narrow amount of topics. Franz dislikes the fact that politicians, as most people, became so individualistic and are less able to agree on common things. Due to this, he is confused by politics and still does not know for which party he should vote.

During his walk, he usually steps by the sports field of his club. As they were not able to find a younger successor last year, he is still the club’s voluntary groundkeeper. However, the job is not too exhausting, as an automated lawn-mower is cutting the grass. Waiting for the lawn-mower to finish, he talks to

some other members of the sports club. As most other team sports, soccer became less popular over the last decades and finding good young players is very hard, these days.

Franz returns to his flat. After the death of his wife, he sold their large house in the outskirts of Munich and moved into a smaller flat in the city center. Luckily, he was able to rent a smart home. Its rent is higher than the rent of a normal flat, but he never regretted paying any cent of his rent. It is helping him to cope with his everyday life. Like most of the men in his age, Franz does not know how to cook very well as this was always taken care of by his wife. Due to this, it is very helpful that a screen in his kitchen showing detailed and animated recipes is assisting him with preparing the meals. Also, his refrigerator automatically calls a delivery service, whenever groceries are needed. Franz does not like going to the supermarket anyway. He is glad that he, like most of Munich's inhabitants, is able to afford this way of smart living, as it makes his life much easier. However, he feels bad for the people that are not able to afford a smart living. They have to spend a lot more time for everyday tasks, without any support of smart devices, and less time for other activities.

Now Franz has some free time for his remote studies in African-American history at a university in the USA. He has never met his fellow students in person, but about 80 % of them are also seniors. In contrast, most young students prefer studying topics that can help them with their future career like business or engineering. After watching a lecture, he is preparing his homework about the early days of Jazz. While sitting in his massage chair he only has to speak out loud. His voice is transcribed by his home and the sentences appear on a multimedia screen at his living room's wall that was showing a slideshow of his travels around the world before. What a change, when he started working, everyone still had to use a typewriter.

In the evening, Franz is becoming sentimental as he misses personal company. His old friends rarely leave their homes as they feel that videochatting is enough and that physical meetings are overrated. Tonight, he might try calling his daughter Sarah, again. He did not hear from her in a while. Sometimes Franz is afraid of the future. He would become really lonely if he was not able to go outside anymore, because he does not get many visits from friends, relatives or neighbors.

Leon Scholl, 21, Student

Leon is a 21-year-old student of computer science at the TUM in Munich, one of the fortunate who directly got accepted at one of the top universities. As most other technical studies, computer science is recently overrun by students, even by girls. Although it is not difficult to find a place at a university, in general the places at the top ten universities are highly competitive. To further increase his chances on the job market, Leon is also taking some additional business courses

next to his major although he is not really interested in them. However, Leon knows that a high level of education and some extracurricular studies are quite important as today it is nothing special to have a university degree anymore.

Yet, the university itself is something Leon rarely visits or sees from the inside. Studying at home in front of his multimedia screen, flexibly choosing when to watch the lectures online and when to write the exams is very common these days. Therefore the university is not a place to meet friends. Meeting and talking to friends is something Leon generally does via his multimedia devices. Nevertheless, Leon spends most of his spare time with doing sports. His electronic personal nutrition and fitness assistant generally advises him to spend at least 45 minutes on the crosser each day and afterwards invest some time into strengthening his back. In that way, later health problems should be prevented. Even more, it forces him to limit the daily portion of his beloved chocolate and peanuts. This is a huge challenge for Leon which is why he frequently gets into trouble with his health insurance that is continuously checking if his lifestyle is healthy and sustainable enough.

Adhering to this fitness and diet program was something Leon found very hard particularly during his trip around the world after finishing school. Sometimes he even had to cook himself, which he is not used to anymore. Still the rest of his trip proceeded very smoothly thanks to the travel application on his smartpad. It booked all the hotels, flights and tickets for extra activities and even took care of taking pictures and travel notes for him.

Now, like most of his fellow students Leon is living on his own in one of the many smart single-apartments near to the English Garden which recently seem to determine the cityscape and replace the old traditional buildings. Of course Leon likes the romantic look of those old buildings where some old-fashioned people are still living as well, but they would just not fit to his lifestyle. The everyday technology you need for living is so hard to install into those strangely cut apartments. Also the people living there normally share their apartment with someone else and Leon already feels irritated when having to talk to his neighbors who want to start a conversation whenever they accidentally meet.

Leon prefers to talk to people whenever he wants to, not when feeling forced to. Like this senior Mr. Kuglbauer who is living next to him. He seems to be quite lonely and therefore often disturbs Leon when he is studying on his balcony. He tells him about his daughter who rarely calls or visits him. For Leon, this seems to be very normal. His parents are still living in Hamburg where he grew up and he does not call them frequently, either. What for, they can read about what he is doing all day long on his personal blog. And then again the next day Mr. Kuglbauer's friendly mood turns and he complains about Leon always listening to too loud music late at night and being very reckless. To Leon's mind that is the common way to conduct. You cannot take everyone else into consideration so it seems to be best to just think about your own needs and wishes.

That is why Leon sometimes invites some people over for partying regardless of the fact that this might disturb his neighbors. He knows that a well established network is quite important for his future career. Therefore, he tries to invite different people every time. Most of them are acquaintances he knows from the virtual get-togethers or online gaming competitions he joins when needing a break from studying.

Generally, Leon is quite satisfied with his situation and his life. Although he never had a serious long-term relationship, he is frequently dating different girls. After all, a marriage like his parents once had before getting divorced is nothing Leon is attracted to.

Sarah Kuglbauer, 35, Entrepreneur

Sarah Kuglbauer is the daughter of Franz Kuglbauer. She is 35 years old and not married. Nevertheless, she has an eight-year-old daughter, Hanna. They are living together in a smart flat in the suburbs of Munich. After getting up this morning, she has a short 3D-video chat with her partner, Dennis Rothenberg, while having breakfast. Dennis is currently working in Dubai for at least one more year. Sarah is not too excited that she does not see him, but she accepts it, as she would have done the same to boost her career. She has to end the conversation as she is reminded by her smartpad that she soon should take an autonomous one-person car to get to an appointment in time. They do not require a human driver and can be booked online, whenever they are needed. Looking outside the window of the car, she sees many small cars. The government really changed the public transportation system when they finally legalized this autonomous means of transport. As she does not have to drive by herself she can prepare her documents for the next meeting.

Sarah is very busy. After graduating from a top business school in Germany, she founded her own high-tech company during the European startup boom. Thanks to the good economy it was not hard to find investors and the government subsidized technology companies like her own. She could never imagine working for a huge corporation as they would never have given her enough space to express herself.

Today, she is working in one of Munich's co-working offices. Since there are many companies that require their employees to be present only one or two days a week, many companies share offices to save rent. Sarah likes working from home, because it gives her more time to spend with her daughter. However, sometimes it is better to meet her colleagues or business partners in person.

After her appointment is finished, she has several job interviews with applicants for an open position in her company. She already knows a lot about them, because she engaged a service agency to collect their personal information. Nowadays, there is already too much personal information available online, so these agencies are very helpful. She has a good bargaining position in the salary

negotiations, as she also knows the applicants' wealth and wages of previous employments.

Late at night, Sarah comes home. It has been a long day and she even missed the monthly meeting of her old friends. Sarah looks for her daughter and sees that she is already sleeping. The robot nanny has really been a good investment. Before going to sleep, Sarah briefly watches a spiritual video. Although she does not follow any mainstream religion, she is fascinated about the theories and lives of Ghandi and Jesus. She is exhausted, but luckily she will have some time for Yoga in the next morning.

Hanna Kuglbauer, 8, Schoolgirl

Sarah's daughter Hanna is a happy and carefree 8-year-old girl. Living alone with her mother is nothing Hanna would ever complain about. After all there is still the robot nanny she spends most of her time with and her American father she can frequently talk to via video chat although he is thousands of kilometers away from her home.

Anyway the expression "home" is something Hanna finds difficult to understand. When she was living abroad for some time with her mother, she could attend her old school and communicate with her friends as much as she does when they are in the same city. So what do you need a place called "home" for? Even when being in Munich Hanna does not attend school physically every day. She prefers to partly use the ability to be homeschooled. Although she will not need it often in the future due to the well developed voice recognition she still learns how to write on a tablet computer. Still, some days, physical attendance is required. Then the robot nanny orders one of the autonomous cars which step by step substituted the privately owned family cars in the recent years.

For lunch she is picked up from school again. When entering the car, it automatically recognizes her from a sensor placed in her necklace, thus it knows where to take her. Furthermore, her mother always knows at any time where Hanna is and where she is going.

When her mother is working from her home office they have lunch together. Otherwise they communicate via video chat. In that way Hanna never feels that she is eating alone.

After having finished her schoolwork Hanna likes going shopping with some friends. She turns on the beamer and immediately feels like being in one of her favorite shops, the T-Shirt Factory. Here she can paint on her tablet the motifs she would like to have on her shirt and choose a color and the preferred material. Her measurements are already known to the system and after some trying out she can see herself wearing the customized shirt in the way she imagined it to look like. But before ordering she always wants to know her friends' opinion on her creation. Therefore, she posts a picture online of her wearing the shirt in order to let her friends vote on it. Customization is something Hanna is used

to. Not only does she design her own clothes but also orders customized food according to the diet plan her health advisor prepares for her.

5.3.2.2 Timeline

2025's individualistic, technological, and prosperous present traces its development to a series of events over the past few decades.

The end of the financial crisis in 2012 was a trigger for many developments. With a better economic situation, the European governments started initiatives to support technology, entrepreneurship, and handle the demographic change.

In 2013, the German Research Foundation (DFG) provided grants for research in the field of electric batteries which resulted in the creation of the lightweight and high energy-density DeBatt in 2016, and its commercialization in the subsequent years. In an effort to increase the birth rate, in 2015 Germany extended its financial support for families to also cover single parents. This came in as recognition to the drop in the marriage rate, and probably contributed to the increase of single-parent families in the late 2010s. Other forms of governmental support included the extension of the EXIST fund to cover the first five years of start-ups in 2014. This sparked a start-up boom, which lead to a drop of unemployment to an astonishing 1% in 2021.

In 2020, the EU launched the United Open Income and Taxes program, publishing the incomes and taxes of all citizens. The program was met with big support from the public opinion.

In the beginning of the century, people were already moving towards individualism. This trend was reinforced by technology supporting an individualistic lifestyle, and a trend towards personalization. The year 2018 saw the closing of many chain retail-clothing stores in favor of the rising popularity of customized clothing.

Advancements in Geo-Engineering allowed humanity to affect the weather and mitigate the effect of some natural disasters. Astonishingly, the cooled-down hurricane Emily of 2017 marked the least damages to its date, and no casualties. The great Nile flood of 2022 was also controlled to keep all cities along its path safe.

The drop in natural catastrophes along with a flourishing economy made people care even less about their society. The year 2019 is considered by many as the end of voluntary work in Europe. Germany announced the closure of its voluntary Bundesfreiwilligendienst, and its replacement by paid workers supported by service robots. Spain introduced a mandatory civil service program.

Today, we trust robots with our health, but that was not always the case. In Germany, telemedicine was only legalized in 2014 in response to the lack of general practitioners in the rural areas. This new way of approaching medicine benefited from advancements in robotics, making way for the first telesurgery

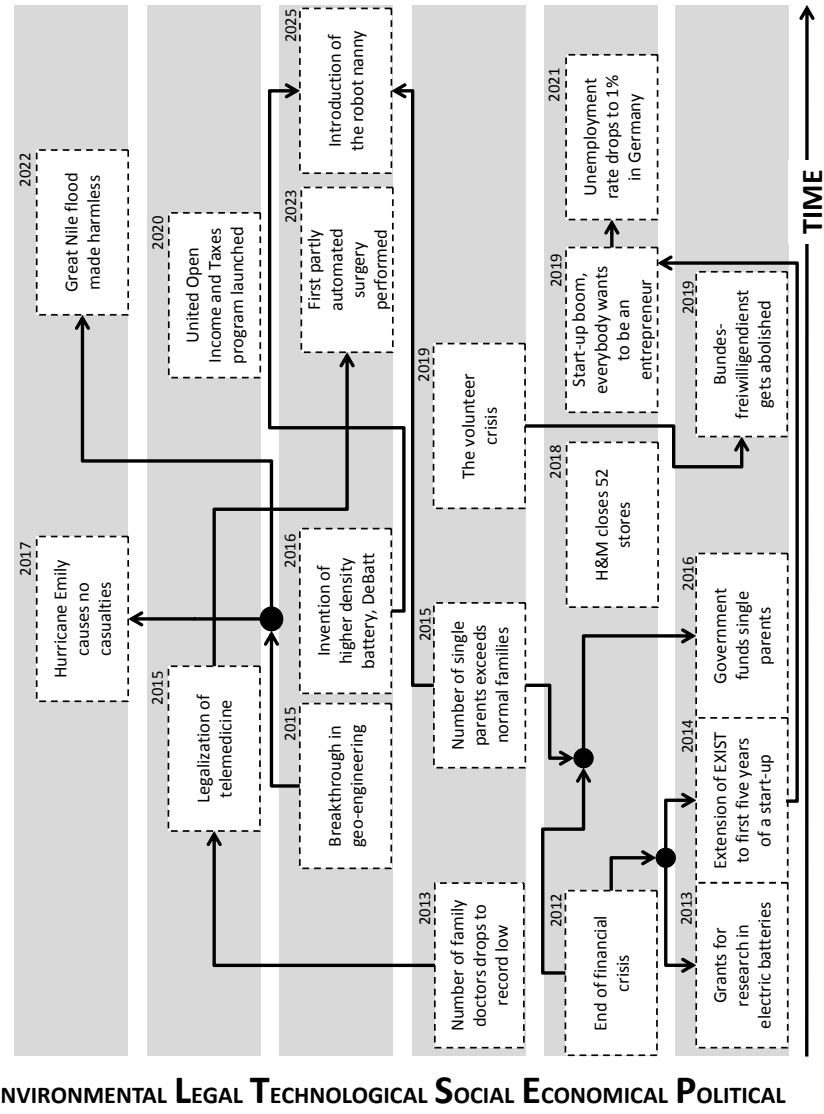

Figure 5.4: Timeline for Scenario "Me, My Tech & I".
Source: own illustration.

performed in Hannover in 2020, followed by the first partly-automated surgery just three years later.

Families, and especially single parents, welcomed the introduction of the robot nanny in 2023, making child-care easier.

5.3.2.3 Signposts

The following signposts identify the development of the future in the direction of the previously proposed scenario.

Shorter Relationships

A rise in individualism can be indicated by a drop in people's willingness to depend on each other. This manifests in the form of avoiding long-term commitments in favor of shorter relationships, and sharing time casually with acquaintances instead of having strong friendships.

Side effects might include a decrease in the interest in marriage, thus a decline in the marriage rate. In addition, a preference to raise children single-handedly could appear. Hence, the number of single parents grows.

Drop in Volunteering

An increase in individualism is also indicated by people's lack of interest in their society. This can be readily seen by a decrease in volunteers. Given the lack of volunteers, the positions previously filled by them are transformed into paid positions.

More Customization and Diversity

Individualistic people give rise to a myriad of tastes and opinions. As a result, the focus on customization increases in products and services. On the political side, the spectrum of parties becomes more diversified, and smaller parties get more members while the previous main parties do not grow significantly, or even shrink.

Technology in Critical Aspects of Life

In regards to technology, its acceptance is indicated by technology entering critical parts of human life. Possible signposts would be the legislation of telemedicine followed by its wide application, or the adoption of telesurgery as a common approach to operations.

The legislation of partly or fully autonomous cars, their introduction into the market, and their widespread usage would also indicate an increase in technology affinity. Smaller cars (for one or two people) and more customizable cars would indicate an increase in individualism.

High governmental interest in investing in ICT and related research, or a surge in smart homes, can illustrate prosperity and technological development.

Publicly Available Personal Information

A decrease in public interest and awareness in privacy supports faster development in related technologies. Such a decrease could be indicated by the official release of public databases containing personal information with no strong reaction from the public, or the creation of services giving public access to personal information.

5.3.3 Scenario "Back to the Roots"

This section will describe a hypothetical scenario, set in the year 2025, when the two key drivers would have developed as low individualism and low technology affinity, respectively.

5.3.3.1 Scenario Description

In the following section you will read about four different characters that live in the year 2025. The situation of our scenario will be described holistically throughout the different perspectives.

Anette Meyer, 72, Retired

Anette Meyer is a 72-year-old woman who lives in a multi-generational home, a residential building in which young and old people live together. The young generation helps the elderly by taking over some of their exhausting tasks and, in return, the elderly have a mentoring role. Of course, this way of living is subsidized by the government but nevertheless the experience gained from other generations makes up for the small difficulties that might occur. Especially Anette is very glad she moved into one of these apartments because since the death of her late husband she felt very lonely. Her husband died of cancer that might have been caused by intensive use of mobile devices. She is very thankful that her roommate can help her using all the new technologies that claim to be radiation free, although her suspicion against technology will never completely disappear. Today is a good day for Anette because her daughter is hosting one of the monthly family gatherings. During these, the whole family meets and Anette has the chance to see her grandchildren, children, and other relatives. It's always nice to know the family is sticking together and especially that her daughter is still there for her.
Before she leaves for the family gathering she wants to attend a church service, where she can meet her friends and find support. What she really enjoys is that more and more young people go to church again and she noticed more baptisms

and marriages take place.
Since Anette lives in an apartment inside the city, she needs to take the public transportation. She doesn't want to drive her car on her own now that the assisting drive modules were forbidden again like many other technologies because they were accepted from society and the legislator too gullibly. Anette prepared for a long time of standing in the public transportation since she is traveling during the rush hour but luckily a young looking man offered her his seat. What a nice gesture. Something Anette can't get used to, is that her apartment doesn't control the safety matters anymore. Even after double-checking the oven, she always worries she might have forgotten something. However the alternative is no longer an option for her.
When she finally arrived at her daughter's home she was happy to notice three new houses being build a little further down the road. Anette is sure that nature and nice people are the best surroundings for a child growing up. Her daughter's two children are very nice and interested in Anette. She has the opportunity to share her experiences with them and in exchange they tell her what the young generation is obsessed with right now. This time she hears about a program that enables young students to be paired up with a mentor who is an older person. They can meet and talk about their choices in life and exchange views with someone of a more insightful background. The idea is to pass on important experiences so that the children can be aware of all the options and have broader horizons when making a decision. The mentors receive a monetary bonus but that is not important for Anette because she knows how much happiness young people can bring her. Her grandchildren are in the mentoring program and have made nothing but good experiences. She decides to take a look at this program and maybe become a mentor herself. All in all Anette can't complain. She has a supporting environment and enough activities. Her family is in a good condition and she hasn't heard from another technology related crisis for a while. In today's society Anette is no longer afraid of aging.

Tobias Reimer, 51, Businessman

Tobias Reimer is happy, today is his 51st birthday. Luckily, it is a Sunday, the regular day for the weekly family get-together. His wife, parents, children and even the very first grandchild - which he is very proud of - are there. They all enjoy a big barbecue and a huge bonfire in the evening. It will be one of the days everybody will remember for a while.

The following day, he gets up early. He is really excited because of a big presentation he and his colleagues planned for several weeks. It is really important for his company since it had been in financial troubles during the past years and the presentation needs to convince a big new customer of their services. To make sure he is certain about his part, he decides to go over it one

last time. To get the presentation, he connects his laptop to the outlet, which automatically provides him access to the companies network. The company switched back to wired technologies several years ago to lower employees' health insurance costs. Still, all of the company's data is instantly available to him over his power outlet to enable working at home or at other locations.

This is important as he has several other jobs as well, including a position in a german political party that stands for traditional social values and an administrative role at a local non-profit organization. Once he finishes preparing the presentation, he gets ready for the car that picks him and closely living colleagues up in the morning. After arriving at the office, he puts his cell phone in its docking station to automatically use the office's wired Internet for calls.

One hour later, the presentation starts. It is displayed on screens that are integrated into the room's walls. Fortunately, he only has to plug in one wire that both charges his laptop and connects it to all peripherals as well. The presentation is an analysis of the current market situation of a big global supermarket chain. Due to the economic crises and the increase of commodity prices especially companies with high transportation costs had very hard times to keep prices low.

Afterwards, he gets back in his office to get some work done. As people don't get paid by hour but by the number of tasks and their complexity, he concentrates on getting as much work done as he can. This also includes some tasks with his colleagues, which his company thinks can be done best by working closely together in one room.

Later, he joins his local group that concentrates on how to use technologies more productively. Because of living in a very technological world for many years, Tobias sometimes has trouble focusing on the important work instead of surfing the web and connecting with people in real instead of virtual worlds. This is especially important to him as he wants to spend the most time possible with his family, to participate in their lives, and share the experiences he gained during the day or overall in his life.

In the evening he decides to read a book one of his children gave him for his birthday. Even though he didn't really like e-readers in the beginning, he started using them once companies built devices that really resembled the traditional reading experience and didn't use any wireless technologies. Also they were quite cheap as the demand decreased after many people lost trust in modern technologies due to radiation damages.

After 80 pages, he decides to go to bed. While laying down, all electronic devices are automatically turned off until he gently gets woken by his wife the next morning.

Marie Roth, 36, Mother and Employee

Marie Roth is a 36-year-old mother that just recently got promoted for a higher position at her company. Because she has to take care of her child, some of the work needs to be done from her home office. This is no problem as her company offers special solutions for such cases. Additionally, she shares a regular office with several other people that take care of the children in turns. This was important for her as she was raised mainly in day care places and thus didn't get a close relationship to her parents. Sometimes, her husband takes care of their son as well.

As both of them see social commitment as an important part in life, they regularly join charitable organizations that focus on supporting people with monetary problems. They try to educate people financially and help them to choose products that are really worth their price. As many virtual goods lost a lot of their value in the past years, they promote the shift towards real values.

Additionally, they developed a strong spirituality in the last couple of years and are now active members of the local church. Because they live in a small town, this connects them with many people and supports building a strong community. This really helped them especially during harder times where they could rely on the friends they got to know there.

The reason to move to that town was mainly to reduce the overall stress she felt in the city. She remembered from her childhood that this was a lot different in rural areas and thus decided to give it a try. After a few months, she finally made up her mind and bought a house. At that time it was pretty new and had a couple of assistant technologies, luckily mainly invisible and just for passive support.

For their spare time, she and her husband really enjoy watching television. But, as most people, this is mainly limited to quality news and good movies. Also, they love to go for a walk with Marie's husbands' parents. Her own parents unfortunately died in a car accident due to a malfunction several years ago.

When she thinks about the past, she really enjoys how the general quality of life improved in recent years. Even though people seem to have less, they look happier and more relaxed overall. This is especially true for older people as they gain social value and aren't just people that don't know how the world works anymore, as her parents always felt. But she also looks forward to her child growing up with a lot of contact to older people, because as she sees in her church group, many of them have experiences and memories that are definitely worth sharing.

Ben Schuster, 21, Student

Ben Schuster, 21, is a freshman at one of the top universities in Germany. He just started studying because after finishing his general college entrance he took one year off. During this time he worked at a school for handicapped people

and plans to continue working there during his studies. Ben grew up with a lot of technology surrounding him and his parents didn't care for religion. Since the big incidents that made technology seem as the major threat of today's society, he wonders how much damage radiation has already caused to his body. Although he is afraid of technology ruining his health, he cannot imagine a life without it. Therefore he started studying the brand new program "Safe Technology". It comprises all the knowledge one needs to research and design replacements of the unhealthy and therefore abandoned devices.
Although in the past trends pointed more and more towards e-learning, nowadays the student's everyday life is pretty much back to the roots. Instead of possibly harmful e-books the students buy real books and instead of virtual classes professors now prefer to hold the lecture in person. Yesterday, Ben was approached by a mentoring program that sounded very interesting but since he is already in a multi-generational home he doesn't know if this mentoring program is really necessary. Especially because his roommate is a very insightful older man of the age of 81. He supports him wherever he can and in exchange Ben always has someone with a lot of experience to talk to.
Ben lives near the university campus, but he is sure that one day he could afford living in a house of its own, just like his parents. Almost every weekend he drives to his parents to visit them. On the way there he wonders how much the ad signs on the side of the road have changed. Instead of an almost naked woman praising the newest smart home tools, there are now a lot of churches and other communities advertising for their program. Nearly all of Ben's friends are members of the church. They once took him to a summer party and he realized that his prejudices against the church are actually not true. Now he is considering joining it himself. While driving down the streets he also notices that the condition of the streets really worsened over the last couple of years. The streets were previously in a very good shape, but now there are holes and patches. Ben wonders if the German economy will ever recover itself.
However, he also thinks that the government currently has more important problems. In Ben's mind the education of the younger is the highest potential Germany has and therefore needs to fostered a lot. Ben's experience in the educational sector gives him the feeling that it is already going in the right direction. A lot interactive learning in smaller groups and the right use of technology is a regular part of the curriculum. Altogether, Ben is looking towards the future hoping that technology hasn't caused too much damage yet and that it will find a way back into our everyday life without harming humans anymore. The growing community feeling gives him the necessary support and Ben thinks that the new way of living feels more respectful and human. Back to the roots.

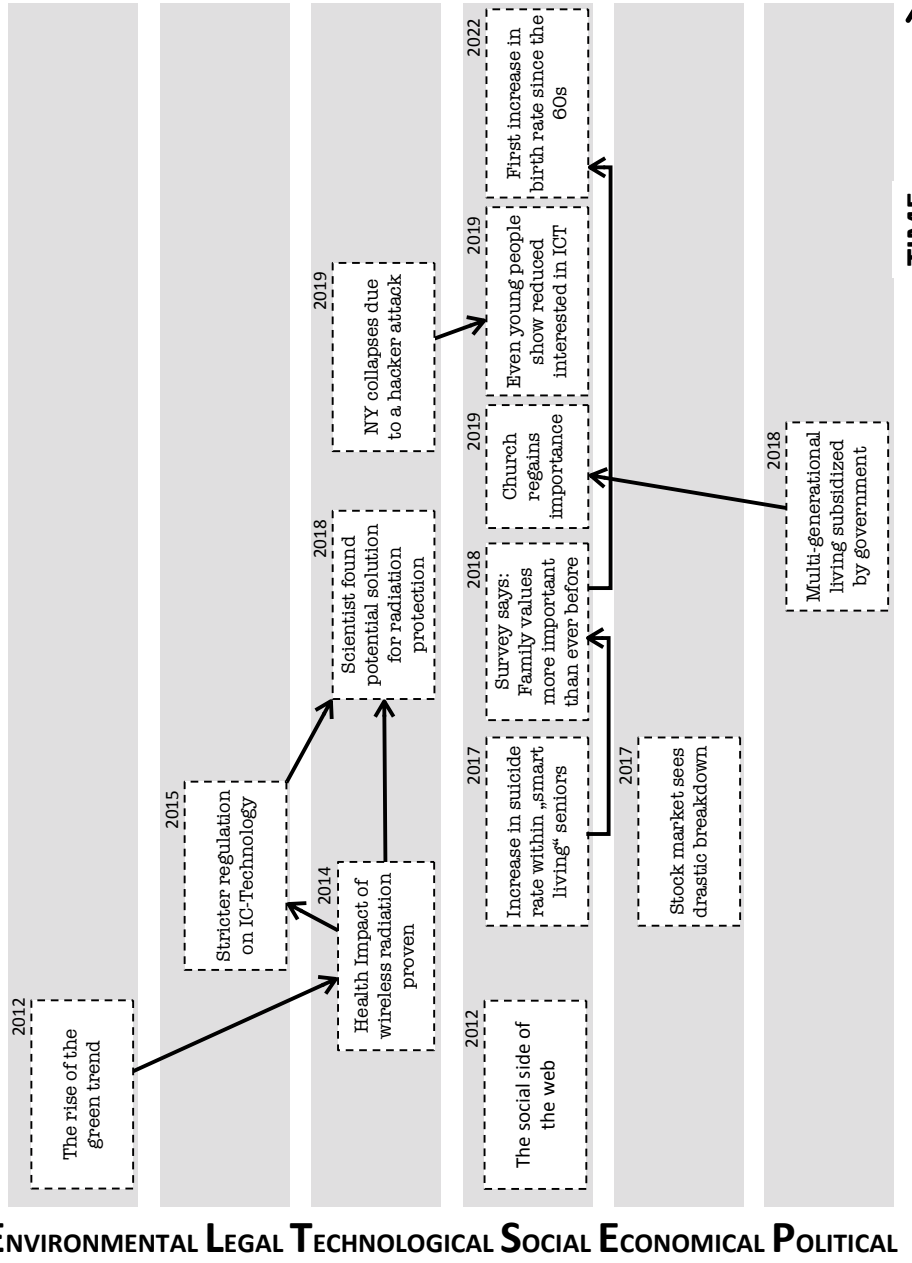

Figure 5.5: Timeline for scenario "Back to the roots"
Source: own illustration

5.3.3.2 Timeline

2012 It all started with the "green trend" 12 years ago, which was still emerging at that time. Society's concern about the human influence upon the environment was getting stronger - people were more interested in organic food and healthier living; sustainable energy sources were the main topic of research and companies would get a better public image through "green" marketing - also called "greenwashing". Another important notion at that time was the movement towards more social technologies. Almost every product was connected to an existing social networking service or offered one of its own. Socializing and collaboration became major buzzwords among service providers.

2014 This year was marked by one very important event - wireless technology was proven to be harmful to people. Even though there was research in this field in previous years, this time the topic attracted the public's attention and spread all over the world. A significant percentage of people refused using their mobile phones and wireless Internet connections, which led to major communication difficulties.

2015-2018 In the following years multiple initiatives were started in order to confront the health issues regarding wireless communication. Governments established stricter regulations regarding the allowed radiation rates of cell phones and prohibited the use of powerful antennas within densely populated urban areas. This led to the lowering of the quality of cellular services and people starting to mistrust wireless technology. A number of research projects started in order to find a viable solution for radiation protection, but they were not widely accepted because of the limitations they had by design - e.g. automatically switching off of the cell phone antennas or limiting the signal strength. The interest in ICT products saw even a bigger hit after the stock market collapsed due to a technical breakdown. People started to doubt the use of technology for essential services such as hospitals, public transportation, and communication.

The high-tech assisted living facilities saw their first victims in the face of the "smart seniors". Statistics showed an increased rate of suicides due to depression and alienation. As a result more families would take care of their grandparents themselves or hire personal caregivers. With people looking out for their relatives, family values became more important than ever before. A great milestone in the field of social interaction was the establishment of multi-generational living facilities, which were subsidized by government programs and enjoyed a high public interest.

2019 After the economic crisis people sought moral and financial support from non-profit and charity organizations. The church as an institution regained new trust and importance among society. Even though technology got less expensive and affordable for most people, it was criticized by the general public due to recent hacker attacks on the public infrastructure of New York. Questioned for their vulnerability and overall reliability, ICT products and services became even less popular.

2022 Long-term government initiatives to improve the demographic situation finally showed successful results. The average total fertility rate of the developed countries, such as Germany, was estimated at 2.4. According to social research this trend might be the result of the ongoing increase of community and family values.

5.3.3.3 Signposts

In the following, a number of signposts will be presented, which could be an indication of the development of the aforementioned scenario.

Impact of Technology on Human Health

There are many past and ongoing research projects investigating the effects that modern technologies have on human beings. A good example is the electromagnetic radiation associated with commonly used devices such as smartphones. A definite proof of the causal link between the usage of wireless technologies and cancer or genetic disorders will lower the utilization of cell phones and wireless networks, which are crucial for AAL products. This will create a further barrier for entering a market relying completely on mobile communication.

Increased Public Interest Regarding Healthier Living

A trend, which is already present today, is that people increasingly pay more attention to eating healthier, organic food, and have a raised awareness of the health issues caused by smoking or obesity. This tendency would escalate to the side effects, both sanitary and psychological, which current technologies have on the human health. For instance, while mobile communication and e-mail can benefit greatly people's professional life, they become an additional source of stress during family or leisure activities, so people actually prefer to turn off their cell phones and computers when they are at home.

Increased Depression Rates Among Users of Automated Assistive Technologies

A rise in the percentage of depressed people supported by AAL services might be an indication of social isolation. As personal assistance will get gradually replaced by assistive technologies, people would lack the human contact in their social lives. Particularly seniors would be significantly concerned because they spend most of their time indoors. Instead of AAL environments, people would rely more on their relatives and would prefer the conventional assistive services such as senior homes and personal caretakers.

News Coverage of Technology Breakdowns

The general public is greatly influenced by the events presented by the mass media. Frequent reports on technical breakdowns, such as leakage of personal information or hardware malfunctions, will have a substantial negative impact on society's attitude towards digital technology. People will begin to doubt the reliability of ICT solutions for providing vital services to society, such as AAL products.

Financial Crisis

During and after the financial crisis people would rely more on the help and support of their relatives and friends. The family would once again become the central part of people's lives. Charity and volunteer organizations will gain importance and be more appreciated by the general public.

5.3.4 Scenario "Me, Myself & No More i"

This scenario describes a world with high individualism and low acceptance of technology. The political, social, and economic changes pushed the people to become heavily self-reliant. This creates difficulties in life management as people aspire to fulfill individual goals with very little technological support.

5.3.4.1 Scenario Description

As Maria rang the doorbell, she remembered that she had not yet completed the weekend assignment her boss gave her. Tonight she would need to work late, typical of most Sunday evenings. Maria waited outside for her mother to get the door. Although her mom only lived thirty kilometers away, it had been two months since her last visit and they had much to catch up on. Maria's mom, an active seventy year old, answered. "Maria! How are you? Come in, I want to hear about everything!" They sat down at the couch and Maria remembered that she needed to call her husband Felix to let him know she would be an hour

late for lunch. Her mother had never been technology savvy and after all the news on privacy, she had removed all electronics except a decade old desktop computer from her household. She would write him an email after catching up with her mom.

"I'm doing very well mom, work hasn't been quite as busy as usual so I have had more time to exercise and I'm redecorating the apartment again." Maria's mom didn't seem as happy to hear this news as Maria had hoped but she knew her mom was not into the recent interior design trend that was all over the news. "Hmm. That's nice. Have you and Felix decided on having a child yet? You turned 35 a few weeks ago." Maria had dreaded this discussion; it wasn't as easy as her mom seemed to think. The "baby talk" with Felix often ended in arguments and they were both frustrated with the situation. "We aren't sure where Felix will work once his contract expires in six months. I'd really like to stay in Munich but we need to figure this out before we decide on when to have a baby. How is your charity work going?" Maria's mom had retired this year and now spent most of her time working for a charity devoted to finding voluntary caregivers for the elderly that could not afford private healthcare. "It hasn't been going well. You've seen the papers, people just don't donate like they used to." "Why do you work on this failing project? It seems like you'll run out of funds within the year." Her mom sighed and seemed visably upset. "Do you realize the huge increase in the elderly population that's occurred in the past couple of decades? It's great that modern medicine has allowed people to live longer but nobody is taking care of all the people that can't afford their own healthcare." Maria secretly believed that it was not her problem if other people were not wise enough to save up for their own health insurance, but she could never tell this to her mother. The movement away from universal health care a few years ago had been popular and Maria liked the extra income in her pocket.

Maria stayed with her mother for a few more hours and wrote her husband to let him know where and when to meet for lunch. I really need to convince mom to buy a new computer, she thought, this computer is way too slow. She knew her mom didn't care about having the latest technology though and would prefer to spend her money on other hobbies. They said their goodbyes and Maria hopped in her car to meet Felix for lunch.

As she drove to the restaurant, Maria thought more about her mom's computer. It was not uncommon for people to have computers much longer than back when she was in university, but she felt ten years was excessive. In past years, many technologies had been released that had too many bugs and the general public was more wary of new products. Most people waited until a computer or phone had been on the market at least six months before purchasing it. She wondered how the technology industry would last if people were not buying technologies when they were released and making purchases infrequently.

Felix had arrived early and was waiting for her when she arrived. They

ordered their food and started to talk about Felix's latest job offer. His contract would be over in six months and he had begun the search for a new position. "So you really think you will need to take the position in Berlin, Felix?" While the economy was booming, the tech industry had shrunk in the past years and he struggled to find positions in Munich. "The job pays more than any other offer and there are really no options for me here. The extra money could be useful to pay for my health insurance." Contracting positions had become popular with companies because the company was not required to offer health insurance benefits to employees. Luckily Maria had insurance because she had a fulltime position with the government but Felix's insurance was very costly. Maria was unhappy with the idea of Felix working far from home but also did not want to switch government offices and move to Berlin. They'd only been married a year but it felt as though they'd been debating what to do about their living situation for ages. The strain that his job's constant travel put on their marriage was unbearable and Maria understood why so few marriages lasted lately. It seemed that every woman's magazine focused on how to make your marriage work or how to get married before you hit your thirties. Maybe I should pick up one of these magazines soon, she thought. Just then, Felix's smartphone rang and she knew he would need to go into work. "Sorry Maria, the project is almost complete and I really need to..." Maria cut him off. "It's okay, I'll see you at home. I need to work as well anyway. We can talk about this later." They paid the bill and went their separate ways.

Maria arrived home and went to her office. She glanced at the newspaper headline, "Carbon emissions at record high!" This came as no surprise to her; lately it felt like businesses had a vendetta against the environment. She tossed the paper in the recycle bin and proceeded to work on her weekend work assignment. It would be a long night.

7:00 am. As the alarm rang, Maria opened her eyes. She looked at the spot next to her but realized Felix had already left. He had a busy week ahead and would not be home until Friday, especially because he was leading a project currently in its final phase. As he was likely already on the plane she planned to call him at some point from the office. After getting dressed she put on the new necklace, which Felix bought her for their first anniversary last month. She recalled the day that they went to a fancy restaurant after spending the whole day in a spa. While putting on her make-up she asked herself: "Why don't we take a time off more often? We can definitely afford it and both of us are working so hard. It's a shame that there's just not enough time."

Before leaving the house she had to deal with the new security system Felix installed last week. The system itself is quite complicated to handle and therefore Maria needed to double-check whether she set it up the right way. She left with the feeling that her home was secure, a previously rare feeling. Starting the 3.2 liter machine of her red BMW Z4 roadster she backed out of their driveway. Although it was a real gas guzzler and very expensive, she loved cruising around

on the highways without being concerned about any speed limit. The drive to the office usually took her at least half an hour due to traffic jams, as it seemed that nowadays everybody has a car. Since the automobile industry had been booming lately, a great number of new premium cars had been introduced onto the market. Therefore, Maria already considered buying a new car, one with more add-ons and an even fancier interior.

Finally arriving at the office she entered the elevator and pushed button "6" – the floor of the executives of the State Ministry of Internal Affairs. She had been promoted only a few weeks ago. Despite the heavy workload, including many weekend assignments, she was looking forward to the new tasks ahead and taking responsibility for her staff. She appreciated the respect she had received lately, especially from her male colleagues. Today was going to be a very busy day as a public vote would take place tomorrow about the introduction of "mandatory fingerprinting at public transportation stations and places". Although part of her job, she was not really supportive of the policy: On the one hand terrorism seemed to be a topic of major importance and widely discussed in public. The mandatory fingerprints would enable the government to ensure safety, especially at airports and other public transportation stations. On the other hand it would reduce privacy as the government would be able to track the movement of the people. Remembering the riots in 2019 due to the set-up of face recognition cameras, in Maria's opinion the policy would not be passed through anyway. Since she had to coordinate a lot of stuff for the next day and speak to various people, the hours passed by quickly.

By working at a governmental institution, Maria stays politically active and well-informed about current political debates and policy developments. She was highly in favor of the tax cuts and in general liked the idea of the government strengthening the position of the individual. Besides, Maria had supported the latest policies which obliged companies developing new technologies to conduct additional tests and studies before market launch, especially with regards to products related to the health care market. Recalling the headline about the death of an old woman due to technical failure, Maria thought this was a necessary step, although the swift move away from many technologies may have had a negative impact on the economy.

At 8 pm Maria was happy to leave the office and headed towards her favorite furniture shop, deserving a treat. The object of her desire was a fancy dining table, crafted and made from premium oak, she had spotted on her last shopping tour on Saturday. Just today, her colleague Paulina had told her what a great taste she has and that she seems to have an eye for individual and fashionable interior design. She actually asked her to help her redecorate her single apartment, offering some money for compensation. Thinking of it, Maria considered the possibility to make a living out of it. Certainly, she loved the idea of being her own boss, but would she earn enough money in order to maintain her lifestyle and to pursue her shopping addiction? She had heard

about increased government funding programs for entrepreneurs and decided to do some research about it at home.

Maria postponed the idea for a moment as she arrived at the "FitIn"- the best fitness club in town. What she liked most about the "FitIn": the exclusiveness. The monthly contribution is comparatively high but Maria was glad to pay for it in return for the privilege of an individualized workout plan and personalized diet. Since she always hated team sports, she really appreciates having some time to herself on the treadmill before going home to plan the next day.

Maria struggled to fall asleep that night as many of the past few days' questions continued to plague her. She wondered how anyone could start a family with this hectic work schedule and so many life goals to fulfill. Her busy life could really use some tool to help her coordinate but too many technologies had proven disappointing in the past. She also wondered how a society could have such a booming economy but some people still struggling with poverty. Her mom was having a lot of trouble getting help for her charity work, what if the elderly population grew even further? Had her mom provided for her old age or would Maria be responsible for her?

In fact, it seemed like society as whole had many issues such as how to handle the tradeoff between privacy and protection. Maria didn't have any answers to these questions and as the challenges overwhelmed her, she fell into a restless sleep.

5.3.4.2 Timeline

In 2011, people were living in a world, in which the importance of technology was increasing day by day. Everyone had a mobile phone, used the Internet on a regular basis, and kept in touch with friends mainly through social networks. As a result, the Pope warned during his regular speech in 2012 of the damage that social values take due to extensive technology usage. At the same time the world was still struggling with terrorism and rumors of the introduction of centralized data retention and online spying by the government became louder and louder.

Besides, the economy was slowly recovering from a serious recession. In order to encourage a sustained economic growth, the German government decided on increasing the financial support for education and entrepreneurship. These measures led to a high employment rate in 2015, the economy was booming, and Germany had the most entrepreneurs per capita in the world. This demonstrated the urge of the people to take control of their lives and pursue their own goals in life. Women were becoming increasingly career-oriented and within a few years they occupied half of the management positions in Germany. In this society, career became a way of life and traditional values such as family, society, sustainability, and charity became less important.

At the same time people were becoming increasingly sensitive to technology

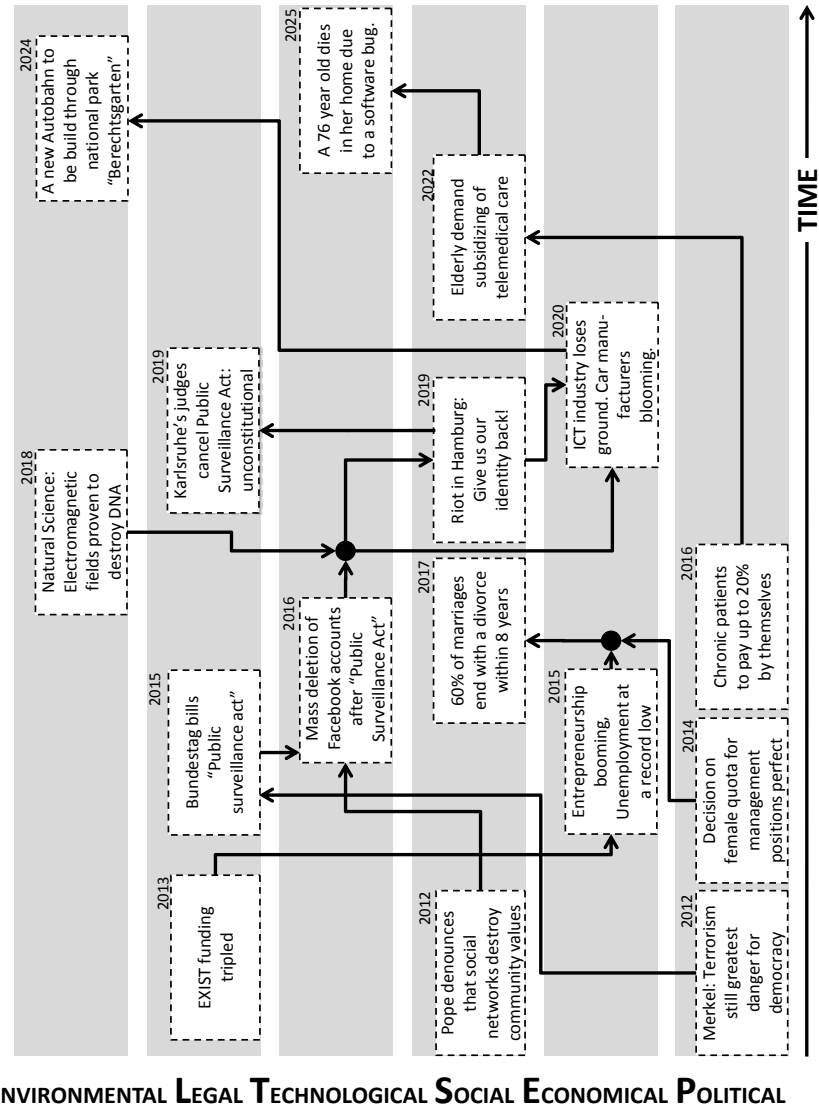

Figure 5.6: Timeline for scenario "Me, Mylself & No More i"
Source: own illustration

and its impact on their lives. When the German government introduced the "Public Surveillance Act", which paved the way for total camera surveillance as well as monitoring of social networks and email accounts, people began to recognize ICT as an invasive enemy. This perception was enforced by the public concerns with regard to the negative effects of electromagnetic fields on health. Gadgets were no longer understood as a status symbol, consequently ICT began losing ground. People were expressing their personalities through their interests, personal style, and career. This led to an increased demand for premium cars and luxurious consumer goods. By 2016 people have become more aware of their privacy. After a two-week riot in Hamburg, the Public Surveillance Act was revoked and social networks lost most of their users.

Although climate change was becoming apparent, governments never agreed on a common plan of action against it. The individual acted to make environmental friendly decisions that did not significantly impact his lifestyle but never forced himself to act on a larger scale. Environmental organizations lost their importance and there were even cases of natural parks being destroyed by enormous construction projects. By 2023 public transportation had become practically redundant and thus reduced to the absolute minimum because nearly everyone owned a car. Traffic problems increased and air pollution in big German cities reached threatening levels. Nevertheless, people didn't consider giving up their cars because they suited their personal needs and working lifestyle best.

The individual was becoming the most important entity of the society - many marriages collapsed and people cared less about those left behind by society's changes. As a result, there was a substantial decrease in charity. In correspondence with the individualistic moods, the social welfare system also took a notable hit in 2016, when the government decided on further deregulation of the healthcare market which led to chronically ill patients paying as much as 20% of their medical care. The elderly saw themselves in distress as family structures have lost importance by 2020 and caretaking has become very expensive. Technology was not an option, since there were numerous cases of people losing their life due to technical failures.

5.3.4.3 Signposts

Following, the fictional events of the timeline are generalized to formal signposts which may help the reader to identify real world developments that could lead up to the described scenario.

Reduction of welfare system A higher level of individualism may force governments to reduce their support for the welfare system. People will consequently find themselves forced to provide for themselves even when they are older. On one hand, reduced taxes will leave the population with a higher amount of

spending money. On the other hand, the elderly population will face a serious problem with providing for healthcare and caretaking.

Promotion of equal employment opportunities for women The introduction of artificial quotas for women in high-level positions will increase their chances to have a successful career. Emancipation will become a lifestyle and women may begin to define themselves by their work. As a consequence, many of them may decide against having children which will make the demographic problems even worse and lead to degradation of family values.

Decreasing importance of families Due to the highly heterogeneous interests of individualists, they tend to not be willing to make compromises with their lives, spare time, and relationships. Families build upon willingness to adjust to other people and new life situations and to sacrifice certain freedoms for the sake of living together and bringing up children. One indicator for the decreasing importance of families is the number of single-parent households. A lack of family values may lead to general weakening of the societal values. Serious problems may also arise for the elderly, since they wouldn't have anyone to rely on.

Frequent technological failures Competition on the technology market has become fierce in the last decades. Manufacturers are extremely pressed for time and the time-to-market may become even more important than extensive testing of the product. At the same time, customers do not hesitate to exchange a product for an alternative one if it fails. Frequent failures led to distrust in technology and may bring whole industries to a halt. Furthermore, people are becoming more aware of their health and of environmental accidents and may thus easily ban certain technologies if they are believed to be harmful.

Environmental destruction The influence on the environment has often been a reason for abandoning a technology. At the same time, people usually put convenience and economical factors before environmental sustainability. It is easy to make environmental friendly decisions which do not impact one's life much and salve one's conscience. Environmental destruction can thus be an indicator for a developing individualistic society which puts it's interests up front.

Loosening of privacy regulations On the one hand, governmental decisions which are intrusive to the private sphere may lead to a general disregard for technology. On the other hand, such regulations may be accepted by the population if they have some kind of fear as a background, e.g. fear of terrorism.

References

[339] Das Grundgesetz für die Bundesrepublik Deutschland. URL www.gesetze-im-internet.de/bundesrecht/gg/gesamt.pdf. Last accessed on 12.09.2011.

[340] Robert Blatt. "de Jure" Standards. *Electronic Image Designers, Inc. Whitepapers*, March 1999.

[341] European Commission. Red tape – less is more, October 2009. URL http://ec.europa.eu/news/business/091023_de.htm. Last accessed on 11.09.2011.

[342] Axel Heinemann Dierk Beyer, Alastair Flanagan and Andreas Poensgen. *Health Care Regulation Across Europe*. The Boston Consulting Group, Inc., 2007.

[343] Tim Hogan et al. Regulation and innovation: evidence and policy implications. *BERR Economics Papers*, December 2008.

[344] Charles Fried. URL http://plato.stanford.edu/entries/privacy/. Last accessed on 10.09.2011.

[345] Charles Fried. *An Anatomy of Values, Cambridge*. Harvard University Press, 1970.

[346] Yanne Goossens. Alternative progress indicators to gross domestic product (gdp) as a means towards sustainable development. October 2007. URL http://www.beyond-gdp.eu/download/bgdp-bp-goossens.pdf. Last accessed 12.09.2011.

[347] Adobe Systems Inc. Adobe to release PDF for industry standardization, 2011. URL http://www.adobe.com/pdf/release_pdf_faq.html. Last accessed on 11.09.2011.

[348] iPass Inc. The ipass mobile workforce report- understanding enterprise mobility trends and mobile usage, March 2011.

[349] ISO 19005-1:2005. *Document management – Electronic document file format for long-term preservation – Part 1: Use of PDF 1.4 (PDF/A-1)*. ISO, Geneva, Switzerland, .

[350] Dr. Vladimir Lepakhin. *Medical Device Regulations*. World Health Organization, Switzerland, 2003.

[351] David Levi-Faur. Regulation and regulatory governance. *Jerusalem Papers in Regulation and Governance*, (1), 2010.

[352] Harald Lothaller. On the way to life-domains balance: Success factors and obstacles. *Intergenerational Justice Review*, 9:48, 2/2009.

[353] Jan H. Maridal. *The concept and cause of human prosperity.* PhD thesis, The Florida State University College of Social Sciences and Public Policy, 2010.

[354] Andreas Monning. Work-life-balance als wettbewerbsvorteil. *Der Tagesspiegel*, 26.03.2007.

[355] Rob Norton. *Unintended Consequences.* Library of Economics and Liberty, 2008.

[356] Wikipedia. Individualism, 2011. URL http://en.wikipedia.org/wiki/Individualism. Last accessed on: 20.10.2011.

Part III

Ideation

Chapter 6

6 AAL in Remote Areas

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The hCube is an abbreviation for "health cube", a medical station which is designed for remote areas like small towns, villages or even less populated areas. The hCube is staffed and monitored by a nurse. It is equipped with state-of-the-art telemedical devices and medical data management platforms that assess health status and risks of individuals and allocates patients to doctors. The hCube tackles the increasing need of people in remote areas to have easily accessible and affordable health care services. Quality of life in villages and small towns suffers from the lack of easy accessible health care as distance to the next doctor's office already appears to be a significant barrier for maintaining high-standard health care. Therefore hCube gives village residents the chance to benefit from comparable health care services like people in urban areas. The hCube's business model emphasizes a strategic public-private partnership by engaging governments, federal states and municipalities in its funding and operation. Instead of equipping every household with costly telemedical devices, the hCube is rather installed in central and accessible locations of villages. Various sensors allow doctors to fastly and reliably make a diagnosis. Funding and revenues for this business model come from the public sector as well as from health care insurances. These customers of the hCube benefit from efficiency gains due to the smart allocation of patients to doctors. The hCube also avoids unnecessary and cost-intensive medical treatment and overmedication through building up integrated health care infrastructures and its interconnection to far off specialist and in-patient health care providers.

6.1 Introduction

Health care related services are one of the most important application fields of AAL. Adequate health care provision, which is easily accessible for everybody, becomes a major challenge in remote areas of industrialized countries: population in German villages and even smaller stripes of land, usually considered as remote areas, will considerably shrink. Furthermore, population in those remote areas gets older [357]. Consequently, the amount of chronic, more complex and severe diseases increases as well. This leads to higher costs for health care as medical therapy for those diseases is even more cost-intensive [360]. As mobility decreases with age, adequate and easily accessible health care infrastructures in remote areas gain importance.

But demographic change does not only affect patients in remote areas: half of the country doctors are currently 55 years and older, especially in the territorial federal states of Germany and is expected to retire in the next two decades with no successors to follow. The increasing lack of general country doctors for maintaining the currently poor health care standards in remote areas becomes even more challenging: with 2.500 country doctors already lacking in 2009, German health care policy makers estimate that in the next years there will be a lack of more than 20.000 practitioners in Germany[361]. Especially German federal states with large rural areas face an imbalanced and therefore highly cost-inefficient provision with health care: while most urban areas already have an oversupply with medical services, remote areas increasingly lack basic health care provision by general practitioners [359].

Country doctors are already overburdened due to the high number of patients they need to care for. Well coordinated and smartly prioritized health care for those patients is needed. Furthermore, country doctors are poorly interconnected with specialists in urban areas. Integrated health care models, which can bridge current boundaries of in-patient and out-patient providers, have not yet been broadly established due to a lack of technological know-how and working business models. These challenges call for business models and product ideas that are able to deliver high standard health care to remote areas.

6.2 Business Idea: hCube

The product name “hCube” is an abbreviation of “health cube”. The hCube is a semi-automated medical station designed for operating in remote areas, where people have poor and inconvenient access to health care. It is equipped with state-of-the-art sensors and software that allow patients to conduct medical checkups and have doctors remotely make a diagnosis. It is connected to a network of affiliated physicians all over Germany and thus coordinates patient data among physicians and involves the right specialist if necessary. Medical checkups in the hCube are time-efficient, as former time-consuming diagnosis

Use Cases	Description	Exemplary Diseases
Acute Treatment, Low Risk Exposure	Realizing efficiency gains through smart risk assessment and allocation to physicians	Common cold, sore throat
Acute Treatment, High Risk Exposure	Coordinating medical therapy through interconnection with specialists in urban areas	Lung inflammation, sprain
Aftertreatment & Curing Chronic Diseases	Avoiding long distances to specialists and in-patient providers for regular checkups	Heart surgery, HIV, diabetes
Early Detection & Prevention, Low Risk Exposure	Avoiding cost-intensive and prolonged diseases at an early stage	Valgus malalignments, metabolic disorders
Early Detection & Prevention, Emergency Treatment	Delivering fast action on medical treatment; Lowering financial burdens due to late sequelaes	Stroke

Figure 6.1: Use Case Categories
Source: Own illustration

steps are taken over by fast and reliable sensor technologies.

Patients using the services of the hCube can be ascribed to one of five use case categories (see figure6.1). The benefits of the hCube for health insurances, doctors and patients derive from the specific use case category the patient is in. Curing low risk illnesses like colds or sore throats usually do not need physicians' advice, therefore costly consultations in the doctor's office can be replaced by standardized telemedical care. On the other hand, serious illnesses call for fast advice and help of (specialized) physicians. In this context, the hCube is able to assess the risk exposure, to prioritize patients and thus smartly allocate them to the doctors who are able to provide the necessary care. Chronic diseases and aftertreatments demand regular appointments evaluating the progress of the treatment. Those regular checkups can be done in the hCube, saving time for the patient by avoiding frequent travelling. Regular checkups with the hCube contribute to a comprehensive picture of the patient from a medical perspective, allowing physicians to detect irregularities and thus to identify risk factors and illnesses at an early stage. Furthermore, cases of emergency can be identified in the hCube (e.g. a stroke) and an emergency doctor is connected while the ambulance is on its way to the hCube.

The following use case scenarios of an acutely ill patient with a high risk exposure and a chronically ill person examplify the functions and processes of the hCube.

Acutely ill patients Tina Meier is 51 years old and lives in a village of 250 souls. She has had a sore throat for three days but has gone to work nevertheless. As driving to the next doctor's office would take 40 minutes and waiting time is usually high, she decided to have the seven minute ride to the neighboring village where an hCube is situated. Before getting on the road, Tina checks the current occupancy rate of the hCube with her smart phone and as expected waiting time for a new incoming patient is only 10 minutes, she enrolls in the waiting list and starts her car's engine.

When she enters the hCube with her electronic health insurance card, the community nurse asks Tina to sit down in the waiting area. As she has not filled out the medical questionnaire yet, she does so by using one of the tablets available in front of every seat. After having answered some personalized questions concerning her current condition, the system asks her to pick a doctor from a list. Usually her family physician would have been picked automatically and thus would be responsible for Tina's hCube visit, but the daily hCube-quota of her family physician is already used up (see figure 6.2). Afterwards, she proceeds to the checkup room, where she stands on a sensor panel. The sensors, embedded in the walls around her and in the panel, are recording body temperature, pulsation, blood pressure, respiratory rate and additional health related data. As she indicated sore throat in the questionnaire, she is asked to open her mouth for the HD-camera to take pictures. Furthermore, she is asked to use the spirometer in order to conduct a pulmonary function test as she indicated that she had breathing trouble last night. After ten minutes the checkup finishes and a lung doctor is connected to the hCube and is displayed at the screen in front of Tina. He tells her that he has had a view on her patient profile. He suspects her to be ill with pneumonia. However, he needs to examine her a little more. Therefore the community nurse helps Tina to put on a vest which functions as a stethoscope in order to conduct a pulmonary auscultation. Seeing the data about Tina's lung function in real time, the doctor decides to x-ray the lungs. Afterwards Tina leaves the checkup room and has a seat at one of the two video conference terminals inside the hCube. Again the lung specialist is broadcasted on the screen for the final diagnosis. He concludes that Tina is ill with pneumonia, gives her some medical advices and sends a digital prescription to the nearest pharmacy where the medicine is available. Tina is advised to have another hCube checkup in two days. Therefore, the lung specialist reserves her a slot in his contingent.

Chronically ill patients Gerd, 39 years old, is HIV-positive since 11 years. He needs regular examinations and as he is under medical treatment at three specialists who work at the university hospital in Munich, his biweekly visits to the doctors including travel and waiting time usually last the whole day. Recently an hCube has been installed in his small home town. Gerd's visits to the hCube usually last thirty minutes. After being checked, the nurse draws

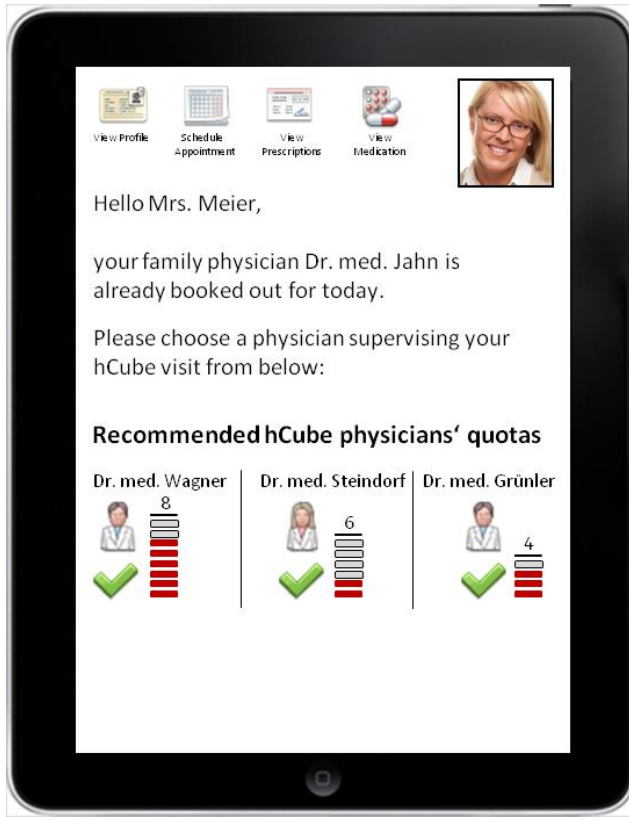

Figure 6.2: Mock-up for Selection of Physician
Source: Own illustration

blood which is directly analyzed. The results are stored in Gerd's medical profile, which is remotely accessed by the three specialists of the hospital. Usually the videoconference with all three doctors takes place at the hCube. But sometimes Gerd takes the opportunity to communicate with a doctor from home, using his own video chat-equipment.

These two use case scenarios already give an impression about the functionalities of the hCube. However, every successful product or service is embedded in a business model. In the following sections the business model of the hCube is evaluated according to Osterwalder's building blocks Osterwalder and Pigneur [358].

6.2.1 Value Proposition

The core value proposition of the hCube is to enhance health care provision in remote areas where patients face difficulties to have nearby access to basic medical services. The hCube is a gateway to high-quality health care in remote areas via an innovative business model: it comprises of telemedical devices and patient data software that handels the medical data of patients in order to smartly allocate physicians to patients based on individual medical needs. Hence the hCube tackles not only the increasing lack of generalist country doctors, but also supports patients to have easier access to specialist medical diagnosis and treatment which are currently mostly located in far off urban areas.

The hCube is built on a strategic public-private partnership, as insurances as well as the government fight high costs and inefficiency in the medical sector. In this context, telemedicine is considered to be a solution especially for areas with few health care providers. Rather than having each patient purchase telemedical devices on his own, hCube bundles state-of-the-art telemedical resources and achieves high quality treatment/diagnosis opportunities as well as operating efficiency through a high occupancy rate. The core strategic approach of the hCube is therefore to provide the benefits of telemedicine to large integrated community as it also helps to interconnect and integrate former separated health care providers, currently located in remote as well as urbanized areas. Through this approach hCube opens up unique opportunities to involve public stakeholders who have an interest in supporting communities rather than individuals. In light of the highly regulated primary health care sector, this approach can lower market entrance barriers. The values for the public and private stakeholders can be drawn as follows:

Patients Patients have more convenient, timely and easier access to health care in their near environment. The hCube provides high-standard health care to patients by building upon newest telemedical technologies. It smartly

coordinates information among general physicians, specialists and in-patient providers. The hCube makes health care for patients more customized and integrated that is highly needed to cure more effectively chronic and severe diseases.

Health Care Providers The hCube helps to save costs and time: it lowers workload of health care providers through smart patient data management which optimizes the allocation of patients in remote areas to designated physicians, pharmacists and in-patient providers. Thereby it can avoid conflicting medical treatments as well as overmedication. Physicians, affiliated with the hCube, are provided with new opportunities for prevention of diseases as medical profiles, which are updated via hCube, enable an early detection of diseases.

Health Care Insurances While statutory insurances set up appropriate remuneration schemes for hCube medical services, they highly benefit from the smart and efficient pooling of health care provider resources. The hCube supports insurances in depletion of cost-inefficient double structures and oversupply in health care. Therefore it stabilizes and saves spending through the avoidance of unnecessary, cost-intensive treatments.

Public Sector The hCube strengthens the health care industry which has been promoted by public policy makers in Germany for years. It offers expansion opportunities by building up high-tech medical systems in remote areas, simultaneously creating new employment opportunities for nursing staff. From the view of public sector entities the hCube serves as a solution to fulfill their legal obligations to ensure an adequate standard of primary health care across the whole country. Furthermore, the hCube could enable opportunities for new quantitative (statistical) public health research through the anonymous collection and evaluation of constantly updated medical profile data. Patient data, collected and evaluated in the hCube, could be exchanged with public entities for public health purposes.

6.2.2 Customer Segments

The hCube has two customers segments: the public sector including national government, federal states and municipalities and on the other hand health care insurances. The national government provides funding and financial incentives for interested parties while federal states which usually (co-)finance health care infrastructures as well as municipalities compensate for the acquisition costs of the hCube.

The other customer segment of hCube are health care insurances. They remunerate the medical services as well as other running costs which arise during the operations of the hCube. Additionally health care insurances have

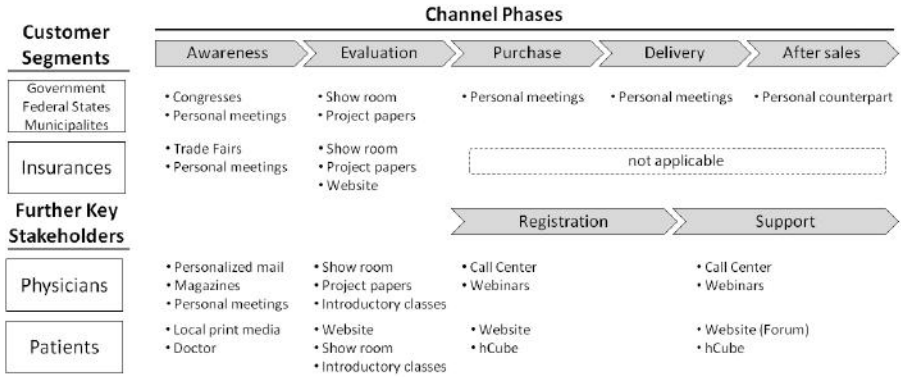

Figure 6.3: Channel Mix
Source: Own illustration

to set up appropriate remuneration schemes for physicians who treat patients via the hCube.

6.2.3 Channels

As the hCube needs to address different customer segments, a multi-channel strategy helps to reach each customer segment according to its individual needs. In the following paragraphs, the channel mix for those who buy the hCube (Federal States), deliver services through it (physicians, pharmacies) and the end-users (patients) are presented.

Channel Mix for Customer Segment Federal States Communication, distribution and sales channel for the segment "Federal States" have to emphasize personal contact. This is due to the high acquisition cost of the hCube which require comprehensive professional advice. Moreover, it can be expected that public authorities purchase hCubes in bulk, which is why negotiations become important. In order to persuade municipalities to install hCube, firstly the top government officials are approached, as the hCube solves a political problem (health care for remote areas). The hCube is delivered ready-to-use. Maintenance is carried out regularly by a team of mechanics, who can also solve software issues remotely. Communication channels for after-sales services are integrated in the hCube itself (e.g. online requests for maintenance including bug report).

Channel Mix for Customer Segment for Insurances Following this top-down approach, hCube representatives raise awareness among insurances on trade fairs

and through personal appointments, already having the support and interest of public entities on their side. Furthermore the functioning of the hCube is demonstrated in a show room, located in Berlin. A website is used to provide interested parties a first contact point, also integrating a virtual show room which offers the opportunity to experience the process of a medical checkup from the perspective of a patient or of a physician.

Channel Mix for Medical Staff Firstly awareness among doctors is raised via personalized mails and articles in specialist magazines. In order to persuade doctors to affiliate to the hCube, they receive a customized calculation created with respect to a doctor's answers in an only survey which shows the potential benefits of an hCube commitment. Furthermore, sales force visits serve as an opportunity to persuade physicians to take part in the hCube model. In this context, the partnering with insurances and medical device suppliers, who already are in a relationship with the respective physician, serves as an opportunity to avoid the disadvantages of cold calls. Regarding evaluation and support purposes, physicians can join hCube classes (e.g. offered at conferences) or sign up for hCube webinars. In cases of urgency call center agents provide help.

Channel Mix for Patients Potential end-users need to be informed about the possibilities the hCube provides, in order to be able to decide if and when to use it. Awareness is raised through affiliated physicians and media coverage in local newspapers. Regarding non-treatment related questions about the hCube, patients can get information on the hCube website or through regular introduction sessions which take place at their local hCube and are conducted by professionals of the hCube team.

6.2.4 Customer Relationships

Since the customer segmentation for the hCube has lead to two different groups with individual needs and interests, one needs to clarify the type of relationship that is intended to be established with both customer segments. The federal states and the municipalities need dedicated personal assistance, as trust has to be built and maintained permanently. Therefore one person is assigned to deal with all the upcoming issues personally. Problems can be solved individually and the personal approach emphasizes the importance of the relationship. The importance of approaching public authorities as the gatekeeper to the primary health care market justifies the high costs for this type of relationship.

Relationships to insurances are maintained on a personal but not that intimate level as with the public sector. One exception is the implementation phase during which insurances receive a dedicated personal assistant. For insurances' questions

concerning running hCube operations, automated services are implemented, as the hCube can handle a high number of different patients.

Although not being a direct customer, the relationship to end-users is shortly described. End-users will be supported by automated services and if necessary receive personal assistance. For instance, the hCube automatically communicates with patients and the community nurse can provide additional personal support. Since end-users can be divided into five segments, according to the use cases, the hCube's automated service needs to be adjusted to each end-user segment's needs.

6.2.5 Revenue Streams

The revenue stream of hCube's business model consists of a onetime payment for the sale of the hCube and a continuous cash inflow during operations. Municipalities and federal states are financing the entire physical build-up of the hCube, paying for the ready-to-use hCube. The price includes the production and development costs as well as a certain margin.

The second revenue stream is generated through the operations of the hCube and depends on the kind of treatment that is conducted in the hCube. The treatments of the patients are remunerated by their health insurances and are paid to the administration of the hCube.

When comparing this two revenue streams, major earnings are made through the second stream, assuming a high occupancy rate and lifetime of the hCube. The first stream's onetime payments are not accounting for high margins, as penetration pricing is used as a strategy in order to gain high market shares.

6.2.6 Key Resources

The resources required to deliver the value propositions of the hCube can be divided into the categories physical, intellectual, human and financial, whereas the physical and intellectual resources can be perceived as the most important factors.

Physical

Taking a closer look at the physical resources, the hCube consists of a moveable, standardized container providing the working space. The interior and overall equipment is set up in a modular structure, thus allowing for customized settings. This container is equipped with medical devices, like a chair furnished with sensors and a body scanner, telemedical devices like a high definition camera as well as the ICT infrastructure to connect the patient and the nurse in the hCube with the physicians in hospitals and their surgeries. These devices are not only transmitting video and audio data, but also other related patient data measured through the sensors. Already existing and medical technology

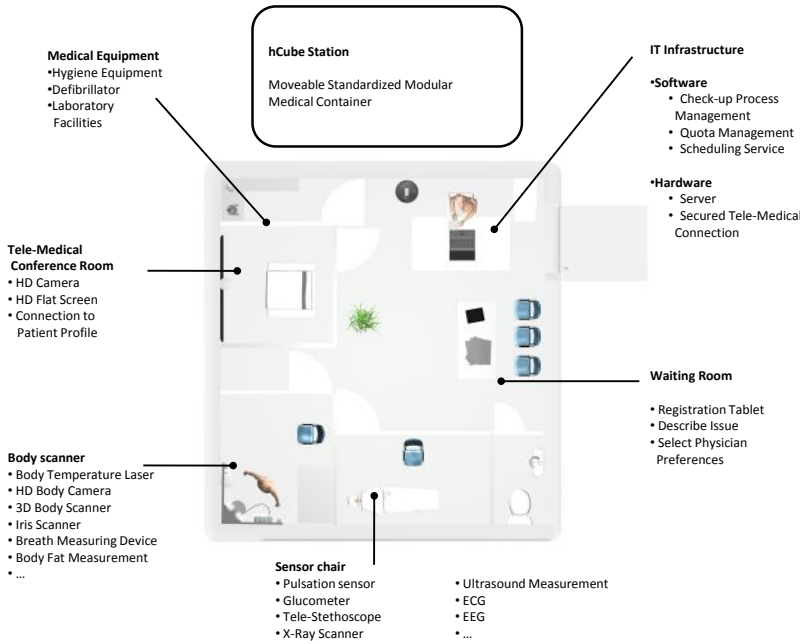

Figure 6.4: Groundplan and layout of the hCube
Source: Own illustration

developed till 2025 is used to set up the hCube laboratory, like for example instruments like an X-ray unit or an ultrasound scanner. Beside the medical technology, general medical equipment for such a station is needed to ensure the hygiene requirements and allows the nurse to follow instructions of the doctors, like instruments for blood taking and analyzing in the hCube laboratory. Furthermore, the container will be equipped with general office equipment like a laptop for the nurse to provide for example the scheduling service.

Figure 6.2.6 shows the layout of the hCube from above. The desk of the nurse is located close to the entrance and waiting area in not separated rooms, allowing the patient to have a chat with the nurse while waiting. In the two separated measuring areas the sensor chair having physical contact with the patient and the body scanner with visual measuring sensors are located. A separated tele-medical conference room and the above describe laboratory are located on the left hand side of the hCube layout.

Intellectual

Looking at the required intellectual property needed to secure the business model, first of all patents for the telemedical measurement chair and the body scanner as well as utility patents for the medical container itself and the standardized layout of the hCube is needed. Secondly, the software to run the ICT infrastructure like the scheduling software to organize the specialists and telemedical appointments with doctors has to be acquired or protected. The required legal and professional medical knowledge is provided through the key partners.

Human

Regarding human capital, specially trained nurses are needed, who are familiar and educated for the hCube and its instruments. Furthermore the nurse is acting as a social contact for the patient and therefore will additionally receive a psychological training as well. This helps to reduce the workload of the doctors, who are often consulted to have social contact. To introduce the hCube to the heads of the municipalities, educated representatives and sales experts are needed. Technicians are providing the maintenance of the station and the medical devices within the hCube. Furthermore, an emergency hotline for patients and nurses and emergency technicians ensures the satisfaction of safety standards. Finally a headquarter of the hCube venture is responsible for the administration, operation, production planning, sales and after sales of the entire hCube.

Financial

Several funding stages are necessary to run this business model. First of all funding for the R&D and establishing the described intellectual property is required. The R&D can partly be outsourced and provided through cooperation with key partners like universities and independent research institutes. After developing and evaluating a prototype, a customer base and distribution channels are built up. At the same time the series production is set up and needs to be funded. After creating the first revenue stream through sales, the second stream through the operations of the hCube is emerging and is step by step replacing the required funding to serve the expenses.

6.2.7 Key Activities

The key activities discussed in this section can be divided into activities required to produce the hCube and those which are needed for the hCube to operate successfully.

Key Activities Before Factory Acceptance Test

As the hCube is a complex high-technology product, R&D are important activities. Doctors, insurances and patients have to be closely involved in the development process, in order to meet everyone's needs satisfactorily. Thus requirements engineering becomes a key activity. The development phase concerns hardware (e.g. architecture of hCube, sensors) as well as software (e.g. design of checkup surveys).

Every hCube is made to order and can be customized due to the modular design. The manufacturing process is similar to the one of a car, with the specialty that every product part is produced by partners. In terms of producing the hCube, only the assembly of the pieces and the installment of the software system are done inside the hCube production plant. Therefore a smart procurement and logistics system is important, as pieces that are out of stock delay the made to order production process.

Delivering the hCube to its final destination by truck is the penultimate key activity. Lastly, the hCube is set up correctly, including connecting it to the circuit and internet and doing some general test runs on correct functioning.

Key Activities For Operating The hCube

Four key activities for operating the hCube can be distinguished: risk assessment, quota management, telemedical checkup and billing.

Patient data that is collected during the hCube visit is constantly assessed for risk, in order to improve allocation of physicians' resources. The immediacy of medical consultation depends on the risk category a patient is in. Ranging from "Emergency" (level five) to "No Risk" (level one), the calculation of the risk level lays the basis for the physicians involvement in the hCube (see figure 6.5). The algorithm used for this calculation considers the historic as well as recently collected medical data which is used for updating the patient profile. Through physicians' feedback on every patient's assessment ("Has the risk category, hCube calculated for the patient you just reviewed, been correct?"), the algorithm is generally optimized and the individual accuracy for each patient is improved.

However, the risk assessment and the decision about involving doctors on this case to case basis do not work without a quota management. Doctors have to indicate when they are free to care for level four patients and how many patients regardless of risk category they can handle per day. Instead of letting doctors enter their hCube time slots maunally, it is also possible to connect the quota management system to the doctors' schedules and figure out optimal hCube time slots automatically. Thus the hCube's software optimizes resource utilization. This doctor specific time slots are then filled by hCube patients all over Germany, whereas patients' preferences (e.g. one specific doctor, a doctor nearby) are considered.

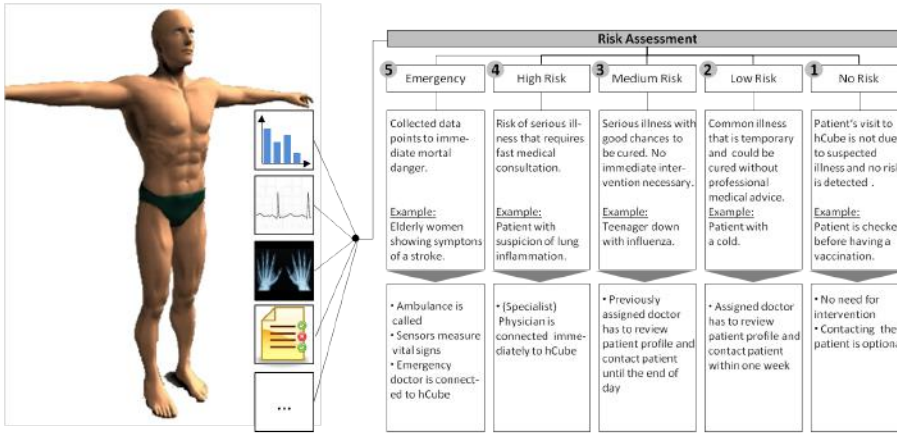

Figure 6.5: Risk Assessment
Source: Own illustration

Doubtlessly, the medical checkup during which data about the patient is collected builds the basis for delivering the value proposition to patients, physicians and insurances. Numerous sensors allow collecting exact vital data. Furthermore questions about symptoms are asked and answered by the patient via touchpad. Physicians can configure patient-specific checkup-procedures, indicating which data and therefore which sensors are needed. All information is stored on the electronic health insurance card (respectively its online servers).

Billing is the last key activity for ensuring successful hCube operations. The fee hCube charges physicians for each patient's visit depends on the visit duration, remuneration and number of hCube patients that a physician has already cared for. Physicians therefore have to indicate the type of treatment they conducted via the hCube as the remuneration they receive from insurances depends on this type. In general the billing system is designed to ensuring comprehensive medical care and allocating resources by setting financial incentives for specific physicians, treatment time-slots or hCube areas.

6.2.8 Key Partners

Important partners are the government and federal states, especially the so called territorial states like Lower Saxony. Public authorities are asked to subsidize the hCube development, as well as to promote the hCube among statutory health insurances. For both, insurances and physicians, the government can set up incentives that lead to a greater acceptance of the hCube business idea. Therefore it is important to get those public authorities enthusiastic on hCube. The fostering contact with insurances leads to the second important

partnership: the statutory insurances. On the one hand they have control over the remuneration of authorized physicians and therefore influence hCube's revenue stream and the attractiveness for a doctor to affiliate with the hCube. On the other hand, insurances have access to the patients' profile database and are involved in the development of the electronic health card platform which is a key resource for the hCube's business.

Since the general business idea of hCube includes the coordination between physicians and their patients, another very important key partner are professional associations of physicians. In order to reach and persuade physicians to affiliate to the hCube network other trustworthy channels of these associations may be used. Furthermore, education on newest hCube developments can be provided in cooperation with associations which often host conferences around Germany.

The third key partners are the production partners. They are necessary to build up a solid production and supply chain.

Lastly, for producing a highly complex product like the hCube the different technical devices need to be selected and constantly checked for improvement opportunities. Therefore, the engineering departments of universities specializing in medical technologies as well as university hospitals are key partners in the field of R&D.

6.2.9 Cost Structure

The hCube is a manifold business model that not only includes a compact cube container, state-of-the-art telemedical equipment, and patient data software, but also requires the supervision by a nurse. Therefore the most inherent costs in the business model are R&D costs, fixed and variable costs for producing the cube itself, as well as running costs.

R&D

While the hCube can build upon already developed, but non-contiguous telemedical devices, there is so far no comprehensive telemedical device set for health care provision in remote areas. Therefore, the business model in the first place calls for R&D costs in order to develop and standardize a comprehensive und coherent set of telemedical technologies.

Production of hCube

Another cost type are fixed costs like employees' salaries or the rent for the production plant. They occur independently from the number of output (hCubes). Variable costs however only occur if an hCube is produced. This cost type consists for instance of the pieces' buying prices (sensors and other material) and the costs of the electricity needed for the assembly of all components.

Running Costs

Fixed running costs occur, no matter if patients visit the hCube or not. The salaries of the community nurse or the rent for the lot serve as examples for this category. Variable running costs are electricity costs, materials like one-way gloves, syringes, detergents, as well as maintenance of the software and the other telemedical technologies. In comparison to the fixed costs these variable costs are not only well assessable as they are comparable to already existing and conventional medical practices of physicians, but they can also be reduced over time: with increasing standardization and mass diffusion of hCubes economies of scale can be realized. This holds particularly true for software and equipment maintenance and the purchase of medical materials. In conclusion, the hCube is rather a value driven business model as it focuses on value creation to provide innovative and high-standard health care to patients in remote areas.

6.3 Scenario Robustness Check

In the following sections the four scenarios will be assessed regarding their compatibility with the business model hCube and its core value proposition, features, and functionalities. These four scenarios are based on a four-square-matrix with individualism and technology acceptance as the two continuous key drivers. Main crunch points are data privacy concerns of the population as well as the unwillingness of customers to accept technologies interfering in their well-being, health and personal lifestyle. Furthermore, the robustness check refers also to the growing loss of social interaction with doctors as patients will be primarily treated via telemedical devices in the hCube.

6.3.1 hCube in Scenario "Back to The Roots"

This scenario is very unsupportive for a healthcare solution like the hCube. Due to the recent catastrophes caused by intensive integration of technologies in the everyday life, people fear that the use of technologies might cause diseases. As a consequence the original value proposition becomes futile and the hCube experiences big distrust. The medical development turns away from technologies and ordinary medicine gains in importance. Additionally remote areas are attractive due to stronger family values and therefore densely populated. That on the one hand allows doctors to settle down in remote areas without problems. Thus the lack of medical support in rural areas will reverse by its own. On the other hand the stronger family network makes telemedicine questionable, due to enough proximity within the family. Nevertheless, if the hCube can guarantee harmlessness, people could use the product despite their fears. hCubes's value proposition is still working because it organizes the doctor-patient communication very effectively. Prevention is also still an

interesting factor for both insurances and patients. Summarizing the situation in the scenario "Back to the roots", the hCube would face huge risks of being rejected.

6.3.2 hCube in Scenario "Me, Myself And No More I"

In the scenario "Me, myself and no more I" the protagonist Maria wonders how a highly individualistic society can provide care to people in need if society is not in favor of new technologies that could help and assist them. While the general need for health and foster care as well as personal assistance increases, people will in the same time focus more on their personal life and well-being. They won't be as willing to care for others. In fact, in this scenario hCube would face a rather unsupportive or at least questionable business environment for broad implementation: People will express severe reservations about technologies interfering in their personal life with regards to privacy issues as well vulnerability to technological failures. Consequently, they will not be very supportive towards handling and management of their sensible patient data via hCube. On the one hand, there will be an increasing need for health care and medical services, especially in remote areas, since villages and other rural areas lack community spirit and family structures which could step in if relatives are sick. This will increase the spending on health care services even more as people cannot primarily rely on their families and close community. On the other hand, people will have a more skeptical and hostile attitude towards hCube as it embodies high-tech telemedical appliances and data management. In conclusion, hCube faces a paradox situation: The business model might be poorly accepted among potential customers as people will be sceptical towards the smart exchange and management of their personal medical data with third entities via hCube. However, the market environment is quite favorable for hCube as there will be a high demand for health and foster care services in the meantime, especially in remote areas.

6.3.3 hCube in Scenario "Me, My Tech & I"

Comparing the scenario "Me, My Tech and I" with the other three scenarios, medical care in rural areas will be most important in this scenario. People are focusing more on themselves and help each other's less within social communities like families. Advanced demographic change and rural depopulation increases the demand for health care among the remaining citizens in rural areas. The population is willing to use new medical technology, which goes hand in hand with legal acceptance of new medical technology. Treatments like prevention and assistance services for a healthier life are growing. As a result research and application of technology in the health care sector will increase and new treatment methods will be developed and reach a marketable stage. Telemedical

treatments are standard methods of the health care sector. This lowers the price for medical and telemedical equipment due to economies of scale and increasing availability and affordability of AAL products on the mass market. As hCube will be equipped with several state of the art telemedical sensors and actors, the price of a product like the hCube is decreasing. Against this background, in this scenario the described factors will lead on the one hand to the highest demand for products like hCube and on the other hand to the lowest production price compared to the other three scenarios. Finally these facts will lead to the highest sales rate of the hCube in this scenario.

6.3.4 hCube in Scenario "Electronic Hearts"

In the scenario "Electronic Hearts" technologies are commonly accepted to improve everyday life by taking on tasks that are time-consuming and not yet carried out efficiently. From a technological perspective, the state of development (e.g. concerning sensors) as well as the acceptance of technologies by end-users will favor the emergence and successful implementation of the hCube. Health care is considered to be an important topic in the scenario. People emphasize family values and want to be able to actively take part in community life as long as possible which requires high quality health care for this ageing society. The scenario shows that remote areas are still attractive for people to live in, as a lot of daily tasks can be done at distance (e.g. videoconferencing). Thus, people expect the public sector (municipalities) and insurances to offer similar possibilities in terms of health care. One important barrier, the hCube faces in this scenario is the lack of human contact. Although technologies are accepted, they are expected to support interactions and not to totally replace them. Thus doctors' personal commitment plays a key role. Certainly, the community nurse supervising the hCube is of great importance, as she cares for the social dimension of an hCube visit. As long as doctors can make their patients feel that a human is actually understanding and caring for their needs, people will consider they hCube as a device, that like their smart home devices, yields efficiency gains.

6.4 Conclusion

The hCube is an innovative business model that helps to maintain primary health care infrastructures in remote areas. The hCube yields new synergies in terms of integrated health care services by smartly matching patient and doctor capacities and interconnecting formerly separated in-patient and out-patient providers. Hence it directly responds to the emerging policy and social trend towards a more integrated "ambulatory health care centers". This enables not only new individualized medical treatment opportunities for chronically ill

people, but also provides benefits to the public sector and health care insurances by avoiding unnecessary and poorly coordinated medical treatments.

However, the outlined business model is based on the current technological state regarding medical sensors and appliances. Further business opportunities for the hCube may arise from technological progress in the (tele)medical equipment industry once new sensors and thereby therapy appliances become available. In addition, hCube carriers can achieve additional returns once the hCube can be interconnected to home- and mobile-focused AAL sensors and services like mobile or smart home devices.

Another possibility is to set up the hCube as a more flexible cube which can be moved more easily from one village to the other. By bundling financial resources of several administrative districts and municipalities these public sector entities may also lower their acquisition costs and still deliver the benefits of the hCube to their inhabitants.

Finally, additional business opportunities and revenues for hCube carriers may also arise from processing individual medical profiles. Those private customers could be provided with add-on premium services like voluntary health and nutrition counseling, privately paid preventive check-ups or any other health and lifestyle coaching.

References

[357] Statistisches Bundesamt. Entwicklung der privathaushalte bis 2030: Ende des ansteigenden trends. ergebnisse der haushaltsvorausberechnung 2010. http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Publikationen/Querschnittsveroeffentlichungen/WirtschaftStatistik/Bevoelkerung/Privathaushalte2030___32011,property=file.pdf accessed on 01.10.2011, 2011.

[358] Alexander Osterwalder and Yves Pigneur. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. 2010.

[359] Hochschule Neubrandenburg Prof. Dr. Thomas Elkeles. Vortrag: Gesundheitliche versorgung und ihre infrastruktur im laendlichen raum. http://www.boell-brandenburg.de/pics/images/Elkeles_20.01.07.pdf accessed on 01.10.2011, 2007.

[360] Statistisches Bundesamt und Robert Koch Institut. Sterblichkeit, todesursachen und regionale unterschiede: Themenheft april 2011. http://www.gbe-bund.de/gbe10/ergebnisse.prc_tab?fid=13932&suchstring=&query_id=&sprache=D&fund_typ=TXT&methode=&vt=&verwandte=1&page_ret=0&seite=1&p_lfd_nr=1&p_news=&p_sprachkz=D&p_uid=gastd&p_aid=65204404&hlp_nr=2&p_janein=J accessed on 01.10.2011, 2011.

[361] DIE ZEIT. Notruf nach dem landarzt. der provinz droht ein medizinermangel. http://www.zeit.de/2010/11/M-Aerztemangel/komplettansicht?print=true accessed on 01.10.2011, 2010.

Chapter 7

7 Second Healthcare Market

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Valeo is a Latin word that means “I am in good health“. It is a mobile application that supports the user to eat healthy and avoid malnutrition.

In order to create individualized nutrition plans Valeo collects health data from the user via questionnaires and medical sensors that are attached to or even implanted into the body. Furthermore, eating habits such as veganism and intolerances such as allergies are taken into consideration.

Based on these individual user profiles Valeo recommends nearby restaurants and automatically generates shopping lists that fit the specific nutrition plan. Since Valeo connects with the user’s calendar it perfectly adapts the nutrition plan to the physical and psychological requirements. Additionally, the users can share and exchange healthy cooking recipes or transfer their medical data to their attending physician.

Thus it is interesting for the mass market of health aware people in general as well as allergy sufferers, overweight people and people with special eating habits.

Valeo’s business model is based on different revenue channels. Users pay a monthly fee depending on the variety of services they use. In addition, restaurants can buy a premium membership, which enables them to present more information about their dishes and get a higher ranking. Moreover, based on the aggregated user data, Valeo sells advertising space to companies that then can make use of highly customized advertisements.

7.1 Introduction

Today's society that is constantly on the go and has no time to plan its meals, and an accelerating technological development which makes individualized apps and devices possible gives rise to the need for an innovative and new health product that satisfies and solves the problems and necessities that appear.

Society

Nowadays many social phenomena are in a certain way contradicting and therefore lead to a society of extremes instead of a well-balance. This holds true for society's attitude towards healthy food: on the one hand, people become ever more health aware and therefore the wellness trend still seems to be on an upward movement. Organic and low fat products are big sellers in most of the supermarkets. In its extremes this does not lead to a healthy nutrition but almost turns into a mania for dieting, e.g. anorexia has become a prevalent problem of nowadays society. [365]

On the other hand, the number of fast food restaurants is growing. Each Year the market leader McDonald's opens new restaurants which leads to an increasing number of fast food consumers. In 2009 the number of McDonald's guest rose by 3.2%. [363] As a result, a large part of young people suffers from overweight. This is due to three main reasons.

First, Germans in general are not willing to pay a lot for food: In 2011 German households spend only 14% of their income on groceries, which is well below the European average. [362] As healthy food in general is more expensive than fast and unhealthy food the willingness to pay for healthy food is therefore expected to be low.

Furthermore, working life has changed and food is something one handles in between and does not spend a lot of time on. Many business people do not have the time to go shopping (especially when coming home late from work when all supermarkets are already closed), prepare their own dishes or even just care about healthy food. Therefore, the frozen pizza or the drive-in burger is often the fastest and best fitting dinner after a stressful office day. Moreover, globalization increases the necessity of people travelling a lot due to their job. Irregularity determines their schedule and it becomes quite difficult to plan lunch and dinner time and place.

The third reason for a society with an increasing number of overweight people is that they are just not informed well enough about healthy food and even if they try to follow a professional diet plan it probably does not fit to their schedule and personal life situation.

Business Lifestyle

From an economic point of view organizational downsizing has taken place in recent years. [364] Thus, the number of small companies and start-ups increases. Those small and middle-sized companies do not possess any cafeterias for their employees and as a result people tend to eat out in small restaurants close to their office.

Technology

Technology already has become a maintaining factor of the everyday life of the majority of today's society.. The number of smartphone users steeply increased in the recent years and this trend is about to continue.

To sum up, people in general want to live healthily but most of the time they either overdo it and just follow a slimness craze instead of having a balanced diet. On the other hand, they often simply do not have the money, time or knowledge to live healthy or follow a specialized diet when aiming to lose weight or training for a special sporting event and hence tend to eat irregularly, too fat or simply too much. They increasingly eat out in small restaurants and are willing to use technology to simplify their lives. The eating out habit also gives rise to the problem that people with allergies or diseases have hard times to figure out what they are able to eat when they do not prepare their dishes themselves - another problem that could be tackled by a technological solution.

7.2 Business Idea: Valeo

The mobile application Valeo offers an individual nutrition plan that suggests recipes to prepare at home or recommends healthy dishes at nearby restaurants. The recommendations are based on data that is collected by medical sensors and personal input by the user. Thereby diseases such as lactose intolerance, gluten intolerance or diabetes can be taken into account. The data is connected to the users' calendar and can then be used to create most fitting dishes or recipes in order to fulfill the schedule, personal preferences and health values best, e.g. Valeo suggests a carbonate-rich meal several hours before doing sports (see also figure 7.1). In the following subsections the Canvas approach by Alexander Osterwalder is followed in order to fully picture the business model of Valeo.

7.2.1 Value Proposition

Nutrition as well as sports and stress respectively relaxation are the main factors determining the degree of a healthy life. Although they are closely related and interacting, each aspect should be balanced out by itself and cannot be compensated by one of the others.

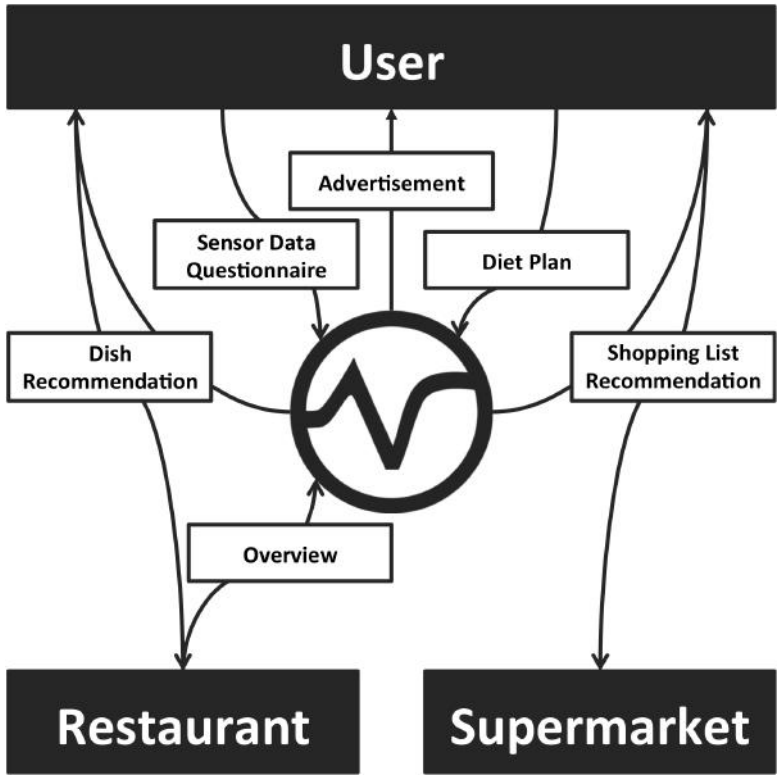

Figure 7.1: Valeo product overview
Source: Own illustration

Valeo is a solution consisting of services and devices that support a well-balanced and healthy nutrition by coordinating all areas that influence a healthy diet in general. As a result, Valeo does not only improve the nutrition but also leads to a less stressful life (see figure 7.2). Its main components are an individually designed diet plan, a restaurant and dish finder as well as an intelligent grocery shopping assistant. Those services are integrated into one solution thus communicating with each other and adjusting its suggestions and plans.

On the one hand, Valeo adds new features to already existing services and technologies, like providing a restaurant finder but with a focus on healthy dishes considering your personal diet plan. Additionally, information about calories, fat, and ingredients, the user might be allergic to, can be provided.

On the other hand, Valeo combines those simply extended services with totally new and innovative devices which complement the app. High-tech sensors will

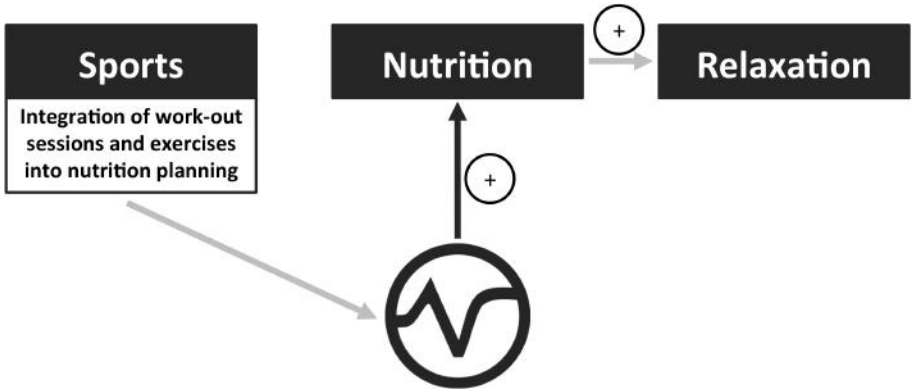

Figure 7.2: Valeo value proposition
Source: Own illustration

regularly measure the user's health data and transfer this information to the integrated digital diet coach thus guaranteeing a secure and effective nutrition. An intelligent fridge can be integrated and used to perfect the shopping assistance and track the user's nutrition in the easiest and most user-friendly way.

Through the combination of innovative new devices and existing functions extended by healthy add-ons Valeo satisfies several customer needs. They can be classified into different categories which will be described in the following.

Need for Security

In an aging population and a society where the concept of sustainability gains more and more importance, the sense of security in form of health prevention and an adapted nutrition regarding the respective allergies of the individual become increasingly significant. A solution that ensures a healthy diet by using reliable dietary information and individually adapting it to the personal lifestyle of the user solves this emerging need.

Need for Flexibility

Furthermore, society becomes ever more mobile and a growing part of working men and women have an irregular and unpredictable schedule. Therefore the need for flexibility arises and can be satisfied by a solution that proposes an idea for each and every situation - cooking at home, having a quick snack on the go or meeting friends in a restaurant for lunch.

Customization

The increase of mass customization in every kind of consumer goods became one of the most important phenomena in recent times. Regarding food, people want to have a personalized diet plan that fits to their schedule, preferences and family situation. The Weight Watchers concept showed that individualized diet plans are quite successful because they fill the existing need for individual diet consultancy on a low price basis. Valeo can be seen as Weight Watchers 2.0 for everybody and not just people who want to lose weight. Its self-learning software improves over time by collecting data and figuring out the habits and favorites of the customer thus creating adapted and individualized diet plans.

Price and Accessibility

As already mentioned Germany is one of the countries where people are not willing to spend a lot of money on food. It can therefore be concluded that people would not pay a lot for a personal diet coach although the general wish for a healthier diet exists. A cheap application that substitutes the personal nutritionist on a low price basis will solve this problem and make a well-balanced and personalized diet plan also accessible for people with a normal to low income.

Moreover, people who previously did not have the time to take care of their nutrition because they were always on the go and missed the opening hours of supermarkets due to their stressful working life can get access to a healthy nutrition that perfectly fits to their schedule. Valeo assists ordering healthy grocery regarding their personal preferences and the suggested diet plans. The user does not need to revert to fast food which often is the only food available outside "normal" working hours but will always find a fridge stuffed with fresh and healthy food when he comes back from work.

Thus, Valeo solves the problem of an unhealthy nutrition caused by a lack of time or too high prices for a health consultant by making a personal diet coach accessible for everyone independent of their time schedule, job or income.

Convenience and Usability

From a marketing point of view people can mostly be seen as lazy, impatient, and with a favor towards individual treatment. As a result, the easier a product can be used and the less effort is needed to follow a device's suggestions the more successful it becomes.

Due to a high integration of different tools into one solution Valeo combines many functions that cover all aspects of healthy nutrition. Therefore, the user does not have to use different apps or devices to organize his nutrition but will only have to open Valeo to plan and coordinate all life aspects which influence his nutrition in any way. Furthermore, Valeo is flexible and barely any manual input of personal data is necessary to still get good and personalized advices.

To sum up, Valeo is exactly the solution needed to fulfill the needs of a health aware and mobile society with an affinity for technology. It combines the aspects of flexibility, high integration and customization at an affordable price.

7.2.2 Customer Segments

Valeo is based on a business-to-customer model. Its customers are private people who want to take care of their health with the help of smart digital technology that integrates all systems and communicates automatically in the background without the need of the user's input.

Valeo targets a mass market. The value proposition, distribution channels and customer relationships all focus on one large group of customers with the common wish or even need to live healthier. This wish cannot be fulfilled by themselves due to a lack of time or discipline to follow on a healthy nutrition. The customers can be divided in two main groups, normal users and users with restrictions such as diabetics, gluten intolerance, lactose intolerance etc. For these restricted users the app has to automatically exclude certain recipes, dishes etc. that their bodies are not able to ingest.

Furthermore, a distinction between three different customer segments can be made depending on the functions they use. The basic user using the app with the included basic questionnaires, the sensor user extending the dataset through medical data obtained from a special sensor and the premium users who get supported by a professional nutritionist (see also figure 7.3).

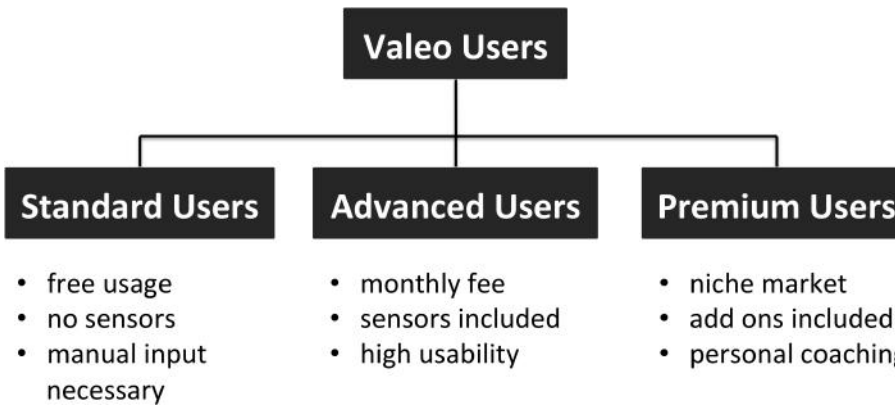

Figure 7.3: Valeo customer segments
Source: Own illustration

Basic users

For basic users Valeo mainly provides recommendations for healthy food offered by restaurants nearby and dishes to prepare. Based on the users' input it creates a nutrition plan that matches the users' schedules.

This version on the one hand really aims at the conversion of basic users into paying customers. Therefore, regarding the demographical, socio-graphical and psycho-graphical attributes of this customer segment, the basic version tries to acquire customers with the attributes of advanced and premium users. On the other hand, there is a large group that really does not want to invest into the full service or is skeptical about the technology involved and therefore only wants to use the app without making use of the sensors.

Advanced users

The advanced version of Valeo includes sensors that enable the app to get the important health condition information of its users. For the advanced users the mobile application offers an even better fitting nutrition plan that suggests recipes to prepare at home or recommendations on restaurant dishes nearby. The recommendations are based on data that is collected by medical sensors. This data is connected to the users' calendar and can then be used to create most fitting dishes or recipes in order to fulfill the schedule best, e.g. many carbohydrates if a tennis match is on schedule.

Looking at demographic attributes of the advanced users the app basically targets everyone who independently takes care of himself. Gender and family status are dispensable. Furthermore, the advanced users aim at a sustainable change of their lifestyle regarding nutrition. They plan to adjust it without putting up a time-consuming and expensive nutrition plan by contacting an expert. This often fails due to the users' lacking discipline and persistency of putting together all data manually and executing a diet plan without anyone monitoring it. Compared to the benefit the app creates, the monthly fee has to be bearable to the customers and should generally not display a knockout criterion. Of course the app requires the customers to use a smartphone with an Internet connection in order to run the app.

Premium users

Premium customers get a more convenient product that goes beyond the automatically handled customer relationship management. By assigning real nutrition experts to the premium users a personal interactive customer relationship is maintained. The coach helps to coordinate the customers' time management and aligns nutrition, personal features, preferences, and calendar activity on a more personal note.

Premium users are mostly older than 30 years and single. They are rather well-off and have a high self-awareness. Regarding the regional mapping premium users mostly live in urban areas.

7.2.3 Channels

First of all, the awareness towards Valeo has to be raised. In this process, different strategies for the three kinds of users should be considered. The attention of potential basic and advanced users can most likely be gained via online marketing, e.g. an online advertising campaign in social communities, health forums etc. The premium user will be reached on a more personal level via personal invitation letters. For example, Valeo cooperates with fitness studios in order to get access to the customer information databases.

Valeo reaches the customers via two distribution channels. The app itself is sold via an indirect channel, namely the appstores of the different smartphone operating systems. For the advanced and premium users sensors have to be distributed to the customers in order to automate the input of medical data. These sensors are sold via direct web sales or retail stores.

Regarding the after sales support a service call center is established for the basic and advanced customer requests. Basic customers can only reach the technical support division of the call center. For the advanced customers this service is extended to content questions. The premium customers, considering the very high profit margin, get special individualized support service with 24/7 support and a call back option.

7.2.4 Customer Relationships

People in general are not willing to spend a lot of money for an application. Hence, to attract customers in the first place the use of the app with its standard functions is free. Only for the use of advanced and premium features an extra fee will be charged. In this way, a broader customer base is addressed and a certain customer-lock-in is assured.

Although, regarding the basic and advanced user, the service is fully automated, customized customer treatment is ensured by personal profiles and software that adapts to personal data. This data must be inserted by the user through questionnaires or is automatically transferred by the sensors. The extend of information which has to be entered manually depends on the customer group - from very low for the advanced and the premium users to relatively high for the basic user who only uses the app without any sensors. The more information is available, the better the service will work. In this respect we can talk about an automated process combined with an user self-service. Due to the individual treatment a personal relationship is simulated, which is a quite important factor regarding customer retention. As mentioned before, a call

center will provide help and support in case of individual questions or problems that cannot be solved by the app itself.

As described earlier, a dedicated personal assistance is offered to the premium user instead of a digital assistance only. This implies a very intimate relationship between Valeo and the user which in certain ways assures a long-term customer lock-in as a personal relationship generally builds upon trust and reliability and will not be quit immediately or without sound reason.

Furthermore, a community service will be integrated into the app to facilitate connections between members. Thereby they can share healthy recipes or rate and recommend restaurants and their respective dishes. In this respect, a service enhancement is achieved and due to the increased customer information available Valeo can continuously be improved and adapted to the customer needs.

7.2.5 Key Resources

In the following, the two most important key resources, human and physical properties, will be described.

Human

During the software development phase there is a big demand for high skilled programmers in order to guarantee quality and functionality of the product. In the future the app should be easily connectable to other devices, therefore interoperability is a key issue.

Beside the programming of the app the development of the questionnaire and interpretation of the sensor data is highly complex. Therefore, not only health care professionals such as diet coaches and nutritionists are needed but also bioengineers with whom they have to work closely together.

As previously mentioned, strong customer retention will be created through a call center supporting the user handling the device. Therefore, trained and educated employees are needed.

Premium users will receive a personal coaching from a diet expert via their mobile. Thereto, a pool of nutritionists has to be built up.

Physical

Valeo is an application that mostly targets users possessing a smartphone. In the future a connection to other capable smart devices seems possible. Anyway, since the number of smartphones is steadily growing this does not represent a serious obstacle.

The advanced customers using sensors in addition to the app will form the prevailing customer group with which Valeo will earn money. Thus, functional entitlements on the sensors are high: only one sensor device should be able to

measure several different kinds of data. Basic data such as blood sugar are quite easy to measure but for example blood iron levels are hard to quantify. Furthermore, the sensors must work very accurate as wrong data may lead to wrong advices and users might end up with malnutrition. Another obstacle Valeo will have to face is the protection against data theft. Since implanted sensors are imaginable the data will be transmitted wireless, thus they are accessible for everybody nearby. In order to prevent thievery of this sensitive information a strong encryption is needed and has to be verified: Once the users lose trust in the encryption the app will probably not be used anymore.

The size of the target group is closely related to the affordability of the sensor. As Valeo improves the quality of life of allergy sufferers significantly, their payment reserves are estimated to be highly independent of the sensor price. Another main customer group, the advanced users, will not be willing to pay that much for the sensors. In conclusion this means that the sensors must be affordable for all possible customer segments and a compromise has to be found. The cheaper they are the bigger the group of end users will be. There will be several different kinds of sensors with different waering comfort or data generation available fitting to the individual willing to pay of the users.

7.2.6 Key Activities

The key activities to reach a mature product mainly consist of five big parts: The application development, integration with the sensors, building a database containing all necessary information, acquiring key partners and communication activities.

Application Development

Application development is one of the most important activities during the first couple of months. In order to be available to a broad customer base, several platforms need to be taken into account and expert knowledge has to be gathered. The application needs to be intuitive, easy to download and power efficient. Because of high volumes of data, efficient storage and processing algorithms have to be developed. To be accessible also for older people, interfaces need to be easy to read and quickly understandable. Also, acoustic and motion feedback can be integrated.

Integration with Sensors

To minimize typing efforts and enlarge the knowledge about the user, external sensors and other devices need to be connected with the application. Thus, software interfaces and development cooperations have to be established.

Building a Database

The database is crucial for the success of our product. Restaurant information has to be gathered and recipes need to be developed and integrated. To speed up the process, external databases could be incorporated. The database must be large enough to provide several recommendations for potential meals once a health condition is identified. Also, customers should to be able to find retailers that sell the sensors directly inside the application.

Acquiring Partners

To enable recommendations of nearby restaurants, detailed information about meals have to be made available. This requires restaurant owners to enter and update information about their menu. To quickly get a broad range of partners, agents have to be sent out to promote the platform.

Communication Activities

After the initial phase communication structures with both customers as well as partners have to be established and operated. This is mainly done through a call center but also includes, in case of the partners, other communication methods.

7.2.7 Key Partners

As the solution integrates very diverse products and technologies a large network of different partners is necessary to ensure a successful business.

First, one of the most important partners should be mentioned: the restaurants supplying the data for the restaurant finder. At the beginning one can talk about a one-way dependency relationship between Valeo and the restaurants. The restaurant finder will only work out successfully if a large number of restaurants participate. The tool to facilitate the data transfer therefore must be provided for free.

Furthermore, not only the number of participating restaurants is crucial for the operation of the restaurant finder but also the fact if the restaurants frequently insert the data for changing menus or daily dishes. This can be assured by using contracts that determine each party's obligations. On the other hand, Valeo profits from the cooperation if the restaurants will offer free promotion by pinning Valeo stickers to their walls or doors following the Qype example. Qype is an online evaluation organization which marks its evaluated restaurants, shops etc. by pinning its logo on the respective door thus showing that the restaurant's quality can be voted for and looked up by the Qype society and doing free advertisement for its brand at the same time. By adopting this business model a win-win situation for both results and the partnership can be

described as a strategic alliance between non-competitors who depend on each other's activities and profit by cooperating.

Another important partner is the sensor supplier. As they produce the complementary good for the app that will be necessary to ensure the full Valeo service and functionality a close cooperation is reasonable. This can be realized as a joint venture, which aims in selling the full package consisting of the app and the sensors. Thus, an existing customer base and name recognition of the sensor producer could be exploited. Moreover, both partners would profit by a considerable risk reduction. Another possibility would be a simple buyer-supplier relationship. Valeo would buy white labeled sensors and afterwards sell them under its name in combination with the app.

The third group of potential partners are supermarkets offering online shopping or shopping assistance solutions like NoQ (Cross Reference), which will be described later on. Since the app simplifies ordering by compiling a shopping list connected stores could increase their turnover and NoQ would be extended by a healthy factor. Therefore, a beneficial situation for both partners can be achieved when cooperating.

7.2.8 Cost Structure

Costs can be divided into three different kinds: development costs, market entry costs and continuous costs after the market launch.

Development Costs

In a first step, the platform for the restaurants and the app itself must be programmed. Since nowadays interoperability is a main success criteria an efficient and easy to enlarge software is needed. Therefore an elaborated and expensive development process is needed.

The basic user-data such as sportiness or smoking habits are gained through a questionnaire. As recommendations are based on the questionnaire it should be all-embracing and therefore input from several health care specialists is needed. Since expert-knowledge is rather expensive, further costs arise.

Further information about the health status of the user is gained through sensors. Biomedical sensors are highly complex and due to that the development of these should be outsourced at least for the beginning. Anyway a secure interface between the sensors and the smartphone is needed and therefore the development costs increase further. The data is computationally analyzed which requires interaction with several specialists in the development phase.

Once the software and the sensors work, a test run is recommended to make sure that the software gives the right advices and that all errors have been eliminated. Independent of who exactly does the test run more costs will arise and furthermore the time to market will be longer, which causes higher interest costs.

Market Entry Costs

In order to make the app attractive for the end user a large number of restaurants should be participating. But in turn Valeo is only interesting for the restaurants when a high amount of potential customers exists - a typical chicken-and-egg-problem comes up. To solve this problem Valeo could pay the restaurants for inserting information about their dishes in the beginning.

To increase the probability of success a broad marketing campaign should take place before the market launch, which causes further costs.

Continuous Costs

To guarantee a high degree of customer satisfaction and therefore a better customer binding a call center will be opened. Call centers are a major cost factor that can only be reduced by efficient utilization.

Further costs are caused by the IT-infrastructure: The users order food in grocery stores and therefore bandwidth is needed. To customize advertisements all available user data should be stored over a longer period of time, which causes demand for storage devices.

7.2.9 Revenue Streams

There are several possibilities to generated revenue with Valeo, which will be described in the following.

Basic User

Since Germans spend far less money on groceries than the central European average their willingness to pay for Valeo is estimated low. For acquiring new customers the basic version of Valeo will be free but only basic features are available.

Advanced User

As already mentioned the user can buy sensors in order to increase the effectivity of the app. The advanced users pay a monthly fee in order to use the application. Further revenue gets generated through additional margins when selling the sensors.

The rather prosperous advanced users form a niche market with high margins.

Premium Users

Highly motivated users can upgrade their accounts and become premium users. They can use more detailed questionnaires concerning their sportiness or their sleeping habits for example. Additionally, they can get assigned a personal diet

coach who supports them using the information the app provides. The monthly fee for a premium user is depending on the used services.

Restaurants

Presenting their dishes and the ingredients should be free for restaurants. Additionally a premium Membership exists for restaurants, which enables them to present pictures or special offers. The premium accounts are limited to a fixed amount of restaurants in every city.

Supermarkets

Valeo is a mediator between the end customers and the supermarkets and is therefore able to claim agency fees from the supermarkets.

Other Advertisement

Through the sensor and questionnaire data a detailed profile of every user will be generated. Based on the user information a detailed user profile will be generated. Thereby, highly customized advertisements e.g. wellness or sport offers can be sent to the users.

7.3 Scenario Robustness Check

In this section, Valeo will be checked against the different scenarios introduced earlier. The idea fits to most of them very well although some adaptions may be necessary.

7.3.1 Scenario “Electronic Hearts”

In case of developments towards the scenario “Electronic Hearts” our system will be favored by many people because of the tight integration in their busy work schedule. They like technology and would probably be very open-minded when it comes to wearing or even implanting sensors.

A challenge would be the management of having meals together which is quite common in this scenario. In this case, the software automatically needs to generate recommendations that would fit everybody best - health and time wise. Also, big differences regarding income require a high flexibility of the system. The application needs to be attractive without any sensors as well and should be able to recommend meals that do not require expensive ingredients.

7.3.2 Scenario "Me, My Tech & I"

As people are more prosperous, sensors could be a major source of revenue in this scenario. They also generally tend to enjoy using technology and have busy schedules. To relieve them from some of their tasks, assistive software will be very appealing. Integration of other services like shopping automation would promote this even further. Because of the high trust in technologies, the option to share information directly with a doctor would probably raise a comparably low burden regarding privacy concerns.

7.3.3 Scenario "Back to the Roots"

This scenario combines some of the problems mentioned before. Because of the family orientation, difficulties regarding the management of meals arise. Also, people will likely abandon any technology that does not provide big benefits in a short term. Transmitting data anywhere would probably be not accepted by many so storage of the data should be limited to the devices themselves. On the other hand, Valeo would be a very valuable product for health aware people since it will be a cheap and maybe the only affordable solution to get personal recommendations for improvements regarding health and specific nutrition. Therefore, even though the business model and the application itself would need to be altered, a market could probably be established successfully.

7.3.4 Scenario "Me, Myself & No More I"

Having many people interested in their health is one of the main benefits in this scenario. People tend to care a lot about it and also have the money to even get Valeo's more expensive services. Therefore, the advanced and premium options are very important and should be well developed and widely available. The application itself would be easier to implement since group management tasks are not very important. On the other hand, the application must be very good at recommending meals spontaneously since people have busy but not very well coordinated lives. Also, as the number of smartphone users probably decreases dramatically due to low technological affinity, the user base would be much smaller. This problem also requires the development of very nontechnical looking sensors since people tend to avoid technical devices.

7.4 Conclusion

Ultimately, one is able to recognize that every scenario provides a nutritious ground for Valeo to grow and establish a respectable service. However, it is important to watch out for the changing needs and wishes of the society since different developments require an appropriate adjustment of Valeo's value

proposition, especially regarding the key drivers individualism and technology acceptance, that influence the future scenarios' development the most.

Valeo is a product that sustainably adds value to people's lives because it offers an intelligent, intuitive and affordable supply of services that reduce the complexity of the challenge to live a healthy life in every aspect. Another advantage of Valeo is the high degree of interconnectivity: The app itself could be easily connected to other AAL-product ideas such as NoQ and contribute further medical data to increase the quality of health care services.

But potential dangers must not be neglected in order to ensure a successful market launch of Valeo. The current discussion on privacy regarding the storage of digital data endangers the people's willingness to share sensitive data, especially regarding their health condition and diseases etc. Therefore Valeo has to preventively become active and secure shellproof data storage in order to have long-term success.

References

[362] http://umweltinstitut.org/lebensmittel/allgemeines-lebensmittel/allgemeines-lebensmittel-155.html, accessed on 30.09.2011.

[363] Mc donalds in deutschland 2009. http://www.mcdonalds.de/metanavigation/presse/pressecenter/suchergebnisse/detailansichtpm.cfm?pressId=75, accessed on 23.10.2011.

[364] Grant. *Organization Theories*. 2010.

[365] Prof. Dr. Bernhard Strauss Katja Aschenbrenner, Florian Aschenbrenner. Essstoerungen sollten nicht auf die leichte schulter genommen werden.

Chapter 8

8 AAL Systems Supporting the Work-Life-Balance

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In today's hectic and complex world, people are stressed and increasingly struggle with their work-life balance in everyday life. Therefore, there is a high need for assistance and efficient coordination of their tasks and daily routines. NoQ is an online shopping service for groceries enabling buyers to order fresh food and pick it up within 24 hours at their local supermarket's pick-up station. NoQ's customers are the premium grocery chains, as this white label solution provides a promising, customized system for their missing e-commerce business. The value proposition of the NoQ system enhances the grocery chains' customer lock-in effect through an innovative shopping experience including special offers, recommendations and favorite lists. Furthermore, the integration within smart home solutions offers the buyers intelligent assistance and more flexibility in their everyday lives. Hence, the NoQ service provides the supermarket chains with an opportunity to create a strategic competitive advantage and generate new revenue streams. The business model is based on a premium customer service and support including in-depth consultancy and customization, long-term maintenance as well as process optimization. NoQ's unique selling proposition is the integrated system: via smart fridge connection the user is able to check his provisions at home, order and pay the selected groceries with his mobile device or on the website and finally collect them from the pick-up station. In

order to successfully set up the service, NoQ puts high effort in the development, design and implementation of the online platform. Since it provides exceptional benefits, the business model allows a revenue structure based on an initial set-up fee, a monthly license and a small fee per transaction. This secures NoQ's profitability despite high primary investments and cost intensity.

8.1 Introduction

In today's world, a lot of people face the problem of balancing their professional life and their personal life.

On the one hand, in the competitive business environment employees need to be flexible and mobile. They have to cope with variable working hours and be capable as well as willing to move from one place to another, temporarily or permanently. Furthermore, they seek jobs that not only offer financial security, but also have freedom, meaning and the opportunity for development and enhancement.

On the other hand, individuals want to pursue their personal interests and goals. They need to spend time with their families and friends. Aside from that, people increasingly want to live a healthy lifestyle, do sports and aim for a balanced nutrition.

This trade-off between career and ambition, on the one side, and family and leisure, on the other, creates a great challenge in their everyday life. The ideal individual work-life balance varies over time, often on a daily basis, as well as with regards to the personal and professional life situation. The right balance for a single will be different from that for a married person or a parent; it is also different if one starts a new career or is close to retirement.

However, work is likely to invade your personal life nowadays, and maintaining work-life balance is not a simple task. Time pressure, overstrain and frustration are the consequences which may lead to an increased risk of burnout. Therefore, people seek for technologies that assist and support them in order to overcome this. The increasing adoption and usage of smartphones as personal digital assistants illustrate that people want to get access to information, communicate and interact anytime and anywhere. The rising choice of applications offers a broad range of functionalities for office and coordination, gaming and entertainment as well as search and navigation.

People want technical assistance that facilitates their everyday life not only on the go, but also at home. The so-called smart home solutions are highly advanced automatic systems with a wide field of application such as lighting, temperature control, multimedia and security. This shows that there is a high need for new products and services that combine both the mobile and the home systems.

In the following a product is introduced which facilitates the optimization and prioritization of daily duties and can help achieve a better work-life balance.

8.2 Business Model

NoQ is an online shopping service for groceries, which enables buyers to order fresh food on a daily basis and pick it up anytime at their local supermarket's pick-up station. NoQ develops this white label solution for the premium

supermarket chains as a promising system for their missing e-commerce business (see Figure 8.1).

At the beginning of the purchasing process the buyer - at work or on the go - automatically receives information via Internet about his groceries stock as well as purchasing recommendations from his smart fridge at home. After that, the user selects the most conveniently located store of a certain supermarket chain, orders, and pays the groceries through the application. The order is then processed by the supermarket's workforce and deposited at the pick-up station for the customer to collect on the go and anytime, thus making him indepedent from usual business hours.

Figure 8.1: The NoQ service system
Sources: Own illustration

In the following the business model of NoQ is described on the basis of the nine building blocks of Osterwalder and Pigneur's Business Model Canvas [366]. The first building block depicts the segment of clients that is addressed by NoQ. Subsequently, the value proposition of the NoQ service system is described. The following building blocks then explain the channel to reach the clients and offer them the white label solution as well as outline the relationship to the clients. Based on that, the NoQ infrastructure with its key resources and key

activities for successfully establishing the business model as well as the key partners and their motivations to participate are illustrated. In the end, based on the description of NoQ's revenue streams and cost structure, it's financial prospects are illuminated.

8.2.1 Value Proposition

The German food supply market is very competitive, as various supermarket chains compete for the loyalty of the customers. The problem is that groceries and drugstore articles are commodities with a low level of involvement and as nearly the same manufacturer's brands can be bought at almost every supermarket and therefore it is rather difficult to build up a repeat customer base. NoQ provides a promising solution for this, since it facilitates the customer lock-in by an online registration for a membership account. Through special offers, recommendations and favorite lists grocery stores are able to establish and maintain customer relationships, benefiting from the impact of social media. By this means, NoQ offers a digital shopping advisor with an easy interface that makes users aware of new products and special offers. Furthermore, it gives information about product quality, origin and nutrition facts. Due to high staff costs of this service, it is not feasible within the conventional shopping concept. Therefore, NoQ creates an innovative selling strategy and a promising e-commerce solution for the supermarkets. The collaborative filtering system enables successful product bundlings through an individual approach and unlocks profitable cross- and up-sell potential. Consequently, NoQ has the ability to set a grocery chain apart from its competitors by keeping existing customer relationships, by canvassing for new clients, and by increasing the spent amount of money per purchase. Additionally, the independence from opening hours generates a higher profit.

All these advantages lead to a greater customer lifetime value and an improved customer satisfaction. Consequently, this generates higher sales and increases profitability. But there are further benefits from a strategic point of view. The automated data processing through NoQ enables supermarkets to receive detailed and valuable information about the clients and their buying habits. They would be able to find out what kinds of customer segments exist, which shopping baskets match in each case and which products are most in demand. Subsequently, the range of articles can be adapted in an efficient way. Top sellers can be ordered in appropriate quantities and ineffective products can be eliminated from the line of goods. In this manner, NoQ enhances the transparency regarding purchasing patterns and helps even the offline business, as the whole point of sale can be reviewed and adjusted accordingly. Not only the product line-up can be optimized by implementing NoQ, but also the ordering process and the whole coordination along the value chain can be improved based on up-to-date information. In the long run, other typical

arguments in favor of online distribution such as the saving of cost intense exhibition space in stores indicate the way towards electronic commerce with an automated warehouse system.

Furthermore, NoQ will influence marketing and advertising efforts positively. Both the pick-up station and the app design are distributed in customized versions. They reflect the corporate design of the company and make it more present. Besides, the web platform offers enough space for banners and advertisements which can be cheaply modified and frequently changed. Since every buyer has his own personal account, targeted coupon and discount campaigns can be implemented more effectively than by using bonus stickers or loyalty points. Through its progressiveness, NoQ can give the customer a unique market position by establishing an attractive image, by saving expenses, and even by optimizing the offline business.

8.2.2 Customer Segmentation

Above all, the NoQ system is a value added service that establishes new and strengthens existing customer relationships through an improved purchasing comfort and flexibility. Therefore, it makes sense to approach premium grocery chains such as Rewe, Edeka or Tengelmann that want to offer their customers a special service and represent quality consciousness. These companies already have a target-group-specific orientation available which can easily be linked to NoQ's concept. NoQ needs to be beneficial to the end-user as well as profitable for the supermarkets. Thus, it is of great interest to define the end-user segments and how they can be addressed.

NoQ is all about time efficiency. Everyone is able to access the system at any time and from any place via online devices e.g. smart phone, tablet or laptop. Accordingly, the system addresses especially business people who are constantly pressed for time; between meetings and project work ordinary grocery shopping can become a strain.

Generally, the NoQ system could be implemented in metropolitan areas as well as in rural areas to benefit commuters. After long working hours, shopping would be simply done on the way back home and is thus independent from opening hours. As people are accustomed to their local grocery there would be no skepticism on quality and freshness. For this target group NoQ offers an innovative and comfortable shopping experience that saves time.

Frequent travelers also fit perfectly into the target range. Since the big grocery store chains can usually be found all over the country and moreover at exposed positions such as train stations and airports, NoQ is well qualified to function as a traveling accompanying system. On top of that, people may want to connect it with their personal calendar and let NoQ intelligently decide which grocery is on their route.

Besides, NoQ enables a healthier lifestyle. How often does it happen that

people find an empty fridge at home after a stressful business day and instead of eating fresh victuals they choose fast food or frozen food. With NoQ a healthy nutrition becomes not only feasible but can also be coordinated. People have the chance to comply with their diet or fitness plan by scheduling their food-ordering for the entire week.

NoQ not only supports businessmen but also families in their everyday lives. For example, orders can be carried out considering certain recipes and special household needs. Picking up the purchases after fetching up the children from school becomes very simple.

In summary, NoQ supports the work-life-balance of individuals in many different ways. Therefore, it is a promising solution for all customer segments of premium grocery chains. However, it should be mentioned that the NoQ pick-up station consumes a lot of space which could determine the number of supermarkets meeting these requirements.

8.2.3 Channels

The product and services offered by NoQ are highly customizable and can be tailored to the needs of the individual customer. Therefore, the clients will be approached via direct marketing and selling, including personal demonstrations and complimentary consultations. A wider spectrum of customers will also be reached through trade fair exhibitions and showcase presentations.

In the initial phase of the project commercialization the main focus will fall exclusively on one premium grocery chain. This will provide for a more prominent image of the customer and will add to the value proposition of the product. In the long run, the strategy will shift towards selective distribution within the sector and possibly expand to other markets, such as over-the-counter drugstores and beauty and health care retailers.

Since the actual deployment and installation of the hardware is highly dependent on the specific stores and their locations, this initial set up and the maintenance will be coordinated in direct cooperation with the local store managers and the pick-up station manufacturers.

An important channel concerning the consumers is the variety of distribution stores for mobile and web applications. In order to attain a broad span of end-users, the NoQ client application will be offered on diverse mobile platforms and their respective online stores, such as the iOS AppStore and Android Market. Additionally, the application will be available on the customer's website as a viable e-commerce solution.

8.2.4 Customer Relationship

Due to the white label nature of NoQ and the heterogeneous character of the needs of the individual customer, the customer relationship is a key factor of

this business model. In this regard, the customer assumes not only a role as a client but also as main business partner. The following paragraphs elaborate on areas that are central for this business model in order to establish and maintain a successful customer relationship. The first two focus on the pre-sale and set-up activities whereas the concluding ones describe the after-sale consecutive relationship with the client.

Customization Consultation The essence of NoQ lies in delivering a highly customized product, which can serve the specific needs of the customer. This involves detailed discussions in order to define the exact requirements of the customer, the potential technical alternatives and to reach an agreement about the final product specifications. Furthermore, NoQ strives for continuous improvement of the service quality. Therfore, meetings with the customer will be scheduled on a regular basis in order to analyze and exchange views on the product's progress and to propose proactive solutions.

Service Integration An inherent part of the NoQ environment is the integration with the existing infrastructure of the customer. It is essential to work in close cooperation with the grocery stores in order to achieve a seamless inclusion of the coexistent product database and an interoperability between the individual information subsystems.

Customer Service and Support Product maintenance and troubleshooting is also an important part of the customer relationship. On one hand, this domain is defined by service and repair duties regarding the hardware, on the other hand this also includes bugfixes and software updates concerning the software products, such as the mobile and web applications, as well as the extensions to the existing inventory database. Since personnel training is a critical part of the business of the target customer group, a significant portion of the support responsibilities of NoQ will be carrying out instruction courses for the existing staff.

Upselling and Cross-Selling Optimization As an e-commerce solution, NoQ provides means to analyze and potentially employ upselling and cross-selling techniques. It can supply regular usage statistics regarding the selling rates of certain products with respect to the locality, consumer age and time of purchase. Furthermore, NoQ also offers a solution for promoting specific articles as daily deals or product fire sales, based on a user's purchase history and interests.

8.2.5 Key Resources

In order to run the NoQ business successfully and create the value proposition for the customers, different kinds of resources are required.

Physical Resources

The physical resources play important roles in the NoQ business and some of them are indispensable. As the basic and key component of NoQ, pick-up stations are needed for each grocery store. These are similar to the current DHL packstations but should be further customized for each case. For example, they should be able to cool the groceries to keep them fresh and should also fit the space requirement of each grocery store. NoQ pick-up stations will be located within or close to the grocery stores and by entering the order codes, users can easily get their packages.

Besides, smart refrigerators can help track the groceries stock within the household. This is presented to the end-users via a web site or a mobile application. With smart refrigerators, NoQ can deliver an additional value to end-users by helping them order groceries more efficiently, as well as save money.

Furthermore, because of the potentially large customer base, a lot of data needs to be processed and stored. Therefore, NoQ also relies on hardware infrustructure, such as servers and data storage. However, different from the pick-up stations and smart refrigerators, NoQ will not own these servers and data storage itself. It will rent them from the data center providers.

Intellectual Resources

The intellectual resource mainly refers to two types of data. The NoQ system needs the inventory information of grocery stores in order to show end-users the availability of different goods. Another important asset is the history of purchases. Based on this customer data, NoQ would be able to deduce the consuming habit of each end-user and therefore generate personalized shopping recommendations to them. The inventory information belongs to grocery stores, while the history of purchases is provided by consumers and owned by NoQ.

Human and Financial Resources

In addition to the intellectual and physical resources, human and financial resources are also essential for the success of NoQ. NoQ requires qualified workforce for the development of the website and the smartphone applications, sales and consulting service, software and database maintenance, internal management, as well as the coordination between different partners.

Moreover, as NoQ is an integrated solution and quite cost intensive, the business also needs financial support and investments from third parties to purchase the customized pick-up stations, develop the required software, and rent the servers and data storage.

8.2.6 Key Activities

This subsection describes the key activities, both in terms of initial development and the subsequent management, which are required for the success of NoQ.

Customer Acquisition and Contracting First of all, the NoQ team has to approach potential customers and sign contracts with them. At first NoQ will be exclusively offered to the biggest premium grocery store chains.

Collaboration contracts have to be signed also with all of the NoQ's partners.

Consulting and Planning of Hardware Installations A key resource of NoQ's business concept are the pick-up stations, located at the grocery stores. NoQ consults its customers case-by-case on what type and size out of a variety of pick-up stations fit in a certain store. NoQ plans the installation and orders the pick-up stations from an external partner. The hardware design itself is also outsourced.

Software Development and Support In order to provide for a very user-friendly experience and to make NoQ available on the go, applications for different mobile platforms have to be implemented. This software has to be specifically branded to the grocery store chain. By using interfaces to external applications, NoQ should be incorporated in an integrated AAL system. In this manner NoQ could be able to keep track of the user's schedule, geographical location, commute route, nutrition plan (i.e. by interfacing to Valeo (see 7.2)), etc. and thereby recommend grocery stores and products which fit those factors best.

An interface to smart fridges which are able to keep track of their contents should be realized. The NoQ system uses this information to display reminders on expiring and running out products to the users and prevent them from buying already present groceries.

Online Services As described in 8.2.1, one of the most important parts of the value proposition to the grocery stores is the chance to get their business online. This requires development and maintenance of a sophisticated online shopping system, which includes a user-friendly interface with an overview of the available products, a shopping cart, a check out system and a store locator for the pickup. NoQ's system relies on data and web servers, which may be located in an off-site data center and managed remotely by NoQ's team.

An essential part of the system is a connection to the product database of the grocery stores, which provides up-to-date product and availability information. Since the customer may not want to change his database system or give full access to it, a satisfactory solution which does not compromise the usability of the whole system has to be developed. This includes setting up an additional

reduced product database, which is synchronized with the customer's one on a regular basis. In this manner security concerns of the customer can be relieved because he retains full control over the information exchange. On the other hand, NoQ will provide sales volume information to the customer. Additionally needed software and user interfaces on his side will also be developed by the NoQ team.

In the context of AAL it is very important for the system to know its customers and give personalized recommendations according to their needs and lifestyle, which implies implementation of certain machine learning algorithms. A special care has to be taken to assure the security of the system because it will contain sensitive user information, e.g. payment data, shopping behavior, personal addresses, etc. The grocery store chains should have access to this information through an application interface to be able to optimize their supply chain and lock in customers by offering them well-targeted product promotions.

Furthermore, a connection to commonly accepted online payment providers (e.g. PayPal, credit card payment processors, giropay, etc.) must be realized. NoQ only manages the online payment process and does not act as an intermediator in the monetary transactions.

Last but not least, the NoQ team will have to provide the online buyer support and will further develop the system based on buyer recommendations and customer wishes.

8.2.7 Key Partnerships

As previously stated, the primary partner is simultaneously the grocery chain - only by a successful collaboration can both businesses benefit from each other. Another essential business partner is the manufacturer of the pick-up stations. He is responsible for the hardware production of the end-user devices and for implementing the customizations requested by the customer. This is also the company that carries out the maintenance and repair of the pick-up stations.

Another important set of associate companies are the online payment providers, such as PayPal, GiroPay and Sofortüberweisung.de. The transparent integration of a secure and flexible electronic payment method, supporting both bank accounts and credit cards, will allow for a uniform purchase process and improved usability.

As an AAL product, NoQ relies on a strong integration with other consumer devices. A good example for this is the possibility to connect to smart household appliances such as refrigerators and kitchen inventories, in order to inform the user about his/her current grocery needs. Another prospective partner is Valeo [cross-ref] which supports the consumers in their choice with food suggestions based on their diet and nutrition demands.

8.2.8 Cost Structure

In this subsection, the cost structure of NoQ is introduced (see Figure 8.2). NoQ is cost intensive and more value driven: it focuses more on high quality and value creation, rather than on reducing the costs. Furthermore, NoQ's cost structure is characterized by economies of scale, which means the average cost per equipped grocery store will reduce as the customer base increases. Therefore, NoQ will obtain cost advantages from expanding its business size.

Among all the costs described below, the customerization for both hardware and software is the biggest cost element. However, as the customer base increases, this cost for each customer will reduce because NoQ can reuse the already existing customerized hardware and software solutions for its new customers.

Development and Customization of Hardware and Software

One big cost element is the design, development and test for NoQ's website and smartphone applications. This job will be done by NoQ's development team for only once. But it requires long time and big manpower.

An even bigger cost element is the customerization for hardware and software. The pick-up stations of NoQ can be purchased directly from the manufacturer. However, because the functionality of NoQ's pick-up stations is quite different from the current products, these pick-up stations must be customized according to the needs of NoQ. Deployment of cooling systems in the lockers of pick-up stations is required in order to keep the food fresh. Moreover, different food requires different storing temperature, which further increases the complexity of pick-up station technology and cost. Furthermore, since the free spaces of grocery stores vary greatly, the size of pick-up station will be customized, which further increases the cost. On software side, the website and smartphone applications should also be customeriezed based on the original version according to customer's requirement.

Maintenance of the NoQ System

On the one hand, if there are some problems with the pick-up stations, service engineers from the manufacturer are required to identify the problems. In most cases, new hardware parts are needed to fix the problems. Both the service and parts fees will be paid by NoQ to the pick-up station manufacturer. This cost is a variable cost: it is not high in the beginning, but will increase gradually as pick-up stations wear down.

On the other hand, the software part such as website, smartphone applications as well as databases also needs maintenance. Bugs should be fixed and update patches will be installed from time to time. It is also a variable cost.

Rent for Data Center

Because a lot of data has to be processed and stored, a data center is required. Purchasing servers and storages and setting up a new data center would be too cost intensive. Thus, it is more suitable to rent servers and storage from data center providers. In this case an annual fee is paid to the data center provider, who will take care of all the hardware operations. The contract with this provider will also include a service level agreement clause regarding availability and maintenance. As NoQ's business size changes, NoQ would rent more servers and storage to meet the operational requirements. To NoQ, it is a fixed cost every year. Besides, this cost for each customer will reduce when the customer base increases, because of the share of common resource.

Operational Cost

Another part of the total cost is the operational cost. The rental for office, electricity fees, and the initial purchase for hardware infrastructure like computers can not be neglected. Moreover, other than the manpower for development and maintenance, additional labor cost for internal management, customer training as well as consulting service also contributes to the total cost.

8.2.9 Revenue Streams

NoQ's revenue model involves several different sources of income which will be described shortly in this section. In addition to that, a few revenue options for the grocery store chains are depicted (see Figure 8.2).

The business model includes three revenue sources for NoQ:

- **Initial fee** – NoQ will charge its customers a one-time set-up fee. Those include first of all the hardware development and installation which are outsourced but still managed by NoQ. Secondly, NoQ will earn money from branding and customization of the developed software to the customer's needs. Lastly, the grocery store chains will get consulted on the best pick-up station solution for every store. The amount of the setup fee will depend on the size of the pick-up station and the amount of consulting and customization involved.

- **Licensing** – Another revenue source will be the monthly fee which grocery stores pay to NoQ for the management of the system infrastructure (e.g. databases, software updates, web site enhancement, hardware maintenance, etc.). The monthly fee will depend on the size of the store in question, its location and the amount of its end-users. This source will be used to cover most of NoQ's costs.

- **Usage fee** – NoQ will put a relatively small margin on every transaction which is processed by the system. In this manner NoQ will directly take a

share in the turnover of the grocery store chains. The usage fee is NoQ's main profit source.

Figure 8.2: The NoQ cost and revenue model
Sources: Own illustration

Grocery store chains also have a number of options to increase their revenue through the introduction of the NoQ system:

- **Additional margin** – The grocery chains put an additional margin on the products sold online. The minimal ordering amount also contributes to a higher sales volume.
- **Increased sales volume** – Due to the new online distribution channel, grocery stores are able to increase their sales volumes and thus their revenues.
- **Monthly subscription fee** – The supermarket can introduce a monthly subscription fee, i.e. by offering the pick-up station as a premium service for regular buyers and thus locking them in.
- **Advertising platform** – The web site and the mobile applications can be used as an advertising platform, which grocery producers may use to place well-targeted promotions and advertisement.

8.3 Scenario Robustness Check

In the following section the NoQ business model will be checked against the scenarios, based on the different outcomes of the key drivers individualism and technology affinity. Figure 8.3 gives an overview of the scenarios and the fitting of NoQ's business model to them.

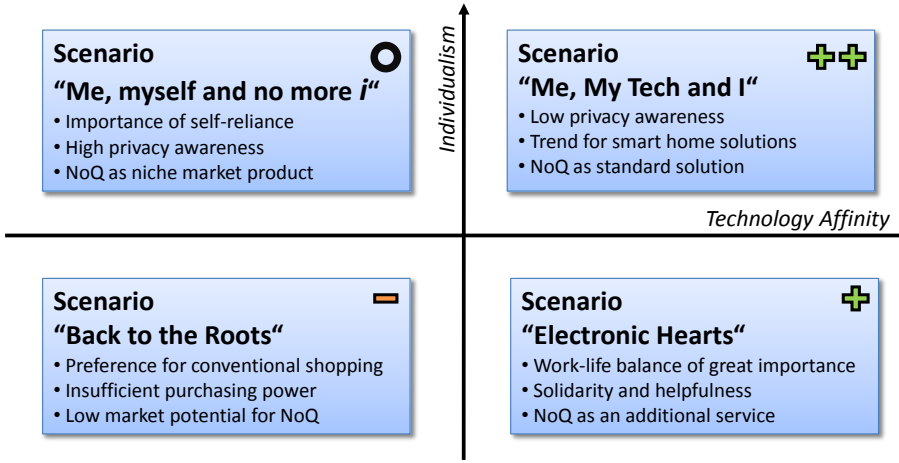

Figure 8.3: Overview of the fitting of NoQ's business model to the scenarios
Sources: Own illustration

8.3.1 Scenario "Back to the Roots"

The scenario "Back To The Roots" describes a world that is driven by low technology affinity, as well as low individualism. In addition, people live in lower prosperity. As a result, NoQ would face a lot of challenges in this business environment.

Generally, because of the low technology acceptance of the public, only few people would use the new NoQ technology in the beginning. They are suspicious of the reliability, efficiency and security of online order and payment systems. Due to the lower prosperity, people would not be willing to pay extra for a premium service such as NoQ. Instead, they would stick to the traditional way of shopping.

Another reason against the use of NoQ stems from the established low individualism in society. People still prefer going to grocery stores, not only for shopping, but also for social interaction.

Therefore, grocery stores might not be interested in buying the NoQ technology. The low technology affinity would force grocery stores to spend more money on marketing NoQ and convincing the end-users of its advantages. This would neutralize the financial benefits and make it unprofitable. In conclusion, NoQ does not fit well in this scenario.

8.3.2 Scenario "Me, Myself and No More *i*"

The scenario "Me, Myself and No More i" depicts a world with high individualism and low acceptance of technology. Although the business model of NoQ fits

to the increasing importance of self-reliance, the low acceptance of technology creates a great challenge for the success of NoQ.

Generally, the individuals aspire to fulfill their professional and personal goals and thus have to deal with a hectic work schedule and a busy lifestyle. NoQ would therefore be a promising solution to support the work-life balance.

However, the skepticism of the society towards technology could prevent the initial adaption of smart home technologies as well as the frequent use of mobile devices and web-based applications in everyday life. Therefore, the business model of NoQ does not perfectly fit into the scenario.

Furthermore, the high privacy awareness poses a problem because the people are highly concerned about their personal data and thus customers would disapprove the idea of sharing information about their buying habits with the groceries chains.

In order to overcome these barriers and convince the buyer of the benefits of NoQ, the business model requires some adjustments. Due to the distrust towards technology, at the beginning the business model of NoQ could be limited to a mobile and online purchasing system without the connection to any smart home technology. Furthermore, NoQ would rather be a product for a niche market. In particular, business people are in high need of such a solution and frequently use smart phones at work. Hence, the NoQ system enables them to improve their work-life balance.

8.3.3 Scenario "Me, My Tech and I"

The scenario "Me, my Tech & I" describes a world that is mainly driven by a high technology affinity and high individualism and therefore creates a promising business environment for NoQ. The majority of the European population lives in the prosperous metropolitan areas with its flourishing businesses, top universities and busy lifestyle.

As the society uses ICT in form of smart phones and smart homes in their everyday life, the NoQ technology could be a part of smart home solutions, and thus beneficial to and available for all customers.

Besides, the society is wealthy and primarily concerned with their individual needs. Premium groceries would be able to expand and dominate the market due to NoQ, as most of their customers prefer the mobile and online shopping system. The traditional business model of groceries might become obsolete because going shopping itself seems to be time-consuming and inconvenient. An automated warehouse system, integrated within NoQ, could replace it and make the business model more time- and cost efficient for both the groceries and their customers.

Furthermore, the NoQ technology supports the work-life balance and enables the society, especially businessmen and women, to cope with their flexible and long working hours as well as their individual lifestyle. The integrated function

of purchasing recommendations and favourite lists fits to the increasing trend of customization. Due to the low privacy awareness, people do not bother about revealing information about themselves and their purchasing patterns to the premium supermarket chains. Hence, this enables the groceries to optimize their product offerings, their supply chain management as well as to increase the customer lock-in.

All in all, the NoQ system could become a standard solution for the grocery chains in this scenario.

8.3.4 Scenario "Electronic Hearts"

The scenario „Electronic Hearts" describes a society with high technology affinity and low individualism, and therefore offers high potential for the NoQ business model. People are open-minded regarding digital solutions and are already used to the comfort provided by smart homes. Consumers trust their assisting devices. Smart fridges for example are able to create individual shopping lists corresponding to people's personal diet plans. These fridges detect what the household runs out automatically and offer a great opportunity to extend NoQ in terms of taking over the whole ordering and payment process. Based on this trust, the NoQ technology is not expected to face many obstacles when being established in the market. Marketing and advertising efforts will keep within bounds for the same reason. Moreover, supermarkets can benefit from the technological affinity of this world by changing their storage structure into a fully automated warehouse in order to reach higher cost efficiency. People do not perceive assisting digital devices as a threat for their employment but as a tool to foster progress and as an opportunity to develop new areas of work in the future.

Although individuals work a lot and travel frequently, their work-life balance is of great importance to them. NoQ provides flexibility and is suited for saving time in everyday tasks and spend it with their loved ones instead. The general well-being of the family plays an important part in people's lives and hence the daily supply of healthy and fresh food exists as an actual need. Since this world is driven by a low level of individualism, the society is characterized by great cooperativeness. The process of choosing, ordering and paying the products can easily be carried out from home and only the picking up of the groceries has to be done in person. Therefore NoQ does not cause major efforts and facilitates neighborly help, supporting the care of the elderly and the handicapped.

Nevertheless, online shopping cannot replace offline business completely. Grocery stores will stay hybrid retailers because many people appreciate their weekly or daily shopping as a way of social interaction. Supermarkets can act as meeting places for societal togetherness. As a consequence the main customer segment would consist of working people who do not feel a lack of interpersonal communication but want so spend as much spare time as possible with their

families and friends.

8.4 Conclusion

In the future, people will need more assistance in their everyday life due to their packed schedule, ambitious career goals, and urge to spend more time with their family and friends. This provides a huge market potential for products which support the work-life balance, such as NoQ.

As described in the business model, although NoQ is cost intensive, its value propositions to both grocery stores and end-users are very promising and innovative. Grocery stores benefit from the virtual extension of their opening hours as well as from the acquisition of valuable customer information which helps them optimize their supply chain better and approach their customers with well-targeted promotions. As for the end-users, NoQ assists them in being more flexible when planning their daily nutrition, saving time in purchasing groceries, living healthier, and coming closer to a perfect work-life balance.

The business model showed also that NoQ's business concept is based on technologies which will be available in the near future and can easily be adapted to fit NoQ's needs. This implies that the required systems can be developed and introduced within a short time span. Still, NoQ requires a large technological know-how as well as qualified workforce to organize all partners.

The scenario analysis proved that NoQ's idea fits the majority of outcomes. Especially in scenarios with high technology affinity, the idea shows a very high potential and may be even further developed to incorporate fully-automated warehouses. In other scenarios some minor adjustments to the concept may be necessary to adapt it to the actual situation.

In conclusion, NoQ is a promising service which combines e-commerce and traditional shopping and thus makes grocery delivery unnecessary. NoQ adds a unique use case to future smart home solutions and broadens the scope off AAL.

References

[366] Yves Pigneur Alexander Osterwalder. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers.* Wiley, 2010.

Chapter 9

9 AAL Systems on the Go

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A significant portion of one's life is spent in transit. Just like other aspects of life, being on the go can be supported by Ambient Assisted Living technologies. One of the most uncomfortable experiences of everyday life on the go is using public transportation. This opens up opportunities for AAL solutions in this market.

Transsistant is an intelligent public transportation solution, learning from passengers' routines and guiding them through the stations to reach the correct mode of transit at the right time, without requiring active input from the user. Additionally, it assists the passengers with ticketing and individual needs, such as elevator use.

Such as a solution is desirable for the public transportation companies because it allows them to observe passenger flow. With this information these companies can optimize their route frequencies, cut survey costs, and learn about station conditions faster.

Transsistant will be sold to public transportation companies for a one-time fee and an additional maintenance recurring fee. Other sources of revenue include lead generation commission from third-party service providers, such as digital ticketing systems and taxi companies.

The basic technologies to make Transsistant a reality already exist. However, there is a need for development in Artificial Intelligence and Machine Learning, which requires research. This product can be viable in a time frame of 10 to 15 years. With the introduction of Transsistant, public transportation of the future can become hassle-free.

9.1 Introduction

Public transportation in Europe, and especially in Germany, is very practical. However the experience of using public transportation can be tarnished with a few inconveniences: a commuter running to a bus station just to discover she is a few tens of seconds late and the bus is at the end of the road, a mother with her child in a stroller walking to the elevator only to find it is under maintenance, a tourist trying to figure how to make the connection between two underground trains.

Many public transportation companies already have services and accompanying smartphone applications to handle these concerns. However, these services are separated and require the active involvement of their users. This makes them less beneficial, especially when people are in a hurry or the inconveniences only arise sporadically. An Ambient Assisted Living solution can be developed to handle these issues and many others, in order to make the usage of public transportation more hassle-free.

Such a solution could be designed in a way that not only benefits the end user, but also the public transportation company. Today, public transportation companies run surveys to understand their user behavior. While these surveys are useful, they are not extensive and do not reflect real-time usage, thus limiting their effectiveness in detecting day-to-day problems and optimizing processes.

Public transportation is used by a variety of people with different needs and expectations. An Ambient Assisted Living solution adapts to each user in a way that best suits him, and thus increasing the overall satisfaction from the system.

9.2 Business Idea: Transsistant

Transsistant stands for "Transport Assistant" and is a service that solves the aforementioned problems by anticipating when the user is about to use public transportation and bringing any relevant information to her attention, based on the context and the user's needs.

One integral component of Transsistant is an application that runs in the background on the user's smartphone, collecting data about her location and schedule. This data is then used in conjunction with information on the public transportation's routes and time schedules to learn the user's pattern and create a model representing her behavior. Modeling and understanding user behavior is complex; research in artificial intelligence and machine learning is required to turn it into an accessible technology. Once Transsistant understands the user's patterns, it can anticipate her usage of the public transportation system.

From the user's perspective, Transsistant is an application that she installs once, and doesn't explicitly interact with afterwards; the application runs in the background and doesn't come to her attention unless it has relevant information.

The system is triggered to look for relevant information when it believes the user is approaching a public transportation station, based on the developed model of the user's behavior, or when using the public transportation system. In that event, live data about the station and the approaching vehicles is pulled and evaluated against the current context, and if found relevant then the user is alerted.

For example, if a user is running towards the station, and the live data shows she will miss her tram nonetheless, she can be informed to walk and catch the next tram, and vice versa, if a user is walking to the station and would only miss the tram by a few seconds, she can be informed to speed up. A handicapped user who normally uses the elevator can be informed if the elevator is broken or under maintenance, and directed to a different route based on the experience of previous users.

The system would also consider attributes of the user when providing its suggestions, for example, an elderly person will not be asked to run to catch the bus, nor a person who has been recently walking slower than normal, maybe due to a broken leg.

Transsistant can also be integrated with additional service providers such as a digital ticketing system, and display recommendations, such as reminding the user to buy a ticket if her previous ticket has expired.

From a business point of view, Transsistant is licensed to the public transportation companies, customized for their needs and providing services for them and for their users.

Data collected from the users can be used by the public transportation companies to replace and enhance usage surveys, which subsequently can be used for planning and optimizing schedules. The data can also be used directly within the system for inference, for example, the sudden stop in the usage of an elevator indicates it might be broken, and multiple people not boarding any train at an underground station could indicate it is crowded. In an indirect manner, Transsistant smartly propagates relevant information from previous users to future users.

Figure 9.1 depicts the key players in Transsistant and the relations between them. These relations will be further explained in the following subsections, where the nine building blocks of a business model canvas (as explained in [369]) are described.

9.2.1 Value Proposition

Transsistant, as a solution, provides benefits for both the public transportation users and companies running the network. The value proposition for each group is detailed below.

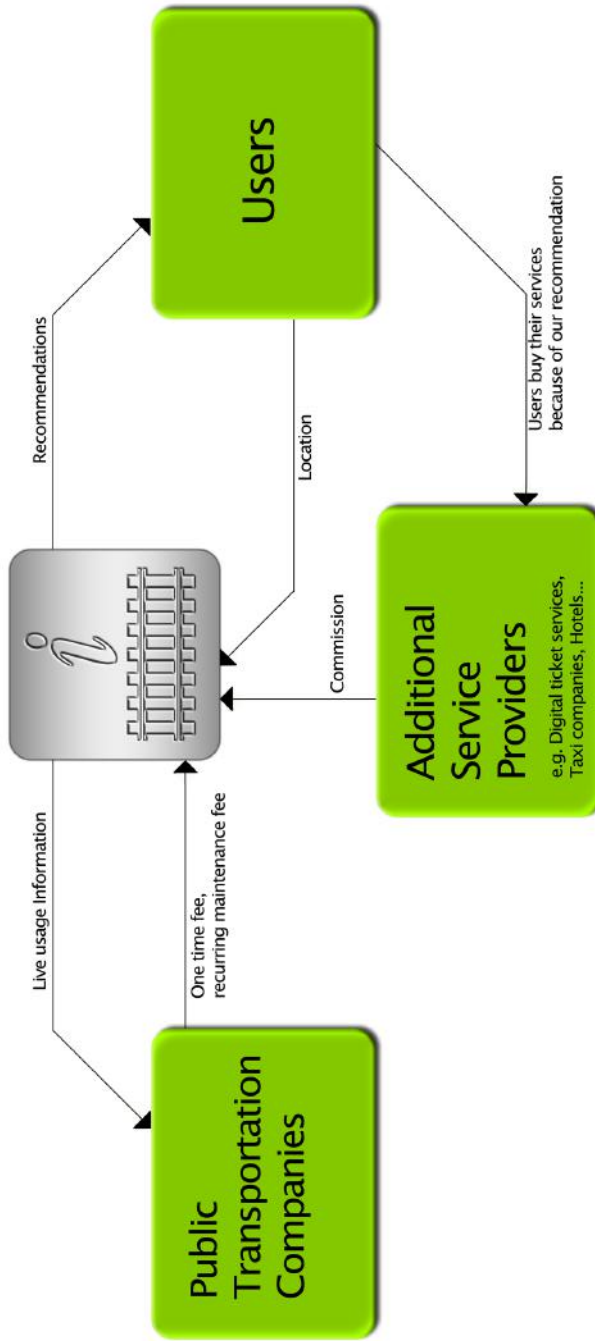

Figure 9.1: Key players and relations between them
Source: Own illustration

Public Transportation User

The user of Transsistant benefits by having many of the inconveniences of using public transportation removed. No active involvement from the user is required except for a one-time application installation. Afterwards, the system runs in the background collecting information about the user (such as location and calendar), and creating a model that is later referenced to provide notifications and suggestions at the relevant time and based on context.

When approaching a station, Transsistant informs the user if he needs to walk faster to arrive on time, or even if he can walk slower in case he is already walking fast and will still not make it.

If the user regularly uses elevators or escalators, which is the case for an elderly person or a handicapped person, Transsistant will report malfunctions or maintenance schedules as the user is approaching the station and suggest an alternative route. If the user is new to the station, Transsistant can also recommend where to board the vehicle when this information is relevant to the user, such as for a wheelchair user, when the station is big, during a tight connection, or when a train will get segmented into multiple segments along its trip.

Transsistant can also integrate with additional service providers as well as provide suggestions and interaction opportunities. For example, integration with digital ticketing system would allow Transsistant to suggest buying a ticket when the user's ticket has expired or if his current ticket does not fully cover his expected next trip, thus avoiding fines. Another example would be the integration with a taxi service, suggesting to call a taxi beforehand when Transsistant detects the user's final destination is not within walking-distance from his last public transportation stop.

Public Transportation Company

The value proposition for the public transportation companies indirectly include the benefits for the user; a more satisfied user is in the interest of the company.

Transsistant can also bring direct benefits to the companies through the system usage information it provides. By having more detailed and live usage information of their system, the public transportation companies can optimize their routes to lower their costs and better serve their users. The information can also be tracked to points in time prior to using the system, allowing the companies to optimize their stations as well as generate automatic alerts of malfunctions or problems in the stations. Another usage of said information would be in handling congestions in the system, such as during festivals, and implementing dynamic route frequencies in such events. The information provided by Transsistant could also eliminate the need for running expensive surveys.

If Transsistant is integrated with a digital ticketing system, the reminders to

users could help increase ticket purchase and thus increase company revenue. It would also cut down on advertising costs for that purpose, if they exist.

9.2.2 Customers

While Transsistant is designed to be used by public transportation passengers (who are the users of the technology), to be most effective and have the largest user base it should be free to the target users. Therefore, the actual customers are public transportation companies and possibly airports if the concept is further expanded. The customer would need to pay a one time setup fee to incorporate their transportation system into the Transsistant network and additionally would pay a smaller, recurring maintenance fee for Transsistant to handle user complaints, updating if the public transport is expanded, and to cover future development costs. In addition, electronic ticketing companies and other third party companies such as taxi companies are customers due to the lead generation by Transsistant's recommendations to users.

Public transportation companies are challenging target customers because they may either be privately owned or owned by a federal or local government. Obtaining a contract with these players may require unique marketing strategies, including lobbying. Public transportation companies will need to be convinced that Transsistant will be compatible with preexisting monitoring systems and arrival prediction tools.

9.2.3 Channels

In marketing the Transsistant service, two groups are targeted: On one hand, the public transportation companies have to adopt the service. These companies are the paying customers. On the other hand however, it is the users that directly take advantage of the benefits of the service. Both must be addressed differently.

The end users are targeted through marketing in those places where the benefits of the service is most apparent: While using public transportation. The advertisement will be placed on posters in the transportation system, on ticketing machines and on the tickets themselves. The display boards at the stations can also be used to market the service, e.g. by advertising it just when a vehicle leaves the station. Any kind of advertisement should convince the user to download and install the service on his device immediately. This can be achieved by providing a direct download link or a barcode. The service should be available to download for free on every major mobile device or platform.

Each public transportation company has to be approached individually. Additionally, they can be addressed by presentations during conventions of public transport associations or trade fairs. Even though the value proposition of the service for the customer companies is clear, adopting it is associated with a

considerable implementation effort.

9.2.4 Customer Relationship

The customer relationship is crucial to Transsistant's success because the company's reputation can lead to or prevent future contracts with other public transportation companies. In addition, each individual transportation company may have slightly different goals that they hope to accomplish and therefore Transsistant must maintain a strong relationship with their customers. It is important to remember that the customers are the public transportation companies, not the end users.

The most important aspect of the customer relationship is to maintain reliability. Users do not want to constantly switch between different sources for their transport assistance and it is very difficult for transportation companies to reach the entire user base to inform them about new sources of information. This means that when Transsistant secures a contract they will need to dedicate a lot of time after initial setup to ensure that the service remains reliable, in addition to continuously improving the product. If companies or users experience any problems with the product, it is important that Transsistant responds quickly to resolve the problem. The public transportation market is fairly small and the company's credibility could make or break future sales. In addition, companies care about customer satisfaction, thus it is important to make sure passenger problems are resolved quickly. Therefore the "customer support" for the passengers should be provided by Transsistant because their employees will be better prepared for troubleshooting than the transportation company customer support. Figure 9.2 illustrates the customer relationships between the public transportation companies, the passengers, and Transsistant

Finally, Transsistant provides an interface to the public transportation companies so they may access and use the data being collected. However, Transsistant maintains ownership over the data and thus this may allow for additional sources of revenue in the future by charging the public transportation companies for access.

9.2.5 Key Resources

In providing the Transsistant service to the customer companies and their users, several resources are of crucial importance: Specialized capabilities, a secure data center, reputation and credibility as well as the created processes and data sources:

Intellectual Resources

The knowledge generated throughout the R&D process is crucial to the functionality of the service. This knowledge concerns pattern and behavior recognition

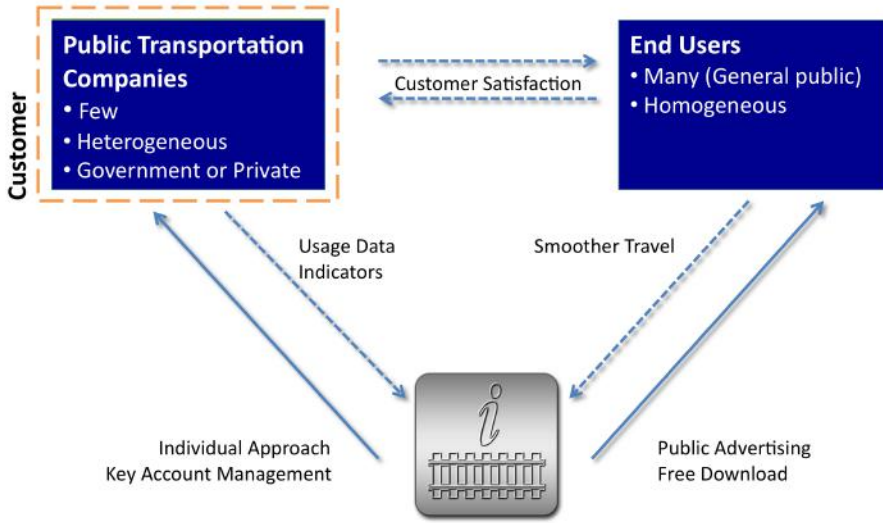

Figure 9.2: Customer Relationship Diagram
Source: Own illustration

as well as public transportation systems and the underlying IT infrastructure.

These capabilities become apparent in two areas: On the one hand in the established application, processes and systems. On the other hand, in the individual persons that generated these capabilities and thus acquired core knowledge of the service. Consequently, both are immensely important and should be regarded as key resources.

The data gathered and processed by the Transsistant service is highly sensitive: It is comprised of current user location, travel routes and behavioral patterns. Accordingly, this data must be secured in the best way possible. In order to prevent legal issues and to achieve a high degree of trustworthiness, the data centers of Transsistant must maintain highest security standards. This applies also to the connection to the users device, to avoid data theft during data exchange.

With approximately 420 public transportation companies in Germany [370], the proposed fields of application can be considered a niche market with room for only a very few players. Hence, a high service quality with a high degree of credibility and reputation is necessary to establish long term relationships with the customers. This should be achieved through an optimized implementation into the customer companies' processes and a high level of usability, reliability and security.

Physical Resources

Since the quality of the Transsistant service depends highly on the quality of input data, such as vehicle positions and travel times, this input data is a crucial resource. This data is gathered through the unique interfaces, processes and relationships that Transsistant establishes with their customer companies. These established processes take into account on the one hand the public transportation infrastructure as well as individual behavioral patterns and on the other hand the gathering of related data from the users. Hence, they are unique to the Transsistant service and are consequently a key resource itself.

[367] Alexander Osterwalder and Yves Pigneur. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers.* John Wiley & Sons, 2010.

[368] Verband Deutscher Verkehrsunternehmen. Daten & Fakten (2010). http://www.vdv.de/daten_fakten_pv.html accessed on 01.10.2011.

9.2.6 Key Activities

In order to successfully deliver the value proposition of the Transsistant, various key activities have to be executed. These activities are strongly linked to the underlying key resources and partners of the product.

Initially, the most important activity is Research & Development, with a strong focus on the prediction of public transport usage. This also includes the recognition and prediction of human behavioral patterns. Moreover, the R&D of Transsistant might also include work on indoor and underground positioning through the triangulation of wireless signals or motion sensors in the users mobile device.

Since an important part of the value proposition of the product is the use on the go, the smartphone application and its mobile usage are crucial. Consequently, the development and constant improvement of the application on all relevant mobile devices is one of the most important activities.

As proposed, Transsistant will operate as a full service provider to the individual public transportation companies, meaning that it will handle all data transfer related to the service with the users. This implies that both, the implementation of the service within the customer companies systems as well as the the provision of an own infrastructure are key activities:

In order to be able to provide accurate information to the users, an interface connection the customer company's IT infrastructure is necessary. The accessible data has to comprise the mapping of the transportation network itself, including the exact position of all stations and stops, as well as the respective schedules. Additionally, the Transsistant software has to be enabled to access the position of all vehicles and their actual travel times from any point within the network.

This data will be enhanced with the location data of the Transsistant users. Furthermore, automated notifications about stoppages due to maintenance or incidents as well as the status of escalators, elevators, and entrance systems have to be accessible to Transsistant. The implementation also includes the customization and branding of the application in line with the corporate identity of the customer company.

To provide a seamless service to its customer companies, Transsistant runs and maintains a data center that serves as the backbone of the application. In addition to transferring the relevant information to the user devices, this data center collects, anonymizes and aggregates the user data and provides it to the customer company and likely city planners and authorities. The transferred information about user position, movement and routines can be used not only by the customer companies to optimize their schedules, to identify temporary bottlenecks but also to learn about malfunctions of vehicles, elevators and access systems. To supply this valuable information to the customers is an important part of the value proposition and should thus be considered a key activity as well.

The entire application functionalities are handled internally by Transsistant, decreasing the extent to which the customer companies have to build up resources and capabilities themselves. This bundling of these tasks for all customer companies enables a concentration of competencies, economies of scale, and thus lower cost for the customer companies compared to individual standalone solutions.

Lastly, selling efforts and contracting have to be regarded as a key activity: Because the target market is a niche market and mainly divided regionally between monopolists, the establishment of business relationships is highly important. Due to the often close connection between public transportation companies and municipalities, the selling efforts can also include talks with authorities and lobbying.

9.2.7 Key Partners

The most important partners that frame the Transsistant ecosystem can be found in the areas of universities and research institutes, public transportation companies and municipalities, as well as in online ticketing and payment companies.

In order to realize the proposed features, Transsistant has to rely on the results of related research. This knowledge can be accessed through partnerships with universities and research institutions as well as with other technology companies or start ups in related fields.

Crucial partners are as well the public transportation companies themselves. They are the customer and yet they supply the data needed to achieve the proposed functionality as well. On the same side, municipalities and authorities

can be regarded as key partners, because they have the political power to promote the implementation of the Transsistant service with their local transportation companies.

The providers of online ticketing and payment services should be considered key partners as well. While Transsistant will not offer these services internally, it does generate leads to those companies by sending notifications to the user. This requires a successful implementation of these services as well as a commission contract.

9.2.8 Costs

The resulting cost structure of the Transsistant service will consist of four main positions: R&D, selling costs, workforce, and infrastructure. During the R&D phase, costs arise from wage payments to the involved professionals, from the building of prototypes, and from field testing. Additional payments to external specialists, e.g. consultants are also possible. Moreover it might include license fees for software needed in the development or operational phase. These development costs continue to arise after the completion of the R&D phase, since the final product has to be maintained and improved constantly and new customers have to be implemented into the service.

Consecutively, costs accrue due to the selling efforts and contract negotiations the company has to perform in a niche market: Even though presentations during conventions of the related associations can lead to multiple interested parties, every single customer company has to be approached individually. Furthermore, most contracts are likely to differ from each other due to the different preferences and service levels associated with each customer company.

Generally, Transsistant has to regard labor cost as one of the major cost blocks. These costs are comprised of wage payments to staff in the fields of development, maintenance, sales, customer service and administration. As most of these positions require trained professionals, labor cost will significantly contribute to the overall cost of the company.

As described above, Transsistant will provide and handle all services related to the application internally. This requires the presence of a considerable infrastructure. Whether leased or bought, Transsistant needs to access computational power and storage space to enable the service. Additionally, Transsistant needs to provide the bandwidth needed to ensure the communication with the users devices and the customer companies. A general overview of the cost and revenue streams related to Transsistant can be found in figure 9.3.

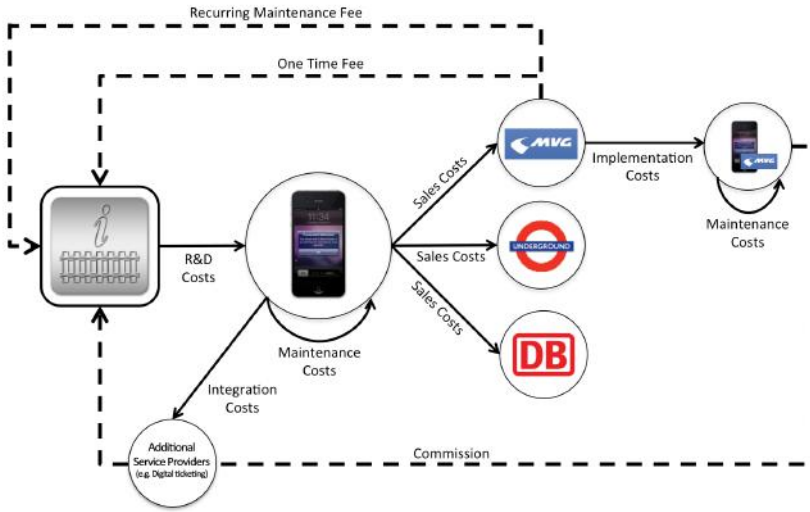

Figure 9.3: Cost and revenue streams associated with Transsistant
Source: Own illustration

9.2.9 Revenue

Transsistant can expect revenue through three main sources: initial setup fees, maintenance fees, and lead generation on ticket sales or other third party services. By signing a contract with Transsistant, the public transportation company is making a long term commitment. Likewise, Transsistant will be heavily invested in maintaining quality service to the customer during the duration of the contract. Therefore, both an initial setup fee and long term maintenance fees are proposed.

The initial setup fee will occur when Transsistant adapts to the particular transportation system, including adding additional servers and potentially more employees to handle the additional work load. The maintenance costs will cover user and customer support as well as new developments to the product. Finally, the partnered electronic ticketing companies should pay a percentage of the ticket fee for each ticket purchased due to the reminder from Transsistant. Other third party services, such as taxi services recommended to the passenger after he exits the station, will also pay some form of commission for each successful referral.

9.3 Scenario Robustness Check

In the following section the four previously defined scenarios are evaluated in order to determine if people will adopt Transsistant. One must take into account not only if people need assistance while traveling due to their personal circumstances but also if the product is compatible to their beliefs and lifestyle.

9.3.1 "Electronic Hearts"

In the “Electronic Hearts” scenario people have a very high technology affinity and attach particular importance to their family and friends. People have the need for physical and emotional closeness but they are also required to be very flexible in their work life. The people’s privacy awareness is low.

Many people will make use of home office solutions and will therefore not be required to come to the office everyday, what will most likely cause that less people in total will use public transportation. This reduce of usage could require public transportation companies to invest more money into the quality of their services in order to acquire new customers. Transsistant’s features make the use of public transportation more convenient so it would be a promising solution in order to improve the customer’s experience.

Due to the high level of technology affinity it is likely that people will accept that their smartphones give personal recommendations and they will also adopt the more convenient electronic ticketing solutions in order to get rid of the impractical paper ticket.

In conclusion, because of people’s high technology affinity and the need to make public transportation more convenient, the chances of Transsistant in this scenario are good.

9.3.2 "Me, My Tech & I"

In the “Me, My Tech & I” scenario, the population accepts technology and has very high individualism. People do not have strong privacy concerns and are ok with sharing a large portion of their private information. Also, the society is prosperous.

Some aspects of this scenario create an environment in which Transsistant can be successful. For example, people’s affinity to technology means they have portable electronic devices, they are familiar with installing and using applications, and they do not mind having wireless devices that are communicating often. Also, a society with low privacy concerns makes running Transsistant easier; personal data about the users (such as their location and schedules) can be easily transferred, stored, and processed. The data can also be easily shared with the public transportation companies, thus increasing the value proposition for them.

Other aspects of the scenario may need to be considered for the success of Transsistant. The combination of high individualism and prosperity could lead to a drop in the usage of public transportation in favor of a rise in personal vehicles. Although such a situation does not necessarily mean Transsistant would not be a viable service, it means there is less interest in public transportation and therefore a smaller market.

In an individualistic and a work-centric society, people travel more between cities and relocate often for their career. In the event of a drop in public transportation usage within the city, Transsistant could be adapted to be used with long-distance transportation using trains or even airplanes.

All in all, Transsistant has a good chance in this scenario. The main change to keep an eye on is a decrease in public transportation usage, which might require a slight strategy adjustment.

9.3.3 "Back to the Roots"

The “Back to the Roots” scenario is characterized by a high low degree of both, technology affinity and individualism. Especially concerns regarding the health impact of wireless technology are prevalent. Moreover, the scenario implies a rather high degree of privacy awareness.

Opposed to that, the Transsistant service proposes the excessive use of wireless technology for the determination of location and for the transfer of information. Additionally, the solution also includes the significant use and transfer of personal data. It is thus very likely, that the Transsistant solution would not be accepted by a broad share of the population in this scenario. The low degree of individualism could furthermore come along with a higher importance of “travelling together”, e.g. in car sharing or the joint use of public transportation, decreasing the need for a solution such as Transsistant.

Obviously, several significant adjustments to the service could be applied with the aim to foster its use in this scenario as well: The usage of wireless communication could be minimized, e.g. by storing more information on the end user device. Privacy concerns could be overcome by a trustworthy and anonymous system as well as by introducing price reductions for transportation tickets as an incentive to use the applications. In order to include the low degree of individualism, functionalities that include and ease the use of public transportation as a community, e.g. a group of individuals commuting together on a regular basis, could be implemented.
To conclude however, the prospects of Transsistant in this scenario have to be described as little. Despite possible adjustments, the risk of a market failure of Transsistant might be too high and the discontinuation of the product seems advisable in the Back to the Roots scenario.

9.3.4 "Me, Myself & No More i"

This scenario is characterized by a high degree of individualism and low technology acceptance. In addition, there is economic prosperity and people are very involved in their careers. The low technology acceptance is caused in part by high privacy awareness.

Transsistant relies on collecting information on the user's location, contrasting the public's high desire for privacy. In addition, it requires the users to have some form of a smart device with them while using the public transportation. If there is a low technology acceptance, it is unlikely that the users will carry these devices. Due to the high economic prosperity, it is also possible that people prefer to buy their own cars and avoid community transportation. On the other hand, they may travel often through work or for leisure and this may require forms of transportation other than their cars, such as planes or trains. The high degree of individualism works well with Transsistant because people would prefer to plan for themselves and this tool would help people stay independent, whether as a tourist that is unfamiliar with the local public transportation or a businessman that is constantly on the go.

Ultimately, the privacy issues and lack of technology on hand would make Transsistant very difficult to implement. This scenario is too distrusting of technology and for certain features to be useful, such as determining if an elevator is broken by obtaining data on the usage, a significant portion of the population must be using the tool. Due to these factors, there is likely not a market for Transsistant in this scenario.

9.4 Conclusion

Due to its competitive pricing, low environmental impact and the practicability associated with it especially in urban areas, the use of public transportation is very attractive. Moreover it is the only means of transportation for persons that do not own a car. Nonetheless, using public transportation can be inconvenient at times: Delayed connections, malfunctioning elevators or the mere fact of missing a train by a couple of seconds negatively influence the travelling experience.

The proposed service Transsistant has the potential to significantly facilitate the use of public transportation systems for all users. With the demographic change in mind, especially those features that aim at persons with physical disabilities and their dependence on elevators are highly relevant. In general, Transsistant shows how modern digital technology and Ambient Assisted Living systems can enhance the use of public transportation. More than just increasing the usability of public transportation systems for the end users, it offers new possibilities to the transportation companies to improve their network according to the needs of its customers. As described above, the value proposition to both the end users and the transportation companies is clear. By performing the

key activities, Transsistant can act as a valuable link between its key partners, namely the users, transportation companies, and third parties, especially online ticketing service providers.

Most of the technology needed to realize the service is available in the present day. However, further research and development on the field of machine learning and behavior recognition might be necessary to fully implement all of the proposed features. Additionally, efficient procedures have to be found to enable the strong implementation within the customers' internal IT infrastructure.

With a large portion of the revenue coming from license fees and maintenance payments, Transsistant could benefit from a constant revenue stream once the respective contractual relationships have been established. However, these contracts will also include usage dependent payments and service levels which emphasizes the need for a high quality service and capable infrastructure.

As seen in the scenario robustness check in section 9.3 Transsistant's chance of success is high in the scenarios with a high technology affinity and rather low where the technology affinity is low. This is because the core of the Transsistant system is a smartphone application that gathers data. In scenarios where people reluctantly use mobile applications or not even possess a smartphone Transsistant's use cases will not work.

References

[369] Alexander Osterwalder and Yves Pigneur. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. John Wiley & Sons, 2010.

[370] Verband Deutscher Verkehrsunternehmen. Daten & Fakten (2010). http://www.vdv.de/daten_fakten_pv.html accessed on 01.10.2011.

10 Chapter 10
Infotainment and Gaming

Julia Aydin, Simon Meyer, Lukas Murmann, Sebastian Rehm, Ludwig Schubert

Already today, family life becomes more and more digitalized. Parents and children share their online calendar, communicate over social networks and video chat services. However, those solutions are not accessible to infants and very young children. Digital devices like smartphones and tablets are not designed for young children; they require a more child-oriented and appealing physical device.

Tego is a stuffed animal, equipped with high-end technology to fulfill this need. It can be called and localized by parents, reminds children of important tasks, and can also detect and describe nearby objects. The toy is targeted at children from two to eight years. By applying advanced machine learning, it adapts to each child's maturity level and individual habits. For small infants, it is a cuddly animal that can play music and explain the environment; schoolchildren use it for communication and educational games.

Still, the concept of Tego may not work equally well in all future scenarios. For example, consumers with low technology affinity may continue to buy traditional toys for their children. On the other hand, the "Electronic Hearts" scenario with its family-centric and tech-savvy society describes a bright future for a product like Tego.

10.1 Introduction

Nowadays, in many families both parents pursue their own full-time job. In addition to that, the number of single parents that have to take care of their child alone and also have to work is rising. Children are more and more parented by relatives, nannies, babysitters or in special fostering stations. Many children are also becoming increasingly self-dependent and spend more time alone or with friends without supervision. Despite the lack of time, parents still want to communicate extensively and take care of their children. Moreover, they are protective and want to know where their child is.

Thanks to innovative forms of human machine interfaces (HMI), such as touch displays or speech recognition, even very young children know how to use their parents' smartphones or tablet computers to a certain extent. Despite this, there has not been any commercially successful communication device designed especially for children, yet.

Most grown-ups still remember their favorite stuffed animal from their childhood, because children have a very special relationship to their stuffed animal. It accompanies them all the time: when they are asleep, on the playground, while they meet with friends or even during their first day at school. However, unlike most parts of modern life, stuffed animals have not been affected by technology, so far. Apart from the used materials they did not change substantially within the last century.

Furthermore, animals often play a role as a child's companion, for example in fairy tales, child stories or fantasy movies. They talk to them, help them when they got lost, and protect them. Due to this, children generally perceive many animals as trustworthy.

At this point, Tego comes into play. It fulfills parents' need to interact with their children even if they are not nearby. It combines the children's relationship to their favorite and trusted stuffed animal and their ability to use digital devices even at a very young age.

10.2 Business Idea: Tego

A Tego is a cuddly stuffed animal for children aged between two and eight. Tegos are available in the form of different animals, like lions, dragons or cats. In order to distinguish itself from ordinary stuffed animals, a Tego is a smart permanent companion for a child. The technology inside of it enables it to assist the child in everyday life. Additionally, those features are not static as a Tego analyzes its owner through speech recognition and educational games to track their level of maturity. It learns together with them and adjusts itself to each individual child. This adaption to the child is called the Tego's Spirit, a personal user profile that is constantly synchronized with the Tego online backend (see figure 10.1). Each Tego can contain only one Spirit at a time. Features like

location tracking and communication possibilities help parents to always be aware of their child's current situation. Object recognition and the use of speech synthesis make a Tego the ideal learning partner for a child. A camera, a microphone as well as a speaker, location and near field communication sensors allow a Tego to fulfill these tasks.

In the following, Tego will be presented using the Business Model Canvas of Osterwalder and Pigneur [371]. This tool is used to describe, analyze, and design business models with respect to all four main areas of a company: customers, offer, infrastructure and financial viability. These main areas are divided into nine building blocks: Value Propositions, Customer Segments, Channels, Customer Relationships, Key Resources, Key Activities, Key Partners, Costs and Revenue.

10.2.1 Value Proposition

Tego provides value for its customers on three levels. First of all, Tego is a completely new product. Stuffed animals sometimes have additional features like playing a melody but no toy animal offers a similar amount of functionality. In addition to this, Tego opens up the possibilities of new ICT technologies to children which so far had little or no access to digital communication. Furthermore, Tego puts emphasis on usability to fully utilize its capabilities.

As a Tego adapts to the child there are functions which are important for children in every age. Moreover, there are features which are first and foremost intended for small infants between two and four years. Other uses for the Tego are targeted at children who already go to kindergarten. Many children retain their special bond to a stuffed animal through their first years of elementary school. Consequently, a Tego also contains functions for those children. Finally, a Tego also offers a lot of value for the parents of the child.

Main Features

In order to increase usability, trends in ICT products converge towards single points of interaction, for example touchscreens, which both display and receive information. In case of the Tego this is accomplished with an audio interface. It receives instructions through speech recognition and communicates with the world through speech synthesis. On the one side, the Tego can understand children of every age group and all its features are available through various audio commands. On the other side, every Tego has its own voice. The speech synthesis built into it is sophisticated enough to give the Tego a natural human voice. It speaks to the child like a companion. This way, it answers to instructions and also communicates information to the child. (see figure 10.1)

Furthermore, the aforementioned speech recognition is not only used to understand commands but also to assess a child's maturity level. In the targeted age group the way a child speaks is one of the main indicators of this.

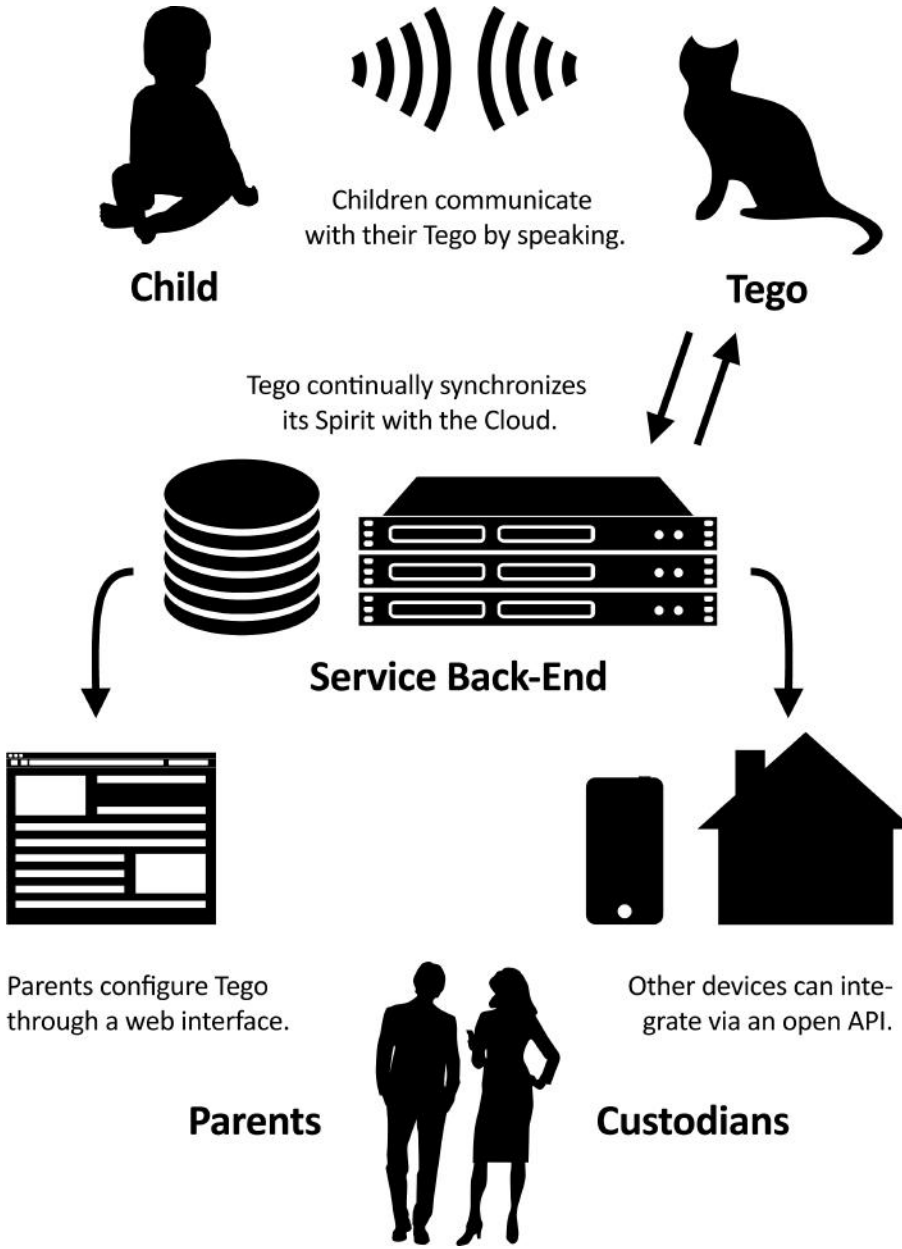

Figure 10.1: Network of Tego.
Source: Own illustration.

Educational games and quizzes are an additional help to estimate a child's stage of development. With the help of this information the Tego adapts itself to the child, using advanced machine learning. This goes much farther than calling a child by its name. The functions, the games and the way the Tego talks to the child all depend on this evaluation.

In order to sustain the illusion of an animal companion and avoid any danger for children, a Tego is very durable. The technological parts are sealed in the inside of the Tego.

It does not need any cables as it is charged wirelessly and has a permanent Internet connection for configuration and synchronization purposes. Every type of Tego has a different charging station called Tego Cradle. A monkey for example is charged while hanging on a tree whereas a lion sits on a rock.

Infants

For young children the focus of the Tego lies not only on its technical features, but especially on its attractiveness as a toy. The bond a child establishes to its Tego is very important, as it needs to be a permanent companion. Therefore, it is very cuddly and appealing to children. Furthermore, the owner can command the Tego to play music using voice instructions. This is easier than interacting with a tactile interface.

Parents or other custodians can get annoyed by the amount of questions children at this stage have as they recently developed the ability to ask about their environment. Consequently, the Tego supports this curiosity by its capability to recognize a large number of different objects and tell interesting facts about it. Using a camera integrated in its eyes and its connection to Tego's online database, it can recognize common objects. The child just has to direct the Tego's eyes onto an object and ask about it.

Preschool Children

After a short time of familiarization kindergarten is a fun and perhaps the favorite place of children this age. Meanwhile, the time at home quickly gets boring when no other playmates are around. To fill this time with meaningful activities a child's Tego knows games popular in kindergarten. Music games with emphasis on rhythm are fun and educational at the same time. To expand a child's vocabulary, as well as deepen its understanding of language, word games like the clapping of syllables are adequate.

Preschool children are still very curious about the world, not only directly around them, but also overall. In addition to that, they have a longer attention span and their imagination develops. As a consequence, they are very interested in longer stories like fairy tales. A Tego can assume the role of a story teller: it can play back audio books which are loaded from the cloud, or read texts out using its built-in camera and text recognition.

Multiple Tegos can work together in group games like hide and seek, where the currently seeking Tego gives hints to its owner about the other players' locations.

Elementary School Children

Children in primary school are usually able to tell short stories about their own activities. The Tego helps to develop their language skills by animating them to speak, for example by asking them about their weekend. It is also possible that a Tego supports a child in learning its first foreign language by doing short exercises adjusted to the child's prior knowledge. Furthermore, children learn simple mathematics during primary school. A Tego supports them with improving their skills in mathematics by posing simple number riddles the child has to answer.

After school, children of that age group often have play dates with their friends or follow other hobbies, such as piano lessons or sports. On the one hand, Tego can remind children to attend their play dates and other activities by notifying them when they need to leave for their appointment. Their school and leisure schedules can be updated online by their parents and can also be synchronized with other calendars, for example a calendar scheduling family time. The time of the Tego's notification can also depend on the child's current location, conditioned on how close to the location of the appointment it already is. On the other hand, a child can also use its Tego to call other friends. However, it is not able to call every telephone number or any other Tego, but only numbers and Tegos that have been approved by their parents before.

Parents

A Tego has various values and fits with many of the typical needs which parents want to fulfill as much as possible for their children. One main aspect is communication. Parents always want to have the possibility to get in contact with their child, talk to it and hear its voice. Tego enables parents to reach their child by calling its Tego.

Additionally, they have the possibility to always stay updated about the current location of the child as Tego has an integrated tracking system. A common fear of parents is that in a short unsupervised moment the child could bush from the parents' home. Therefore, Tego will include an emergency system which warns the parents automatically, if it is out of a geo-fenced area, for example around their home. Of course, Tego should not be seen as a replacement for parental supervision.

Furthermore, some of the Tego's functions that are beneficial for the children also make the parents' life easier, for example the appointment reminder function.

10.2.2 Customers

Tego's users need to be distinguished from its customers (see figure 10.2). Its main users are two to eight year old children. Generally, it is suitable for all types of children, as a Tego also motivates short-spoken children to talk to it. Children are frequently interacting with their Tegos and will enjoy a substantial part of its proposed value. Most of the time however, they don't buy a Tego on their own. Their parents or close relatives, such as grandparents, buy it for them as a present. Therefore the main customers purchasing a Tego are parents or relatives of children in that age group.

Parents buying a Tego are concerned with their child's education and safety. However, they generally should have a high acceptance for and trust in technology, as a Tego is regularly interacting with their child and therefore is getting a lot of information from it. Especially tech-savvy parents are likely to be early adopters of Tego.

A Tego can be particularly useful for parents that work in a full-time job as it enables them to have a more mobile lifestyle and still keep close contact with their child. By using Tego's tracking features, they can for example reassure themselves that their child is on its way home from school or that it is still outside playing with its friends. Hence, apart from children that own a Tego, their parents also enjoy a substantial fraction of Tego's value.

Due to the technology it contains, Tego is more expensive than usual stuffed animals. Therefore, it is targeted at middle-class and upper-class families. All in all, Tego is offered to the market of education-aware parents of young children with high technology acceptance.

10.2.3 Channels

Tego is following different marketing strategies in order to approach parents and their children in distinct ways. The distinction is important, as children can influence their parents' buying decision by asking for a Tego as a present. They also perceive the product and its marketing in a different manner as their parents. Tego is introduced on the online retail market accompanied by an advertisement campaign in the media. Its introduction to offline retail stores goes along with a roadshow through shopping malls and toy stores. It will also be presented to selected children's groups to strengthen the word of mouth effect.

The described marketing channels help to raise the parents' and their children's awareness of Tego by communicating its unique value proposition and also increase sales due to its network effects.

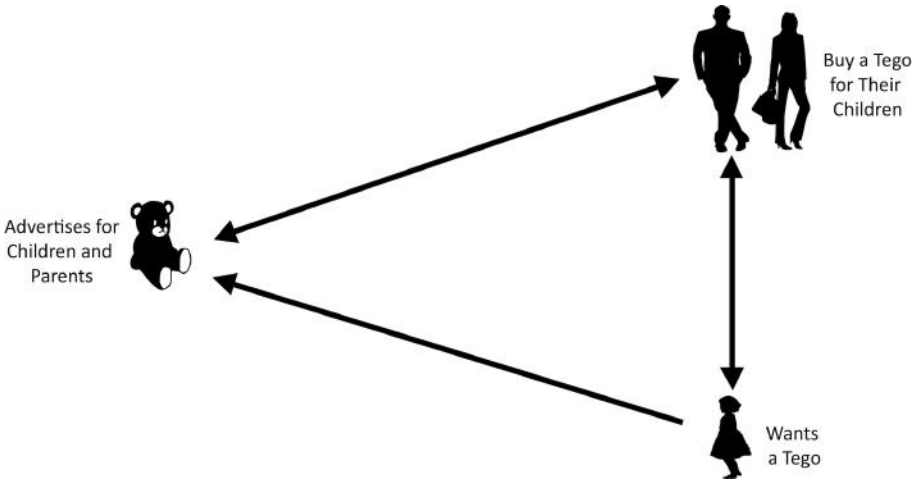

Figure 10.2: Customers of Tego.
Source: Own illustration.

Advertisement Campaign

In order to raise parents' awareness about Tego, advertising in magazines or on websites about parenting is crucial. The focus of this campaign lies on the safety and education features of Tego, as parents are usually concerned most about these topics, when it comes to their children. Furthermore, articles in parenting magazines or websites introduce Tego to the reader. To get hold of tech-savvy parents who are likely to be early adopters, the campaign can be extended to technology blogs as well. All articles contain a link to Tego's website and the number of its hotline, so that interested viewers can obtain more information about it.

As to get children's attention, a marketing campaign is started with advertisements during TV shows specially designed for children. This campaign presents Tego as a must-have product for children. It focuses on the communication, fun and gaming aspects of Tego, as even very young children can relate to it.

With the help of the advertisement campaign, a broad base of both parents and their children can be reached. However, it is a one way communication channel.

Roadshow

The advertisement campaign is followed by a roadshow at large retail toy stores and shopping malls when Tego is introduced to the offline retail market. During this tour, Tego is presented to its target group. Children and their parents can try it and ask questions. There is also the possibility to purchase it right away.

The roadshow reaches a smaller group than the advertisement campaign. However, one can get direct feedback from the customers.

Presentation to Children's Groups

A Tego's perceived value for children increases with its user base, as children can use it to communicate with their friends. Due to these network effects, children that already own a Tego influence their peers to get one, too, as it would be more fun, when they could use them together.

The use of word of mouth advertising makes it easier to sell the product after a sufficient mass of children already owns it. To increase the word of mouth effect, Tegos can also be handed out to selected children's groups (e.g. of a kindergarten) for a certain amount of time. Specially trained Tego representatives introduce it to the children and also use Tegos for group games. Afterwards, the children have the possibility to take it home and try it out together with their parents. Then they may keep it and parents and their children will suggest it to their friends.

Presenting Tego to children's groups establishes a very intense and direct contact to children and their parents and helps to create a word of mouth effect.

10.2.4 Customer Relationship

For getting first information about Tego, potential customers can visit Tego's website. It contains fact sheets with all basic information, answers to frequently asked questions and videos about the different use cases of the product. Furthermore, interviews with experts can be watched, who support the view that using Tego is secure and assisting children to grow up. Customers and interested people also have the possibility to get instant help in a live chat with Tego employees. They can further contact Tego's support center via telephone or e-mail. This enables them to get their specific questions answered and to get direct, uncomplicated and quick personal assistance.

Parents have to visit Tego's homepage to manage the Spirit of their child's Tego, so they can easily be reached and informed about updates or any other news related to Tego (see figure 10.1). In order to stay up to date, they can further subscribe to an e-mail newsletter. To personalize the newsletter, they have the possibility to choose the topics they want to be informed about. Furthermore, the newsletter automatically adapts according to the topics a specific parent looked up on the homepage and gives detailed information about the child's stage of development. For example, each newsletter contains a section about new additional games that match the recipient's child. On a child's birthday their Tego wakes them with a birthday song and gifts them a present in the form of an additional downloadable feature, for example a new game.

Existing customers can also purchase additional products for their Tego that are released at regular intervals after the initial product launch. Parents can also write online reviews to suggest these products to other customers. In an online forum they can share their experiences with other customers, give tips and solve each other's problems. This community aspect helps Tego to better understand its customers as it serves as a bidirectional communication platform.

To implement more ideas of children in additional products and content, selected children and their parents are invited to workshops. During these workshops, they can give feedback and come up with their own ideas on how to improve Tego. Since it is a form of co-creation, this will not only improve Tego but also increase its credibility and customer satisfaction, as it was also designed by its target group.

The mixture of services helps to positively influence potential customers' buying decision and strengthen the relationship to existing customers by increasing their satisfaction with the product. It also increases the probability that they will suggest Tego to others and therefore boosts sales through word-of-mouth-marketing.

10.2.5 Key Resources

Resources needed to develop and operate the Tego business belong to for separated categories: Intellectual, physical, financial, and human resources. The importance of each category depends on the current stage of product development: During the initial research phase, human and financial resources are most important. Once production and sales begin, development efforts continue, but physical resources like manufacturing facilities and retail stores become most crucial.

Intellectual Resources

The most important intellectual property Tego relies on is its strong brand. Creative online advertising and TV commercials foster the diffusion of the brand name.

Another important intellectual resource is knowledge: while most knowledge can be obtained by hiring specialized employees (see human resources later this section), knowledge about the integration of sophisticated electronics and communication equipment into a stuffed animal will be a key success factor for Tego. The toys must be water resistant, robust against drops of significant heights or encounters with real pets. However they still have to look appealing to kids, must be soft and comfortable and light enough to be carried around all day.

Finally, Tego operates a cloud service that hosts Tego Spirits, calendars and communication services. Tego services are accessible through an open API, but

the aggregated usage data and design of this API remain under Tego's control and form another intellectual resource.

Physical Resources

All physical resources of Tego will be acquired from third parties. The production facilities for the stuffed animals are operated by a cooperating manufacturer. Logistics, warehousing and retail shelf space are contributed by partners as well.

Physical resources needed after the device has been manufactured are servers: Tegos constantly sync their status with a web backend. The backend makes this data available through a secure interface that parents use to configure and observe the Tego's status. The storage and processing capabilities for the Tego backend are leased from specialized hosting providers.

Human Resources

Especially the initial development of Tego demands specialized experts. Child psychologists are needed to analyze children of different age groups. The only interface for children is speech recognition, so engineers developing the product must know exactly what will be understood by the different age groups.

After behavior patterns of young children have been identified, the Tego must learn how to adjust to an individual child. It must combine theoretical knowledge about children's use of technology with observations about the individual child's habits and maturity. Therefore, machine learning experts are needed for the development of Tego. They must work closely together with the psychologists in order to make each Tego an authentic and individual companion.

Besides machine learning, the production of Tegos requires research about the application of audible HMIs for young children. When talking to a two-year-old, Tego must use simpler grammar and vocabulary than when interacting with a schoolchild. The voice recognition and speech synthesis components can be licensed from partners, but the developers for the integration of those building blocks into a usable interface will form a key resource.

So far, the human resources needed to initially develop the Tego product have been described. Even after the market launch, developers are needed to update the server backend and API with new features and create add-on content for Tego.

The last category of human resources is sales and support staff. Sales staff must contact retailers to persuade them to sell the new product. For support through phone, email and chat, a support team is employed.

Financial Resources

During the initial development phase, Tego does not generate any revenue so external funding, for example by venture capitalists, must be provided. The

importance of financial resources moves to the background after the product launch though. The Tego business model is rather lean, focusing on intellectual resources and research, while capital-intensive assets like retail, manufacturing, and data centers are contributed by partners (see section 10.2.7).

10.2.6 Key Activities

This section describes the most important activities needed for a successful development, production and distribution of Tego. Both activities to be completed before the launch of the product as well as those continuing after the product launch are presented.

Development Phase

Initially, research on the application of machine learning algorithms and natural speech interfaces must be conducted. Fundamental technology can be licensed from partners, but it still has to be integrated into a toy that is accepted by children with very diverse capabilities and tastes.

A secure API to access the data of each Tego must be designed. Third parties can use this API to integrate Tego functionality into their product. For example, the parents' calendar application may allow them to directly add events to their child's Tego. The full configuration functionalities of Tego will also be accessible from the Tego website. Web developers must create a site where parents can buy additional features like games or a new Tego Spirit.

Software is not the only building block where research is necessary. The electronic parts must be safely integrated into the plush animal. Here, close communication between the internal R&D and the stuffed animal manufacturer is crucial.

During the development-phase as well, partnerships with manufacturers and retailers must be established. Prototypes can be presented at trade shows to contact potential retail partners. Finding the right manufacturing partners will form another important activity: The manufacturer must be able to integrate the electronic components at reasonable costs, while maintaining good working conditions that reflect Tego's brand image as a high-quality and sustainable product.

Post Product Launch

After the product launch, developers will continue to create content for Tego. One main class of add-ons will be learning games, for example a math game, spelling games or quiz games for various subjects. Another feature that will be developed after the product launch is the object tracking and reminder functionality (see 10.2.1).

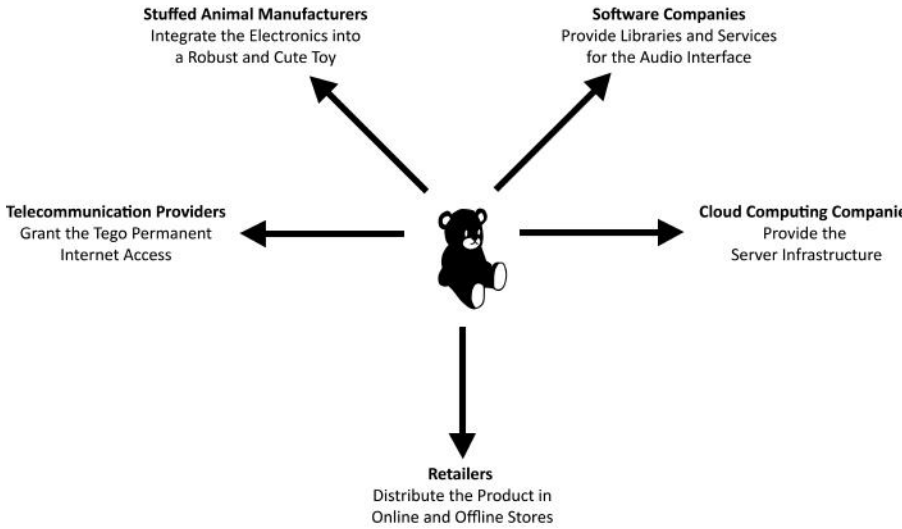

Figure 10.3: Key Partners of Tego.
Source: Own illustration.

An additional key activity after the product launch will be support. Support staff will answer emails, operate a phone hotline and join online chats on the Tego web site.

For the product launch, retailers have to be convinced to offer the product. Online retailers will be targeted first. The launch will be supported by an online marketing campaign, targeted at tech-savvy early adopters (see 10.2.3). After the product has gained the first users and distribution partners, it should be made available at retail stores as well. Marketing campaigns can then focus on mass-media in order to reach a high number of potential customers.

10.2.7 Key Partners

Most partners that help to bring Tego to market are suppliers. The only non-supplier partners are retailers (see figure 10.3). An important partner is the manufacturer of the stuffed animal. The partnership goes beyond a simple supplier relationship, involving joint research on the integration of electronics, speakers and microphones into the stuffed animal. As Tego aims to establish its own brand, the brand of the stuffed animal is not important, so manufacturing costs and flexibility in the production of the animals can be the key criteria when choosing the supplier.

On the supplier side as well, there are companies creating third-party software libraries for the audio HMI and object detection. The partnership is based on

licensing fees. As the HMI is one of Tego's most crucial features, a long-term relationship to the suppliers of audio-related libraries is beneficial.

Tegos are always connected to the Internet. Data connectivity solutions may depend on the target country and future developments, but data traffic is included in the initial purchase of the toy. A possible scenario is a per-country partnership with telecommunication providers. As a Tego only transmits events and usage data and provides only limited audio communication capabilities, the bandwidth requirements are rather low which should allow for low data contract fees.

A server hosting company provides a flexible cloud-based hosting solution for the Tego backend. As Tegos are always connected to the cloud, the hosting solution must be very reliable. Furthermore, it must be able to scale well from very few Tegos in the beginning, to many more once established retailers start selling the product.

After the toys are assembled, they are distributed through a network of retailers. First, focus is put on online retailers, but once the Tego brand is more established, the toys are made available at toy stores, too.

10.2.8 Costs

All the beforehand mentioned activities and resources result in expenses which are necessary to make Tego a successful business. As shown in figure 10.4, the cost structure for the company can be split into two categories, fixed and variable costs.

Fixed Costs

Tego is a new company without resources for basic research in needed technologies. Therefore, the company licenses them from established specialized firms. These technologies are mainly speech recognition, voice synthesis and text-to-speech. For the additional features of the Tego, object recognition technologies are bought as well. This is a one-time big investment into the setup of the company.

In the first phase of developing Tego the salaries for the employees are the main costs. There are three distinct parts of Tego which need to be developed. There is the software part of Tego. The acquired technologies are combined with machine learning to create a reliable companion for children. Then, there is the hardware, the stuffed animal. At last, the brand Tego and a fitting marketing campaign has to be devised. After a roughly 3 years long development phase Tego has its release to the market. Consequently, the development costs decrease drastically after this first phase. However, there is still a need for bug fixing and additional features for Tego need to be produced.

Furthermore, new customers may need help in interacting with the toy as well as with the web interface. Therefore, support staff and Tego representatives are

Figure 10.4: Cost Structure for Tego.
Source: Own illustration.

needed. Once Tego is introduced to the market, additional marketing expenses arise. TV spots as well as Internet and magazine advertisements have to be produced and published.

All the aforementioned costs are independent of the amount of Tego animals produced and are therefore fixed costs.

Variable Costs

The cloud-based infrastructure, which hosts the web platform and the Tego Spirits, is another expense. Moreover, there is a contract with a telecommunications provider to ensure a permanent Internet connection for all Tegos. Those fees are paid for each unit sold and are directly included in the calculation of a Tego's retail price.

Furthermore, there are costs deriving from production. These are the main costs after Tego's initial development phase. Tego does not own any factories but instead uses the production capacities of a contract manufacturer. The costs for material and assembly are paid directly to this partner. Per unit production costs decrease when more Tegos are produced, but at the beginning a minimum amount of Tegos has to be ordered.

As the place of manufacturing and the point-of-sale are likely to be different, the Tegos need to be shipped to online and offline retailers or to storage facilities. A just in time production is desired to minimize storage expenses. However, this cannot be achieved all the time.

These costs all depend on the amount of Tegos produced and therefore are variable costs.

10.2.9 Revenue

Tego has three different income streams (see figure10.5). These are not only asset sale, but also additional hardware or software content as well as the aforementioned Tego Spirits.

Asset Sale

The main income source for the company is asset sale. Tegos are sold at normal toy retailers as well as at online stores. Usually, the pricing for a Tego is fixed, but it can be lowered during promotional events. The price for the permanent Internet connection is incorporated into the Tego's price so that parents will not have another Internet contract just for a toy. As the Tego is a big investment for a toy, financing offers with monthly payments are possible. Together with the Tego or after the purchase, a support plan can be bought. This involves free repairs or replacements for the Tego even if the user is responsible for its malfunction.

Additional Content

The company sells additional content, features and languages. Not every imaginable function for the Tego might be useful for everybody. Due to this, customers can buy and add the features to their Tego via the web portal. Accessories like a second Cradle and clothes for all the different Tegos are sold at the same online and offline retailers as the toy itself. The amount of income deriving from this revenue stream is directly related to two factors. First, it depends on the sales figures for the Tegos. This affects the potential customer base for add-ons. Second, a steady output of new add-ons is necessary. Otherwise, the customers have all their desired add-ons at one point and less revenue is created from additional products.

Tego Spirits

Secondly, the company generates revenue from the transfer of a Tego to a new child. As Tego provides a permanent infrastructure to fully use the possibilities of the Tegos, the upkeep for this service is incorporated into the price of a Tego. This additional charge can be calculated through the average useful life of a Tego. However, this calculation is faulted as soon as a Tego is sold from one customer to another or just handed over to another child in the family because the Tego's useful life is extended. In order to prevent the loss of money, a customer has to pay half the price of a new Tego for a new Tego Spirit. The purchase of a new Tego Spirit implies a complete factory reset of the device. This is necessary for the machine learning algorithms to correctly adapt to the new owner.

As this revenue stream is only affected by the reselling of used Tegos it does not start until an extended amount of time has passed after Tego has come to market. Additionally, the high costs involved with buying a used Tego can lead to a higher amount of new Tegos sold.

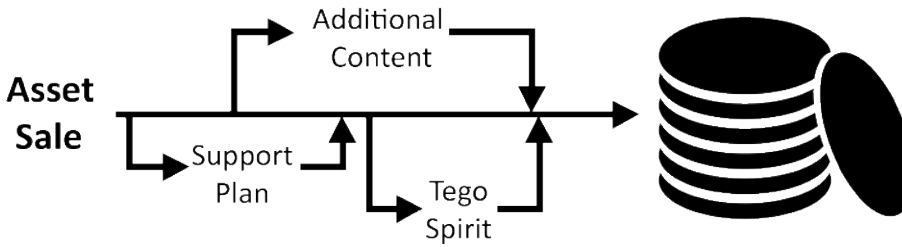

Figure 10.5: Revenue Streams of Tego.
Source: Own illustration.

10.3 Compatibility with Scenarios

It is indispensable to place the product and its modifying marketing strategy within the respective anticipated future surrounding. Thus, the following describes the fit of Tego with the four already mentioned scenarios: “Electronic Hearts”, “Me, My Tech & I”, “Back to the Roots” and “Me, Myself & No More i”.

10.3.1 Electronic Hearts

The scenario describes a world with high technical affinity on the one side and low individualism on the other side. The initial idea of Tego fits perfectly with this scenario. Being less individualized by relying on family values causes the need for products that are oriented towards the requirements of children in their everyday life. Besides, a highly technical device acting as a toy for the young will not lead to acceptance problems. Also, the availability of wireless charging or free ubiquitous Internet, which are realistic features of a future world with high technology acceptance, will ease the diffusion of Tego.

As the customers will mostly have confidence in highly technical products the marketing strategy does not need to focus on security or trust issues. The strategy could focus on Tego’s communication features instead.

Additionally, this scenario generates supplementary market potential for Tego, as people focusing on their social life and family values usually have more children. Self-evidently the higher the number of children the more potential end users exist.

10.3.2 Me, My Tech & I

This scenario is driven by high technology affinity and high individualism. The former again assures that the integration of highly technical features does not cause acceptance problems.

High individualism becomes visible in a decreasing number of family households and meanwhile an increasing number of single households and single parents families. Due to this, the marketing strategy needs modifications in order to focus on the individualized lifestyle: communication with remotely located parents and child occupation are marketed as main features.

Very individualized parents search for products that can operate as useful toys and give their children extra-security, especially as they are often pinched for time. These parents benefit from Tego, because it enables them to live a more mobile life by simultaneously taking care of their children and providing worthwhile leisure activities for them.

10.3.3 Back to the Roots

Low individualism and low technology affinity are the main characteristics of the third scenario. Like in the first scenario, the emphasis on a family lifestyle may lead to a higher number of young children and therefore a higher market potential for Tego.

However, parents do not accept new technological developments in this scenario. Still, Tego perfectly fits the need of their children. Thus, one key exercise of the marketing strategy is to convince potential customers of the product's benefit, despite its highly technical nature. One possibility is to focus on gaming and fun aspects by limiting the number of included technical features and meanwhile increasing the focus on the support of children to play with each other.

Also, some functional attributes can be modified in order to adequately adapt to the potential customer. For example, fear of electromagnetic radiation can be addressed by replacing the Tego Cradle's wireless charging function with a charging cable. Furthermore, the permanent Internet connectivity and synchronization can be limited to the most crucial data transfers.

10.3.4 Me, Myself & No More

The last scenario is characterized by low affinity of technology on the one, and high individualism on the other side. Actually, this scenario poses most challenges for a harmonized marketing strategy and market potential for Tego. Therefore one must combine both modifications mentioned previously in "Me, My Tech and I" and "Back to the Roots".

First, it is important to exclude highly technical features, e.g. the wireless charger. Second, as many parents live an individualized lifestyle, the marketing strategy can focus on additional control possibilities e.g. for parents working full-time that want to be updated about their child's location and context. Another focus can be put on Tego's gaming opportunities and on features that support the self-dependence of growing children.

10.4 Conclusion

Tego can connect children to the digital world of tomorrow. It brings value to both children and parents: For children, it is their favorite stuffed animal that can play games, lets them communicate with friends and explains the environment around them. Parents favor Tego's education features, the possibility to stay updated on their child's location and its ability to remind children of tasks they have to do.

But still, there is space for improvement: This section describes possible technical improvements for the second generation of Tego. Eventually, ways to further strengthen the Tego brand and customer relation are discussed.

Technical improvements

The Tegos described in section 10.2 use voice recognition and speech synthesis to communicate with children. Communication between the child, family and friends using the Tego is audio-only as well. There are no visual communication features.

By utilizing the already built-in camera for communication, parents could see a video image of their child, for example when calling from their smartphone. But still, children would not be able to see their parents when they are talking to them. Integrating a screen is not an option as it would make the product look way too technical.

One possible solution is to integrate a small projector into the Tego's eye. This way, Tego could project images whenever an empty wall or sheet of paper is nearby. Another solution can be the usage of computer and television screens for ad-hoc video display. Children could then do video chats with friends or their grandparents, let Tego stream their favorite TV show or use the video image to play visual games.

Another use case for the already integrated camera can be gesture detection as an additional input method.

Merchandise and Customer Relation

So far, the marketing efforts (see 10.2.3) were targeted at the creation of a strong Tego brand. Additional products like Tego Spirits or the Tego Cradle bear the brand name to foster its diffusion.

Besides the accessories for the Tego toys described in the original business model canvas, the strong brand could be further monetized through additional merchandise: Third parties could sell t-shirts, base caps or playsuits with the Tego logo or the Tego animals on it.

Tego's current customer relationship management (see 10.2.4) is targeted solely on parents. They use the Tego web site to manage their child's device and receive customer support from the Tego hotline, through email or chat.

The only existing way to get in touch with children, the actual users, is through special marketing events in shopping malls or kindergartens.

This could be changed by the introduction of the Tego Club. Children could become a member of the Club and would then receive a monthly magazine with a Tego comic and information about upcoming Tego events or new Tego products. This club for children would be a huge endeavor for a young startup, but a viable option should Tego become a successful mass market product.

References

[371] Alexander Osterwalder and Yves Pigneur. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers.* John Wiley & Sons, 2010.

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