WP2 – Concept, Requirements & Specification

Market and Applicability Watch Report

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When developing a new platform of applications whose final aim is to enter the market, it is fundamental to know and understand that market. In this deliverable, a characterization of the market of independent and healthy living tools for elderly is provided.

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This deliverable is subject to final acceptance by the European Commission.

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Project Partners

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Executive Summary

ALFRED aims at developing and bringing into the market a new platform of applications for helping older people to live independently and healthier. To ensure a successful market launch of ALFRED, an essential focus of the project needs to be on the Market and Applicability Watch, along with the Exploitation and Business Plan.

The Market and Applicability Watch is a continuous task of the Project, covering the whole duration of it. This is the second deliverable of the Market and Applicability Watch from a total of 4 (project months 6, 12, 24, 36).

In the previous deliverable, a mapping of keywords, a glossary of concepts, an analysis of similar projects, products and services, and a technology watch were performed. In this deliverable, a market analysis of the mHealth apps market is presented. The main players in the market are identified and some of the possible revenue models for mHealth apps are discussed.

The market analysis provided in this deliverable will not only help to develop the ALFRED applications, but will also increase the possibilities of a successful launching of ALFRED as a profitable business at the end of the project.

Being an area undergoing developments and changes very quickly, updating this information along the project is a requirement, and will be provided in the subsequent deliverables.

By doing so, it will be ensured that by the end of the project, ALFRED applications can be successfully launched into the market while being profitable and thereby contributing to strengthening Europe's industry.

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1 Introduction

ALFRED – Personal Interactive Assistant for Independent Living and Active Ageing – is a project funded by the Seventh Framework Programme of the European Commission under Grant Agreement No. 611218. It will allow older people to live longer at their own homes with the possibility to act independently and to actively participate in society by providing the technological foundation for an ecosystem consisting of four pillars:

- **User-Driven Interaction Assistant** to allow older people to talk to ALFRED and to ask questions or define commands in order to solve day-to-day problems.
- **Personalized Social Inclusion** by suggesting social events to older people, taking into account their interests and their social environment.
- A more **Effective & Personalized Care** by allowing medical staff and caretakers to access the vital signs of older people monitored by (wearable) sensors.
- **Physical & Cognitive Impairments Prevention** by way of serious games that help the users to maintain and possibly even improve their physical and cognitive capabilities.

Within this deliverable, a first evaluation of the Market and Applicability Watch is provided, sources for searching identified, and a structured way to consider the business side of the whole project is defined.

1.1 ALFRED Project Overview

One of the main problems of western societies is the increasing isolation of older people, who do not actively participate in society either because of missing social interactions or because of age-related impairments (physical or cognitive). The outcomes of the ALFRED project will help to overcome this problem with an interactive virtual butler (a smartphone application also called ALFRED) for older people, which is fully voice controlled.

The ALFRED project is wrapped around the following main objectives:

- To empower older people to live independently for longer by delivering a virtual butler with seamless support for tasks in and outside the home. This virtual butler (the ALFRED app) aims for a very high end-user acceptance by using a fully voice controlled and non-technical user interface.
- To prevent age-related physical and cognitive impairments with the help of personalized serious games.
- To foster active participation in society for the ageing population by suggesting and managing events and social contacts.
- And finally, to improve caring by offering direct access to vital signs for carers and other medical staff as well as alerting in case of emergencies. The data is collected by unobtrusive wearable sensors monitoring the vital signs of ALFRED's users.

To achieve its goals, the project ALFRED conducts original research from a user centred perspective and applies technologies from the fields of Ubiquitous Computing, Big Data, Serious Gaming, the Semantic Web, Cyber Physical Systems, the Internet of Things, the Internet of Services, and Human-Computer Interaction. In addition, there are tasks devoted to the Business Model, Market applicability and Exploitation of ALFRED, to

ensure a successful launch of ALFRED into the market by the end of the three years duration project. For more information, please refer to the project website at http://www.alfred.eu.

1.2 Deliverable Purpose, Scope and Context

The purpose of this deliverable is to:

- Guide the progress of the project according to the identified business opportunities and technology trends and regulations;
- Identify main key players and potential clients and collaborators.
- Identify competitors and compare their technologies.
- Place ALFRED into the context with all the other projects, services, products and technologies that are under development for tackling similar problems as ALFRED.
- Providing a first template for the business plan outline.

1.3 Document Status and Target Audience

This document is listed in the Description-of-Work (DoW) as “public”, as it provides a Market and Applicability information of projects related to ALFRED and can therefore be used by external parties in order to understand the market space on ICT technologies for independent living of elderly people.

While the document mainly aims at the project’s contributing partners, this public deliverable can also be useful for the wider scientific and industrial community. This includes other publicly funded research and development projects, which may be interested in collaboration activities.

The current document is a living document and will be updated biannually.

1.4 Document Structure

This deliverable is broken down into the following chapter:

- Chapter 1 provides an introduction for this deliverable including a general overview of the project, and outlines the purpose, scope, context, status, and target audience of this deliverable.
- Chapter 2 introduces the Healthcare challenges and the potential of mHealth.
- Chapter 3: mHealth market – the market for mHealth apps is described.
- Chapter 4: mHealth Stakeholders.
- Chapter 5: Business models in mHealth: focus on revenue models and distribution channels.
- Chapter 6: mHealth: opportunities and challenges of this interesting market.

2 Healthcare Challenges

2.1 Introduction

EU healthcare systems face significant challenges that are creating concerns about the sustainability of healthcare delivery. The combination of increased prevalence of chronic disease and an ageing population that continues to grow is exacerbating the burden on healthcare delivery and costs across multiple EU member states. Furthermore, well publicised budgetary constraints and a shortage of healthcare resources have created a scenario that inhibits these EU member states from meeting the increased healthcare demand. At the same time, the EU recognises the acute importance of investing in healthcare to tackle these challenges. Various stakeholders in the EU are looking at ways to make healthcare systems more sustainable while contributing for a better health of their citizens. This will improve wellbeing, increase employability and reduce health inequalities.

To address these challenges, EU healthcare systems are moving care for chronic conditions and ageing population from hospitals to community homes. There is an increasing focus on making care more patient-centric, so that patients are empowered to manage their own care process. Along this trend, the healthcare ecosystems are becoming more complex with a wide variety of stakeholders and players (see Figure 1 for a representation of Health systems). In Figure 1, the first blue layer represent the main services available for the older patient, while the outside layer represent several stakeholders and players involved in the health and social care. The red-dotted arrows represent how mHealth can enable better communication between different stakeholders and the patient. The green arrows depict the most traditional financial flows.

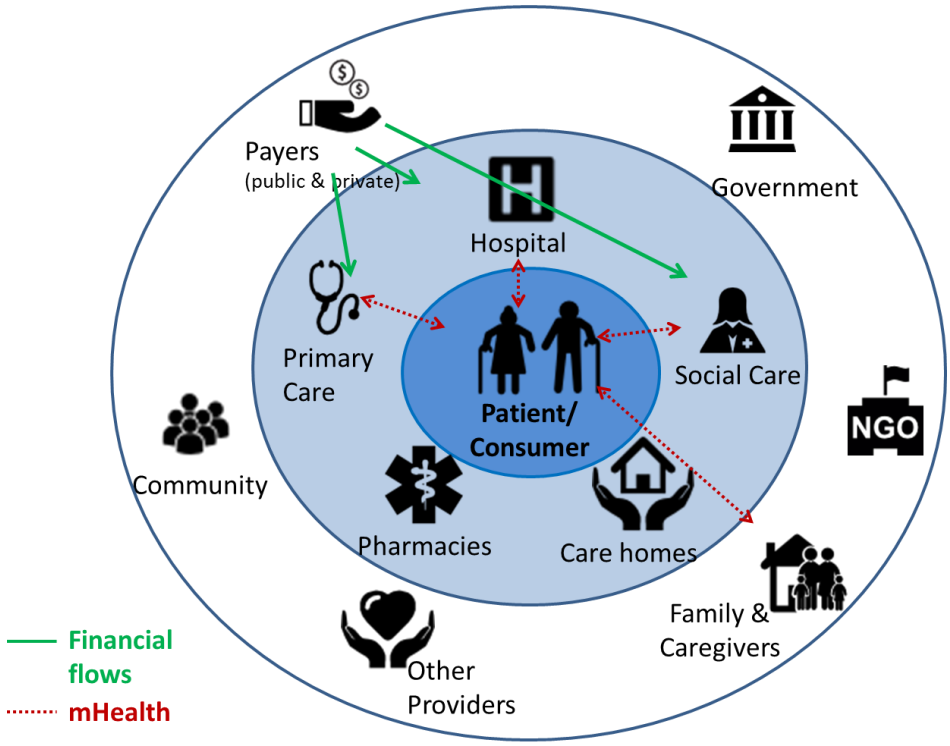


Figure 1 – Framework for a Complex Health Ecosystem

While Figure 1 presents a general framework for a Health ecosystem, EU countries vary a lot in the way their healthcare systems are organized. This is evident not only at a managerial level – Bismarck vs Beveridge models (detailed further in this section), but also at a cultural level. In South Europe, for instance, families have a strong role and are closely participating in the care of their elderly family members, while the same is not true for north European countries. This poses different needs at the moment of establishing the best healthcare process.

2.2 Ageing Population

All over the world, a demographic change is being experienced that is leading to larger percentages of elderly people in society. Within the next 20 years, the amount of people over 75 years old will raise significantly in Europe. According to the third EU Demography Report, the life expectancy has also been increasing in an almost continuous and uniform trend at the rate of 2-3 months every year, and is the main driver behind the ageing population[1]. In 2012 there were approximately 810 million persons aged 60 years or over in the world (11% of total) and this number is expected to grow to more than 2 billion by 2050 (22% of total) (see Figure 2).

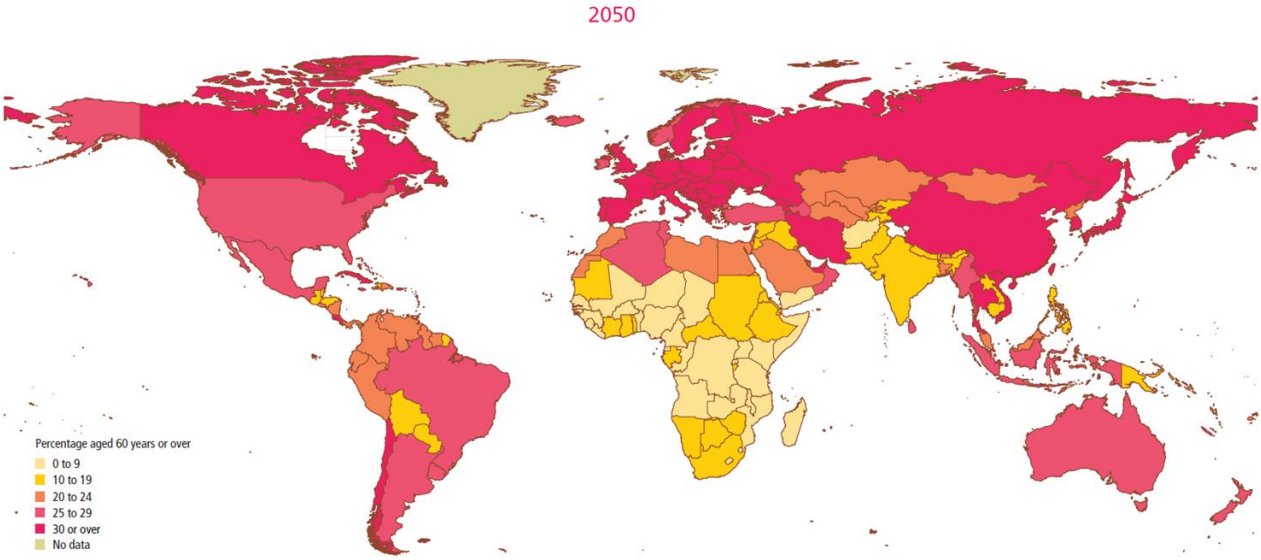


Figure 2 – Forecast with Percentage of the Total Population Aged 60 Years or More in 2050

An estimated 40% of world's older persons [Uni12] are living independently (meaning living alone or only with one's spouse). This is the dominant living arrangement for elderly people in developed countries and is likely to increase as the world's population continues to age.

[1] http://ec.europa.eu/social/main.jsp?langId=en&catId=502&newsId=1007&furtherNews=yes

2.3 Incidence of Chronic Diseases, Multi-Morbidity

Most older people die of a non-communicable/chronic diseases, such as cardiovascular diseases (e.g. heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma) and diabetes. In addition, older people often have multiple health problems at the same time, such as diabetes and heart disease. Managing the complex clinical setting of multi-morbidity especially in an older person poses large difficulties (social, clinical and economical) for the healthcare system.

2.4 Different National/Regional Healthcare Financing Systems

While healthcare systems are all different, they fall into relatively few categories as regards the way funds are distributed by health payers and their relationship to health providers: hospitals, clinics, doctors, nurses and therapists, among others. Often, citizens contribute with their taxes to a health fund/insurance that then contracts several health services. This can either be public or privately managed. The most common classifications of healthcare financing systems apply to four basic systems: Bismarck, Beveridge, National Health Insurance and out-of-pocket. Within Europe, the two main systems in use are Bismarck and Beveridge.

Designed by National Health Service creator Lord William Beveridge, the Beveridge model provides health care for all citizens and is financed by the government through tax payments. This “socialized medicine” model is currently found in Great Britain, Spain, Scandinavian countries, among others. The government is the central piece as the one in charge of providing and managing care for all the citizens.

The Bismarck model uses an insurance system and is usually financed jointly by employers and employees through payroll deduction. Unlike the US insurance industry, Bismarck-type health insurance plans do not make a profit and must include all citizens. Doctors and hospitals tend to be private in Bismarck countries. This model is found in Germany, France, Belgium, the Netherlands and Switzerland.

Both healthcare models face challenges with the demographic change, especially regarding the share of population that will actively pay for the service.

3 mHealth Market

3.1 mHealth Definition

mHealth can be defined as: “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices” [Wor14]. It also includes applications (hereafter "apps") such as lifestyle and wellbeing apps that may connect to medical devices or sensors (e.g. bracelets or watches) as well as personal guidance systems, health information and medication reminders provided by SMS and telemedicine provided wirelessly.

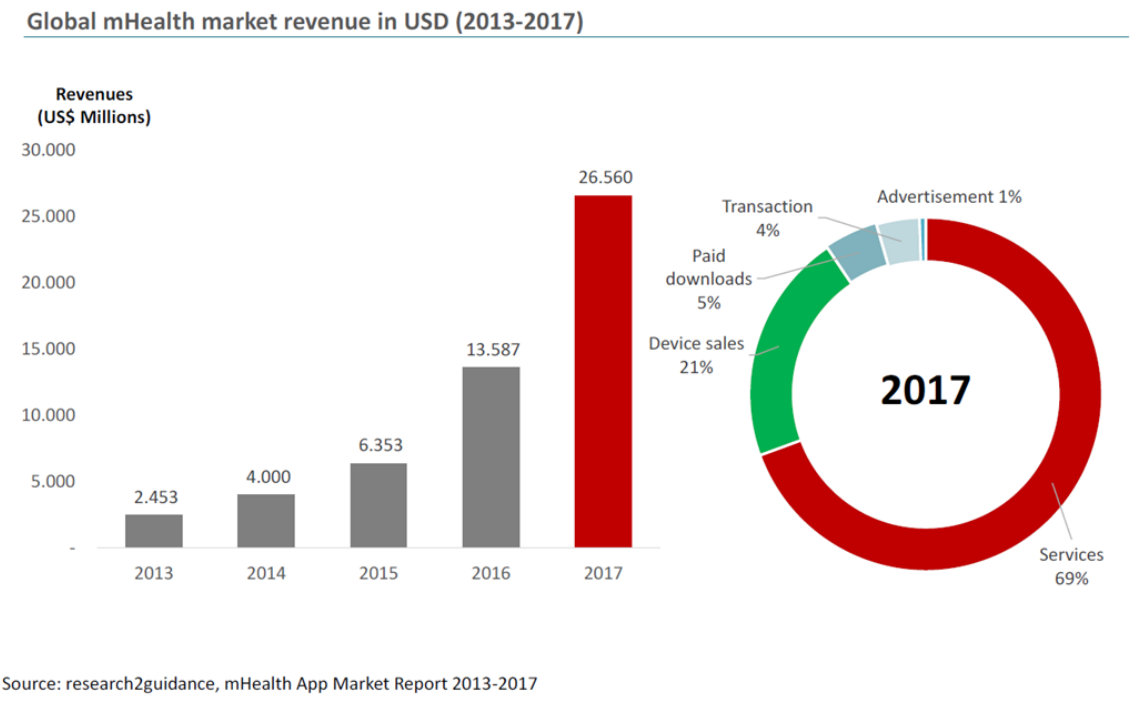
In recent years mHealth has emerged as a complementary way of delivering healthcare building on the ubiquitous connectivity of mobile networks and the proliferation of smartphones and tablets [Com14]. mHealth is an emerging and rapidly developing field which has the potential to play a part in the transformation of healthcare and increase its quality and efficiency.

The growth in wireless subscriptions, reaching over 6 billion wireless subscribers in the world, has favoured the uptake of the mobile health and wellbeing market.

The convergence between wireless communication technologies and healthcare devices on the one hand and health and social care on the other hand, is creating new businesses, while the redesign of healthcare delivery and the emergence of a 'silver economy' are highly promising markets.

3.2 mHealth App Market

Mobile health or mHealth apps and services are software applications and broadband services which may assist in healthcare delivery and consumer-centric health management. According to a 2014 study by research2guidance, the mHealth app market is expected to grow to a substantial size of more than USD 26bn in 2017 (Figure 3). This means that, in the period of three years, this market is forecasted to grow seven times its actual size. The biggest growth is to occur between 2016 and 2017.



Source: research2guidance, mHealth App Market Report 2013-2017

Figure 3 – Forecast of Global mHealth App Market Revenues and Top Ranked Revenue Sources

Regarding revenue sources, and while in 2014 a 24% is coming from app downloads, this study shows that in the future most of the revenues will be given by the additional services associated with apps (e.g. remote consulting).

3.2.1 Apps Categories

The market for mHealth apps can be categorized into two types: **consumer-oriented health apps** and **medical professional-oriented health apps**. Consumer-oriented health apps range from fitness and nutrition-related apps to apps for pregnancy assistance, medication adherence and monitoring, which allow patients to communicate with their doctors. Medical-professional-oriented health apps, on the other hand, are designed to provide assistance to healthcare providers in in-facility or remote patient management, treatment and clinical decision support, and allow access to information management systems and clinical databases [Glo12].

Further classification of apps include the 12 categories represented in Figure 4: Fitness, Medical reference, Wellness, Nutrition, Medical condition management, PHR – Patient Health Records, CME – continual medical education, Diagnostics, Compliance, Reminders and Alerts, Remote consultation & monitoring.

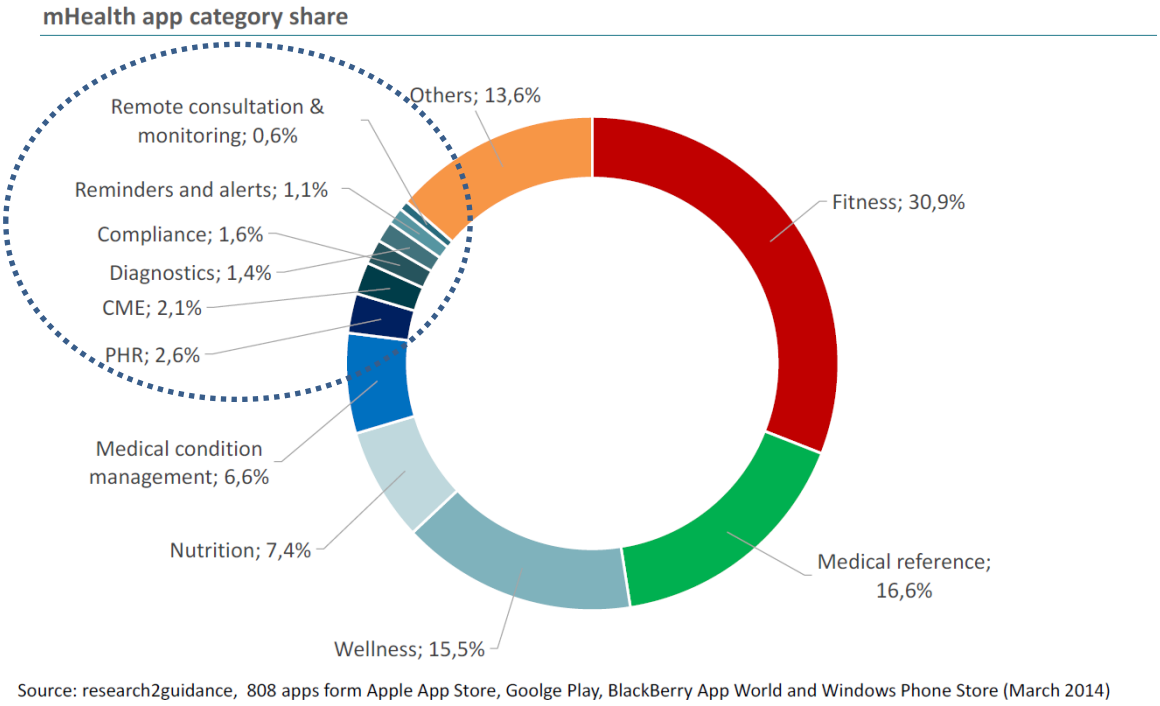


Figure 4 – mHealth App Category Share in 2014

At present, most health apps are targeting young cohorts of the population. ALFRED is targeting older populations (above 60 years) with a solution to improve their health and life quality. This is a relatively small market at the moment, but with a huge potential to increase.

3.2.2 mHealth Users

According to a PwC study commissioned by the GSMA, there are 185 million EU patients who could benefit from mHealth by 2017 if mHealth solutions are used to their potential [Pri13]. Of the total 185 million patients who can potentially benefit from mHealth, 141 million patients could improve their lifestyle to some extent through improving how they manage their medical conditions. 26 million of these are older people who could become more involved in managing their care and lifestyles (see Figure 5).

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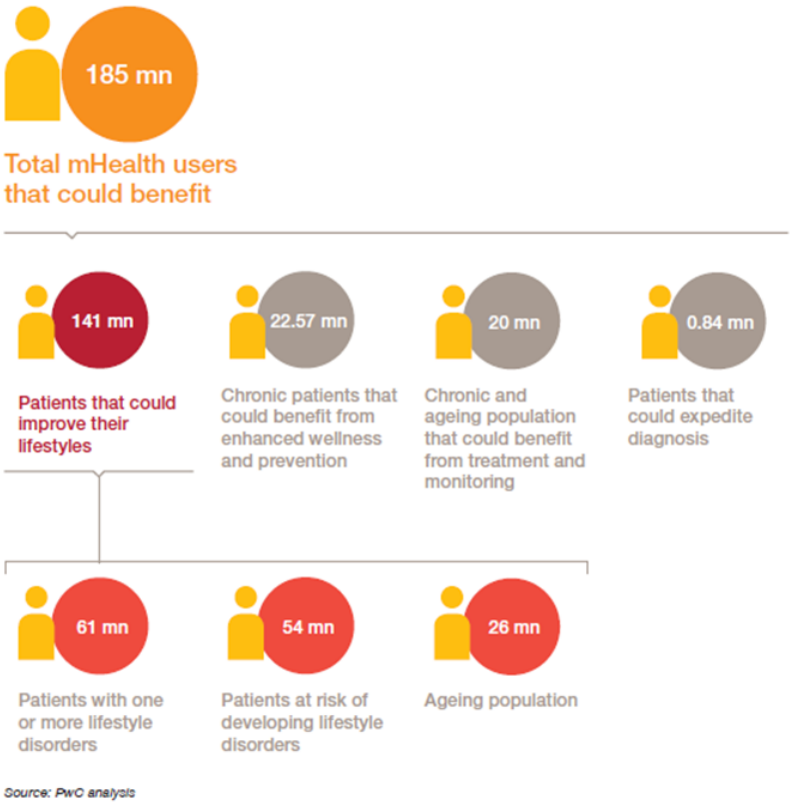

Figure 5 – Potential mHealth Users among EU Citizens in 2017

4 mHealth Stakeholders

mHealth market is still far from reaching its potential despite high levels of investment and excitement. Stakeholders from a wide range of industry sectors have been attracted to the mHealth market: Healthcare providers, Telcos, Medical Technology companies and Biopharmas are some examples.

Each stakeholder is interested in positioning itself in the market, in order to shape the ecosystem and capture the benefits generated. Because they are so diverse, each stakeholder brings in critical assets, though getting into mHealth implies -to a certain degree- a transition or adaptation in the way they are used to operate.

For stakeholders seeking to achieve long-term success in mHealth, the time has arrived to develop plans for capturing the opportunity. They need to develop the right capabilities in order to enter the mHealth market and get a competitive advantage over other players. Figure 6 (adapted from [Gro14]) shows some of the risks and success factors for the main mHealth stakeholders to succeed.

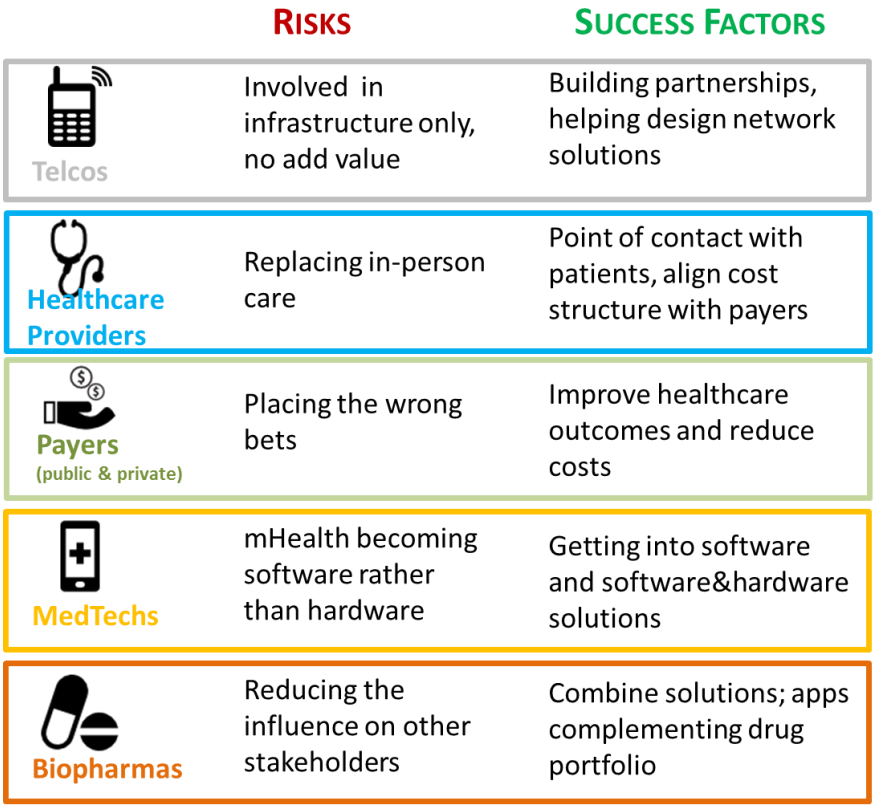

Figure 6 – mHealth Stakeholders Risks and Success Factors

5 Business Models for mHealth Apps

5.1 Introduction

A business model describes the rationale of how an organization creates, delivers and captures value, in economic, social, cultural or other. A possible way to describe a business model is through nine basic building blocks that show how a company intends to make money – the Business Model Canvas [Ost04] (see Figure 7 - rectangles highlight the areas that are more challenging in the mHealth arena and will be covered in this section). These nine blocks cover the four main areas of a business: customers, offer, infrastructure and financial viability. In ALFRED, it was decided to use the Business Model Canvas as a model to see how others are approaching the market, but also on how ALFRED might be doing so.

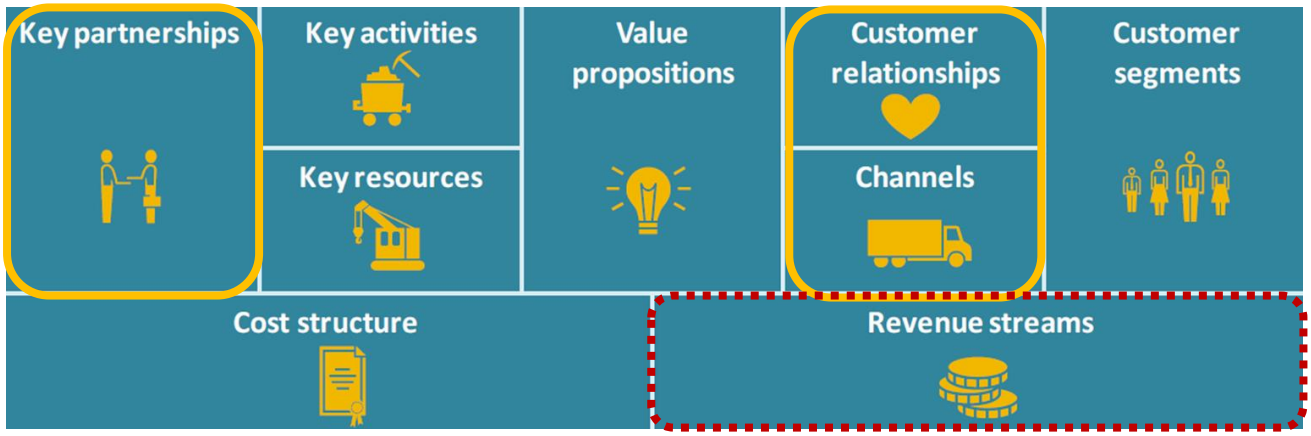

Figure 7 – Business Model Canvas

Despite having well-designed technologies and useful products, many technologies and services struggle with their implementation and entrance in the market. mHealth advantages are clear for stakeholders, patients and governments, but they lack a way to efficiently capture the value created.

The existing refund models seem not to be suitable for the mHealth, at least not without a level of customization. The greatest challenge is generating a viable revenue stream for the use of mHealth: both payers and consumers so far have showed only a limited willingness to pay for mobile health.

On the pricing, there are difficulties setting appropriate commercial prices which the public sector as main customer can afford and which also provide sufficient commercial return to the company.

The following section will introduce the main revenue streams models being used in mHealth. It will be shown how revenue streams are intimately connected with the customer relationships & channels, on one side, and with the key partnerships on the other.

5.2 Revenue Models

Innovative monetization strategies are being deployed to generate revenues for mHealth solutions that apply to a wide range of diseases and patients. Both public and private

sector have a role to play in ensuring that mHealth solutions receive adequate reimbursement. There are three models that have been used by other industries with the same limitations regarding the reluctance to pay. In these three models, the payer can be the public or the private sector. For each model a success case is described.

5.2.1 Free or Low-Cost Model

In this model the app will be offered for free or at a reduced price. The earnings will be generated through alternative revenue sources, like advertisement or the selling of additional services/features. As an advantage, this model fits the multiple elements characteristic of mHealth – e.g. app, sensor, remote patient service [Gro14].

Example: Patientslikeme is a website and app that educates the patients about their disease, allows them to track and manage their health status and also has a social component, where they can connect with patients who are in similar situations. In addition, it displays a real-time research platform with insights about patient's experiences. The information that members enter can be anonymized and sold to pharma companies, medical-device companies and others[2].

5.2.2 Premium Model

This model is intended for apps with unique value propositions that, when compared with the traditional healthcare, prove better or provide the same service at a reduced cost. It is especially suited for situations when the constant contact between user-doctor or user-caregiver is key, like in managing chronic diseases or as a tool for independent living of seniors. Nevertheless, it implies an educational challenge: both patients and payers need to be sensitive to the benefits of mHealth. In addition, payers demand a robust business case is to justify the payments required.

Example: Bluestar is the world's first mobile prescription therapy and was developed by WellDoc. It is an FDA cleared app for type 2 diabetes. For the patients, it provides real-time feedback and customized coaching. The info gathered and analyzed can be send to providers, helping them in their clinical decisions and following up on the patient status. BlueStar is available in some USA states as a reimbursed (by health insurers), prescribable mobile therapy. Many Fortune 500 companies have included it in their prescription benefit plans [3].

5.2.3 Outcome-Based Model

This model is in line with the general trend towards value-based health care and tie payments directly to measurable patient outcomes or cost savings. For this model to be successful, strong data analytics needs to be put in place. By linking the payments to measurable outcomes – reduced hospital admissions or doctor visits, for instance – the downside financial risk to payers and consumers is reduced. A clear alignment with payers for reimbursement rates is required in this model.

[2] http://www.patientslikeme.com/

[3] http://mobihealthnews.com/23026/welldocs-bluestar-secures-first-mobile-health-reimbursement/ http://spectrum.ieee.org/biomedical/devices/bluestar-the-first-prescriptiononly-app

Example: The Bosch HealthBuddy[4] system includes the easy-to-use Health Buddy four-button device (see Figure 8), the web-based Health Buddy Desktop application for providers and over 100 health management programs for a variety of single and co-morbid conditions. It has consistently demonstrated positive outcomes across a variety of disease states and settings through over 20 clinical trials in post-acute and chronic care coordination.

Figure 8 – Photo of HealthBuddy Device

For the patient, HealthBuddy offers support of self-management through daily sessions for symptom review, vital signs, education and coaching. It can be Bluetooth-connected with a bathroom scale, a blood pressure meter, an oximeter, among others. For the healthcare provider there is a desktop app where he can see the info analyzed, and risk areas pre-identified.

5.3 Distribution Channels

Distribution channel is the chain of businesses or intermediaries through which a good or service passes until it reaches the end consumer. In mHealth the main distribution channels are, the traditional healthcare providers: physicians, hospitals and pharmacies. Together, these channels form one side. On the other side are the apps stores and the Healthcare webpages. According to a research2guidance report, traditional healthcare players, like physicians and hospitals, will become the most relevant distribution channels for mHealth market (see Figure 9). This forecast is aligned with the maturation of the mHealth market that should reach a phase of integration within the healthcare processes in the next years.

[4] http://www.bosch-healthcare.com/en/us/products/health_buddy

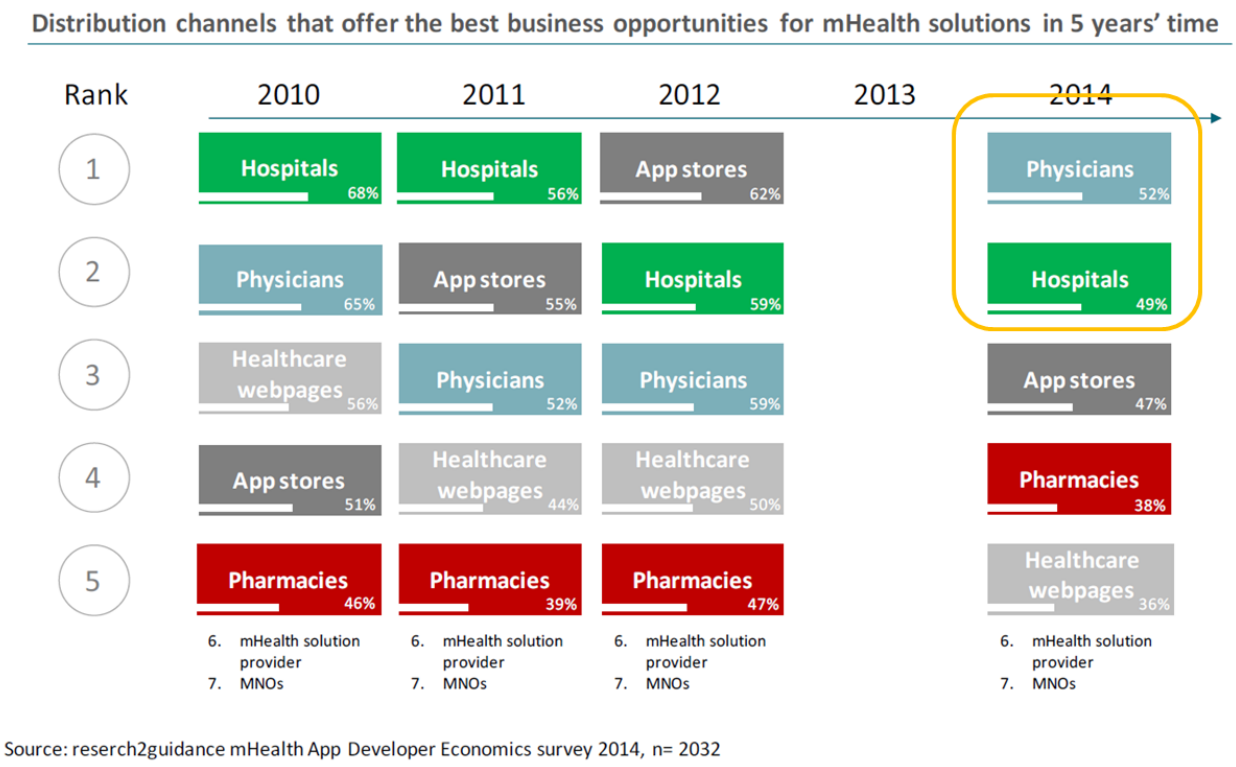

Figure 9 – Distribution Channels Offering the Best Business Opportunities

According to this report, physicians have and will play a key role in the adoption and implementation of mHealth, as they are main point of contact for the patient. Physicians are highly regarded by patients and they have the power to largely influence the patient behavior towards the use of mHealth.

Different key opinion leaders have recently pointed that the future in healthcare will pass by physicians prescribing an app instead of a drug. As a matter of fact, some recent studies revealed that the patients are more willing to accept a prescription for an app rather than for a drug[5].

In any case, the business model for a new app can consider more than one distribution channel, for instance through the hospitals and also available in app stores. Due to their characteristics, most apps are available for download in at least one of the apps stores present in the market. In the next section, an analysis of the apps stores where mHealth apps are available is provided.

5.3.1 Apps Stores

App stores still play a dominant role in the discovery and download of mHealth apps today. While their ranking as the most relevant distribution channel for mHealth apps has fluctuated over the course of the last years, they have always remained in the top five (see Figure 9). Beside the app stores from Apple, Google and other generalists, there are more and more purely mHealth-dedicated app stores like myHealthapps and App RX by Health

[5] http://mobihealthnews.com/23418/most-patients-want-their-doctors-to-prescribe-apps/

Tap. These specialized app stores offer a pre-selection of mHealth apps with better discoverability, enriched app description and doctors' app ratings (see Figure 10).

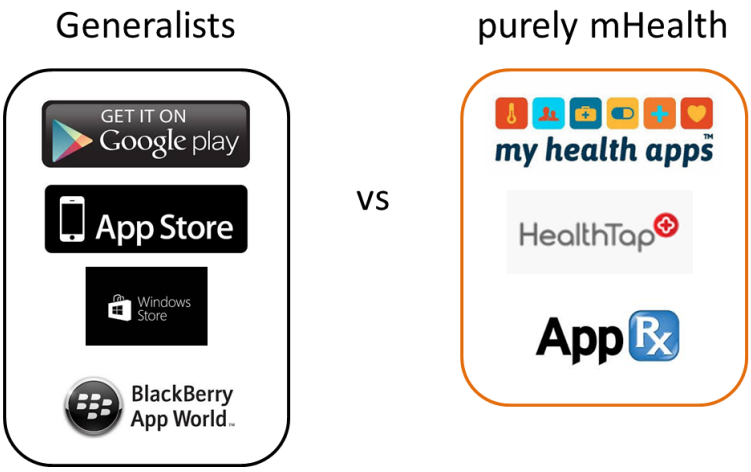

Figure 10 – Infographic: Selection of App Stores Present in the Market

According to recent estimations 97,000 mHealth apps are currently available across multiple platforms on the global market [Res13]. The task for the consumers/patient, to choose which app to download and use from the hundreds of apps available for a specific medical indication is getting harder. Consumers have been looking for some guidance and categorization of mHealth apps in order to perform a better decision. Myhealthapps and HealthTap+AppRx are two app stores that provide an analysis on the available apps helping the patients choosing which one to use for their particular clinical setting.

Example: my health apps was created following the First European Directory of Health Apps recommended by Patients and consumers. Myhealthapps display apps recommended by healthcare communities from all over the world, including empowered consumers, patients, carers, patient groups, charities and other not-for-profit organisations. A rating system is used that classifies the apps according to 5 criteria:

- Helps you control your condition /keep you healthy
- Is trustworthy
- Is easy for you to use
- Allows you to network with people like you / who understand you
- Can be used regularly

Some apps are for free, some must be purchased and some are for free but the tutorial – essential to be able to work with the app – needs to be purchased. Myhealthapps is a Partnership between: PatientView, European Health Forum Gastein, GSK, Janssen, Novo Nordisk, O2/Telefonica and Vodafone Foundation.

Example: HealthTap provides users with immediate access to top medical experts and their trusted health advice anytime, anywhere. It recently included the feature AppRx. In addition to replying patients' questions, the doctors can also recommend them apps for improving their health status. Healthtap works with a freemium model: parts of the services are given for free while other parts need to be paid. These parts include more advanced features as real-time appointments with physicians.

5.3.2 Apple Introducing HealthKit

Last June, Apple unveiled HealthKit, a new app bundled with iOS 8 that is designed to help users keep better track of their personal health and fitness data. HealthKit appears simply as "Health" on the iPhone home screen, and provides an easy-to-access dashboard where you can monitor important health metrics on a daily basis, while also stepping back to examine your fitness trends over a longer period of time (see Figure 11).

Figure 11 – Screenshot - Preview of Apples HealthKit

Health apps have proven tremendously popular with consumers, and this represents Apple's attempt to make a grand entrance — at least among iOS users. Essentially, HealthKit proposes to integrate and analyse data captured from various apps and devices, providing a holistic view of a user's health & fitness, empowering patients to interact with physicians and actively participate in their care. As the telehealth market attracts stakeholders from wide range of industry sectors, acquisitions and strategic partnerships have paved the way for several players to offer solutions and services to this market. Apple's competitive advantage also seems to lay on the key partnerships they have established:

- **Mayo Clinic**: Mayo Clinic has recently been awarded the prize for best Hospital of U.S. in 2014-2015[6]. Mayo Clinic is testing a service to alert patients when their Apple apps detect abnormal health results, and help schedule them for follow-up visits.
- **EPIC**: Epic is considered by many the Microsoft of Electronic Medical Records. Epic covers more than 50% of patient's EMR in the United States, and that number is rapidly growing[7]. Apple's HealthKit is expected to automatically integrate its data with MyChart, Epic's personal health record portal that is used by millions of patients in the U.S.

[6] http://health.usnews.com/best-hospitals/rankings
[7] http://www.imedicalapps.com/2014/06/apple-partnership-epic-game-changer/#bibliography

- **Nike**: Nike is working to integrate HealthKit so that its Nike+ app using Fuelband can incorporate nutrition and sleep information so as to be able to create a more bespoke fitness regime for users.

6 mHealth: Opportunities and Challenges

In this document, a characterization of the mobile Health market is provided. Although the mHealth benefits are apparent, there is a huge gap between current market size and five-year projections. mHealth poses both interesting opportunities and also challenges that need to be overcome so all stakeholders can benefit the most from the value generated. The major opportunity of mHealth resides in the chance of improving the health and social care provided to citizens while reducing healthcare costs – ***doing more with less***. A recent study from PwC on the socio-economic impact of mHealth in the EU showed that the use of mHealth could directly save 99 million EUR in healthcare costs already by 2017 if mHealth is fully adopted [Pri13] (see Figure 12).

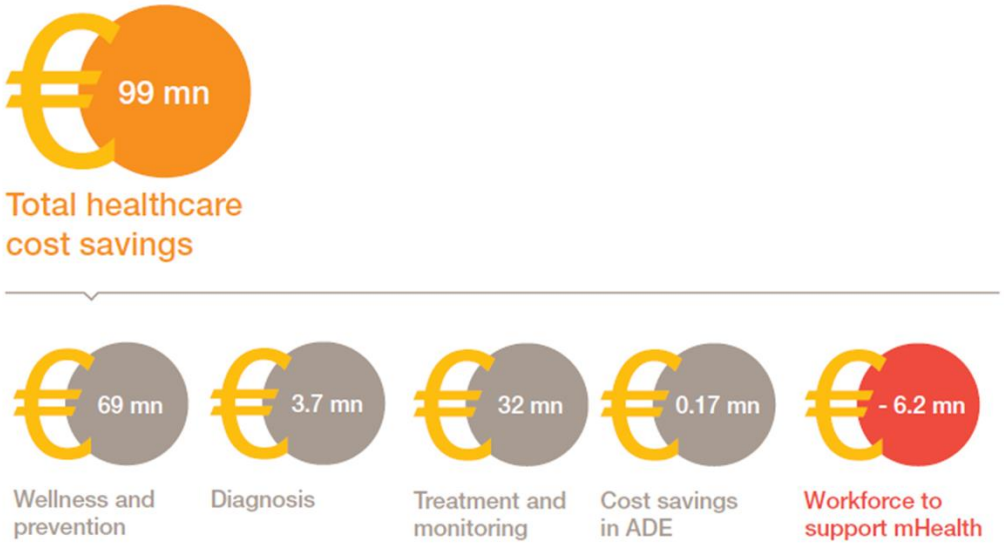

Figure 12 - Forecast of Direct Healthcare Cost Savings in EU by 2017 If mHealth is Fully Adopted

In many cases, the technology is ready and the major issue concerns the creation of sustainable business models for these mHealth solutions. The fact of being the most accessible device makes of the smartphones the No.1 connected device nowadays. By 2019, almost everybody in the world will have a device which could be targeted with a mHealth solution [Res13].

mHealth technologies have a high penetration rate among MDs. Doctors are typically savvy for new gadgets and technology related issues. Also, they realize the potential for improving the communication with their patients and increasing compliance and adherence to treatments. Nevertheless, mHealth solutions need to be integrated in the actual healthcare provision system. This may be challenging at times, especially because the complex organization of many healthcare systems. As mentioned before, physicians will have a key role in encouraging behaviour change in the patients, as well as promoting innovation in the healthcare delivery models. Part of their role will be in creating awareness on the benefits of empowering the citizens to manage their own health.

The complexity of healthcare service organizations, with different paying processes especially in EU, the types of users – older people, caregivers, healthcare providers and

developers – and the industry wide stakeholders establish a difficult but also full of potentialities setting for implementing mHealth solutions. Customers have been showing that they want interconnectivity among different devices and apps, while having their privacy assured. Some past initiatives (e.g. GoogleHealth) may have not worked because the market was still not ready but also due to lack of clarity on what they were doing with users' data. Alongside, there is still a lack of standardization and regulations for mHealth apps. Finally, and as mentioned previously, stakeholders show reluctance to pay for these solutions. On the pricing, there are difficulties setting appropriate commercial prices which the public sector as main customer can afford and which also provide sufficient commercial return to the company.

As mHealth solutions often have several features: the app, sensors, and services, the scenario seems ideal for the establishing of win-win partnerships among the stakeholders. The right partnership may allow each participant to capture the biggest benefit from mHealth.

7 Technology Watch

7.1 Pillar I User-Driven Interaction Assistant

7.1.1 Current maturity and technological development

Spoken interaction is a central aspect of the ALFRED project. Technically, verbal interaction between the end user and the ALFRED system will be handled by a component called Context-Aware Dialogue Engine (CADE). CADE will be based on Talkamatic Dialogue Manager (TDM), a commercial platform for building spoken dialogue systems. It is one of the technologically leading dialogue managers on the market today, with built-in support for rapid development, multimodal interaction, grounding (making sure that all participants in a dialogue agree on what has been said and what it meant), topic-shifts (the ability to keep track of multiple topics), and accommodation (support for integration of relevant, but not requested, user utterances). It also supports context-aware interpretation which can be used to boost speech-recognition accuracy.

The stability and maturity of TDM has been successfully validated in academic user studies.8 The technology is also continuously tested and improved in other ongoing projects such as SIMPLI-CITY and Socializing Around Media (both FP7). However, so far no commercial deployments of the technology have been made. For this reason, TDM's degree of maturity remains difficult to assess.

In terms of anticipated work in ALFRED, the dialogue component will adapt and extend TDM in several ways in order to fulfil the various project requirements. In the frontend subcomponent, running on the end user's device, support for Android will be added. This adaptation has already started in the project SIMPLI-CITY, but will not be finalized when implementation in ALFRED is planned to start.

Additionally, various improvements will be needed in order to satisfy privacy and security requirements. These improvements involve all three subcomponents (frontend, session manager and backend).

In the backend subcomponent, running on a server, support for multiple dialogue domains needs to be added. This involves the ability of the system to handle multiple ALFRED apps. Support for interpreting dictated input is also anticipated.

Finally and perhaps most important for the project outcome, various improvements will be made in order to address foreseen challenges when dealing with older users. These improvements will aim at enhancing grounding mechanisms and increasing the speech recognition accuracy. The foreseen improvements have a significant research element and are highly exploratory in nature, although previous related research documented in the literature will naturally be consulted. The DoW specifically mentions three research directions: interactive and incremental grounding, improved re-ranking of hypotheses and

[8] For example, see Larsson et al. Visual distraction test setup for a multimodal in-vehicle dialogue system. 2013. In *Proceedings of the 17th Workshop on the Semantics and Pragmatics of Dialogue*; Kronlid et al. Using Learned Predictions of User Utterances to Decrease Distraction. 2013. In *Proceedings of the 17th Workshop on the Semantics and Pragmatics of Dialogue*.

language model optimization. Additionally, the iterative development process of the ALFRED project where end users are involved continuously and frequently, will in itself guarantee a sound empirical approach to the anticipated challenges.

7.1.2 Decision to rely on standard commercial speech recognizers

The usefulness of a spoken dialogue system significantly depends on speech recognition accuracy. This is especially true for older users. In ALFRED, several strategies will therefore be employed in order to improve speech recognition accuracy and to deal with misrecognitions.

First and foremost, the project generally adopts a user-driven approach with iterative evaluations involving actual end users. This will provide frequent and detailed feedback to the project partners, guiding prioritizations and enabling difficulties and weaknesses to be highlighted in an early stage.

Furthermore, the ALFRED system will use Talkamatic Dialogue Manager (TDM) and its sophisticated feedback and grounding mechanisms which aim to ensure that the participants in the dialogue understand each other. TDM's ability to interpret speech recognition hypotheses in the light of context (such as dialogue history) will also provide a useful source for improvements of accuracy. Importantly, ALFRED will extend TDM's contextual interpretation and its mechanisms for grounding and feedback by performing experiments and by collecting data and observations from end users.

Additional improvements to speech recognition are expected by optimizing the language model of the recognizer, both online (machine learning) and offline (using analytics tools).

The strategies outlined above can be summarized into the following directions: improving general dialogue capabilities and post-processing ASR hypotheses. None of these directions depend on the speech recognizer itself, and can be combined with any standard ASR product.

As another option, it would also be possible to develop an ASR specifically for older users. However, the consortium lacks experience in this field. Additionally, support for several languages is required in the project. The development of a target-group adapted ASR would therefore have been very costly for the project in terms of resources, and was not conceived to be a realistic option.

Nevertheless, if some other player on the market would release an ASR for older users, it could be combined with the ALFRED solution in order to further boost the speech recognition accuracy. This extensibility constitutes a unique and significant business value for ALFRED.

The anticipated approach also has the benefit of being target-group independent. From a business perspective, this is especially valuable for Talkamatic, whose product will benefit from the developed improvements in use cases that go beyond ALFRED and its target group.

Table 1: User-Driven Interaction Assistant

Technology that will be used/under development	The Talkamatic Dialogue Manager, which will be refined in order to make speech recognition more accurate and error handling/grounding more efficient and robust
Innovative aspects and advantages of the technology that will be used/under development	• Grounding will happen in real time, meaning a more natural way of signaling understanding/non-understanding in the conversation • Making use of user model data in order to make speech recognition more accurate by applying it to N-best output from recognizer unit. • Language model optimizations
Alternatives in the market for the offered technology (name of the product/service and the company	There are no commercial alternatives for this technology available in the open market. The alternative is to build speech interaction from scratch, more or less.
Other benefits (more revenue, less cost ...) that ALFRED technology will provide to the potential buyer.	This technology means considerable less costs when extending the functionality of the system, and leads to a better user experience when it comes to using the system.
Emerging Technologies identified as (possible) future competitors	WIT.ai, recently bought by Facebook. Nuance Nina. Sooner or later Apple's Siri will be developed with older users in mind. Sooner or later, Google Now will be adapted to needs of older users.
Where to keep updated on this info	http://opusresearch.net/wordpress/

7.2 Pillar II: Personalized Social Inclusion

7.2.1 Current maturity and technological development

As described in the Dow, social isolation is a serious problem of older people. The ALFRED project aims to reinforce the social inclusion of older people. Users of the ALFRED app will receive personalized recommendations for events. These recommendations will be based on information about the user (with users' consent) to suggest events that would be both interesting and beneficial for them. The types of information include personal information, health related information and historical data (previous social activities).

The most widely used approach for personalized services is the use of graph based models, such as ontologies. This approach is good but presents problems in inserting the data in the model - it takes time and programming effort. Also, usually applications provide personalization based on data from a single domain such as eHealth or e-commerce. In the ALFRED case, data are originating from various domains (health, personal, events) so the consolidation of the data to a single model is even more challenging. By work within ALFRED such as related research and State-of-the-Art use partners envisioned a new approach for personalization, using the latest technologies in data storage and analysis. The user related information will be stored in NoSQL databases which are able to work with heretogeneous data and schemas. Also machine learning applications and frameworks will also be used for the suggestion of events. To our knowledge (based on our research) there are similar approaches (still in early stages of development and experimentation) in the eHealth domain, however not focusing on the personalized social inclusion aspect – they are either focusing on personalized eHealth or on social inclusion (lacking the personalized aspect). Most importantly there is not a ready solution, a component already in existence that can be taken as is and used in the ALFRED system to perform the social inclusion services of the application.

Table 2: Pillar II: Personalized Social Inclusion

Technology that will be used/under development	Functionalities that will provide personalized recommendations for events to reinforce the social inclusion of ALFRED users (older persons)
Innovative aspects and advantages of the technology that will be used/under development	Use of latest technologies for "Big Data" (NoSQL databases, machine learning frameworks, etc.), in order to overcome the data consolidation and analysis challenges.
Alternatives in the market for the offered technology (name of the product/service and the company) - >should match the info in the database excel list.	Similar ICT based social inclusion services already exist, such as: - ACTing: Social Agents Promoting Active Ageing through ICT[9] - Co-LIVING: An Innovative Social Community Network[10] However, they lack (in our opinion) the personalized aspect of ALFRED which will make its services much more attractive.
Other benefits (more revenue, less cost ...) that ALFRED technology will provide to the potential buyer.	Primarily use of open source frameworks and work within the ALFRED project will decrease the cost for having this functionality and thus ALFRED as well. More control over the developed component thus ensuring the necessary security requirements for the users' information
Emerging Technologies identified as (possible) future competitors	No direct potential competitor identified yet
Where to keep updated on this info	It is difficult to point to specific sources for being kept up-to date regarding the market and competitors of such services. However, ALFRED partners try throughout the project to keep contact with the market and new products from initiatives and websites in the domain such as: - http://carerplus.eu/ - http://www.aal-europe.eu/ and of course other EU funded projects in the domain

[9] http://www.acting4elderly.eu/
[10] http://www.project-coliving.eu/

7.3 Pillar III: Effective & Personalized Care

7.3.1 Current maturity and technological development

The current evolution of the traditional medical model toward the participatory medicine can be boosted by the Internet of Things (IoT) paradigm involving sensors (environmental, wearable, and implanted) spread inside domestic environments with the purpose to monitor the user's health and activate remote assistance. Several years ago wearable computing failed to produce any notable success stories on the consumer front, but advances in materials sciences, battery power and chip evolution have made the possibilities for wearables grow for the next years.

The fact that big brands and fitness-device manufacturers are making significant investments in this area is an indicator that wearables will become a mainstream for devices in the coming years. Another point is that wearables may have many more application opportunities than mobiles in this respect, and they could potentially be the form factor for future mobile phones beyond the platform as we currently see it.

The market for "wearable" devices or electronic devices designed to be worn over our body houses growing projections of 600% in four years, as indicated from the company Blue Coat Systems based on data from IDC Research. According to this, glasses, smart watches, bands for exercise and other devices for the health sector added nearly 112 million units, in a market with a value of 19,000 million for 2018.

Last investigations and new developments are focusing on the software and hardware, developing new electronics, new chips more resistant and with more autonomy with less battery consumption, and low energy connections. Also data treatment is experimenting new advances, implementing solutions with Big Data which give new possibilities for massive interconnections for the upcoming future. Different initiatives are appearing in this way like “wiki-health” or “patientslikeme” combining and sharing information of different users obtained from different kind of sensors.

One of the most innovative aspects of ALFRED in this field, is the development of a new approach which gives the possibility to interconnect different wearable devices to the same system in order to keep a track on the information coming from different sensors, even from several commercial devices from different brands or ad hoc sensor solutions developed for an specific purpose in one single platform. In addition, ALFRED also allows sharing the information between Pillars for offering personalized services according health condition of the users.

Table 3: Pillar III: Effective & Personalized Care

Technology that will be used/under development	Textile sensors Bluetooth Low Energy Storage system for vital signs
Innovative aspects and advantages of the technology that will be used/under development	Open to different Bluetooth sensor devices Adapted cloth design for elderly people Selection of sensors for use in monitoring elderly people Easy to connect and maintenance Easy to recharge battery with wireless solutions

Alternatives in the market for the offered technology (name of the product/service and the company) - >should match the info in the database excel list.	WikiHealth: Big Data infrastructure for Social Wellbeing HealthKit: iOS API that allows develop applications with the user's permission, to access health data. Equivital (UK): Heart rate & breath monitor FitnessSHIRT (GE): Heart rate & breath monitor Heapsylon (USA): Heart rate monitor Hexoskin (CA): ECG signal, breathe & movement Nuubo (ES): ECG and position monitor Smart Sensing (FR): Heart rate and breath monitor Textronics (USA): Heart rate monitor Weartech (ES): Heart rate monitor Wello (USA): ECG, blood pressure, heart rate, blood oxygen, temperature Basis (USA): Heart rate, accelerator, sweet levels, temperature
Other benefits (more revenue, less cost ...) that ALFRED technology will provide to the potential buyer.	Selection of specific applications for elderly Specific algorithms designed to specific situations Scalable solution for increasing number of sensors
Emerging Technologies identified as (possible) future competitors	Watch & band sensors Flexible electronics Energy harvesting Nano-enabled sensor technologies Optical sensors Big Data
Where to keep updated on this info	http://www.wearable-technologies.com/ http://mashable.com/category/wearable-tech/ http://www.wearabletechworld.com/ http://www.gizmag.com/ http://www.talk2myshirt.com/ http://www.innovationintextiles.com/ http://www.smartfabricsconference.com/ http://www.wearabletechnologyshow.net/ http://www.wearablesdevcon.com/ http://www.iswc.net/

7.4 Pillar IV: Serious Games for Physical & Cognitive Impairments Prevention

7.4.1 Current maturity and technological development

The contributions of ALFRED's Pillar IV ("Serious Games for Physical & Cognitive Impairments Prevention") are twofold. First, Pillar IV will conceptualize and develop the "Game Manager" component, which acts as a mediator of sorts between the rest of the ALFRED system and the serious games that run as applications ("extensions") on the ALFRED user's device. The development of an initial set of such serious games, at least five, is the second responsibility of Pillar IV.

One of the Game Manager's main tasks is the meaningful selection of games from the set of all games (as available from the ALFREDO marketplace) which are suited for a specific user. To this end, the Game Manager needs to be able to compare the user's profile to the game's specifications and to then pick those games that best match the user's preferences and needs. This requires a machine processable formalism that allows describing both the user profiles and the game specifications. While similar approaches exist for example in the area of geospatial data processing[11], there are no solutions for matching user profiles against serious game descriptions. In this regard, the development of a "metadata format for serious games" is one of the main research areas of Pillar IV. This formalism should be based on the XML syntax [http://www.w3.org/XML/], which is the de-facto standard for structuring and exchanging plain text information across distributed systems.

As pointed out, Pillar IV is also tasked with the development of five serious games for physical and/or cognitive impairments prevention. Among others, Pillar IV will provide a smartphone-based multiplayer dancing game for senior ("silver") players, an indoor TV-screen based fitness game for sense-of-balance improvement, and a cognitive training game. With the high diversity of these games comes a broad range of technologies and standards used and as such, it is difficult to identify a set of "core technologies" that will be utilized and possibly even improved by the games research and development conducted within Pillar IV. Generally speaking, however, established approaches and technologies will be used wherever possible for the game development, such as the Java for Android programming language, the Unity games engine [http://unity3d.com/], or the Bluetooth protocol for device communication. The game development of Pillar IV will as such focus less on the advancement of existing technologies, but rather on how to achieve the creation of measurable (positive) effects on their players, such as an improvement of the player's wellbeing.

[11] Stefan Goebel, Karen Lutze: "Development of meta databases in the WWW", Springer.

Table 4: Pillar IV: Physical & Cognitive Impairments Prevention

Technology that will be used/under development	Java for Android and XML for Game Manager component. Java for Android, Unity Game Engine and smartphone sensors, wearables and other sensor technologies (e.g., Nintendo Wii balance boards) for serious games.
Innovative aspects and advantages of the technology that will be used/under development	The creation of a XML-based metadata description format for serious games is the main scientific innovation in Pillar IV. Possibly adaptations to existing hardware drivers required for development of serious games.
Alternatives in the market for the offered technology (name of the product/service and the company) - >should match the info in the database excel list.	Considering that serious games are becoming increasingly popular and that there is even a special term for such games if made specifically made for senior players (“silver games”), the amount of companies actually producing and selling such games is surprisingly small. Usually, serious games are made by scientists at research institutes and provided to close-by elderly care facilities, if at all shared with end-users beyond an initial scientific testing phase. In this regard, there are no real alternatives to the ALFRED games on the market, simply because that “market” does not exist yet. The ALFRED project hopes to be able to help establishing such a market for silver games by providing serious games that are both fun and effective.
Other benefits (more revenue, less cost ...) that ALFRED technology will provide to the potential buyer.	The game metadata description format will allow an automatic matchmaking between a user’s wants and needs on the one hand, and the available applications (i.e., games) on the other. In the future, such approaches could help to improve all types of commercial online software distribution platforms.
Emerging Technologies identified as (possible) future competitors	Regarding the production of indoor serious games, especially Microsoft and Nintendo have been tapping into this field in the past, but despite high commercial successes (*Wii Sports* has been the best-selling video game ever) they did not pursue the respective product lines. In regard to mobile serious games, only a very few commercial games exist up-to-date (such as the exergame “Zombies, Run!” by British software company Six to Start). However, considering the success of gamified fitness tracker applications (Nike+, Runtastic), wearables (Jawbone Up, Nike Fuelband) and mobile health technologies (Apple HealthKit, Google Fit), it seems likely that mobile serious games, especially mobile exergames, will become much more prominent in the coming years.
Where to keep updated on this info	Since at this time the majority of serious games are a product of scientific research, updates on new findings can mostly be found in scientific journals and on scientific conferences, such as the “Games for Health” journal or the ““IEEE International Conference on Serious Games and Applications for Health”. For a full list, see ALFRED deliverable 9.4 (“Dissemination Report”). News on advances in the mobile health sector, including wearables and fitness applications, can best be found on news sites dedicated to technology, such as http://techcrunch.com/ and http://www.wired.com/.

8 Conclusion

The ALFRED project is focused on developing applications for older people that meet the needs of the users and, at the same time, the ones of the Market. In this document, a market analysis, identification of commercial solutions and interesting business models are provided. This will allow project' partners to a) have a deep knowledge into the market and b) to take lessons learnt from these examples when creating the ALFRED exploitation and business plan in the WP9.

This task "Market and Applicability Watch Report", which covers the whole project duration, allows keeping the project synchronized with the outer world and will ensure that there is a structured way of feeding in new information into the project. Also, it takes into account the post-project phase.

In such a relatively new market as is mHealth apps, timing is identified as a key factor for succeeding. Some success cases of mHealth are presented in this document, but none of them tackles the specific need of older people.

The market analysis provided in this deliverable will not only help to develop the ALFRED applications but will also increase the possibilities of a successful launching of ALFRED as a profitable business at the end of the project.

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