A Demonstration of 4D Digital Avatar Infrastructure for Access of Complete Patient Information

Project acronym: MyHealthAvatar

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Exploitation plan

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PP	Restricted to other programme participants (including the Commission Services)	
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ABSTRACT:
In order to ensure a successful project cycle, careful dissemination and exploitation strategies are essential. The exploitation strategy concentrates on the project's results to reach sustainability after the project ends. During exploitation we collect ideas from a wide range of stakeholders about how to use the project product and results at local, regional, national, European, and/or international levels.

KEYWORD LIST:
academic exploitation, commercial exploitation, market description, tangible assets, intangible assets

[1] **R**=Report, **P**=Prototype, **D**=Demonstrator, **O**=Other

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Content

1 Executive summary

At the two-thirds mark of the project, this deliverable presents an exploitation plan for MyHealthAvatar (MHA). The word MHA in this context means the outcomes of the project, consisting of tangible assets (the MHA framework and its components) and intangible assets (services, knowledge). The document discusses our approach taken, describes the market around our prototype and charts progress and plans towards exploitation. The document includes several different exploitation aspects, but there is a special focus on the commercial dimension.

Successful exploitation and sustainability of MHA results is a major objective of the project. As a tool to enable exploitation, this plan includes all the important aspects: (1) results to be exploited; (2) stakeholders; (3) possible models of exploitations and (4) a preliminary analysis of the fit between these results.

2 Introduction

2.1 Project Background

Owing to the highly fragmented health systems in European countries, gaining access to a consistent record of individual citizens that involves cross-border activities is very difficult. MyHealthAvatar is an attempt at a proof of concept for the digital representation of patient health status. It is designed as a lifetime companion for individual citizens that will facilitate the collection of, and access to, long-term health-status information. This will be extremely valuable for clinical decisions and offer a promising approach to acquire population data to support clinical research, leading to strengthened multidisciplinary research excellence in supporting innovative medical care.

MyHealthAvatar will be built on the latest ICT technology with an aim of engaging public interest to achieve its targeted outcomes. In addition to data access, it is also an interface to access integrative models and analysis tools, utilizing resources already created by the VPH community. Overall, it will contribute to individualized disease prediction and prevention and support healthy lifestyles and independent living. It is expected to exert a major influence on the reshaping of future healthcare in the handling of increased life expectancy and the ageing population in Europe. This complies with the priority and strategy of FP7 ICT for healthcare, and constitutes a preparatory action aiming at the grand challenge on a "Digital Patient", which is currently the subject of a roadmap in the VPH community.[3]

The MyHealthAvatar project will focus on research and demonstration actions, through which the achievability of an innovative representation of the health status of citizens, named 4D MyHealthAvatar, will be explored. The 4D Avatar is anticipated as an interface that will allow data access, collection, sharing and analysis by utilizing modern ICT technology. It is expected to become the citizen's lifelong companion, providing long-term and consistent health status information of the individual citizen along a timeline representing the citizen's life, starting from birth. Data sharing will be encouraged, which will potentially provide to an extensive collection of population data to offer extremely valuable support to clinical research. The avatar will be equipped with a toolbox to facilitate clinical data analysis and knowledge discovery.

MyHealthAvatar can be described as a personal bag carried by individual citizens throughout their lifetime. It is a companion that will continually follow the citizen and will empower them to look after their own health records. This fits very well into the recent trend of developing patient-centred healthcare systems.

2.2 Structure of the document

The exploitation plan is structured as follows:

1. A market analysis was performed in order to position MHA. The market analysis provides an insight of the health IT market landscape including trends, the multitude of different stakeholders and competing solutions.
2. The exploitation framework describes the methodology that we used in creating the plan, lists and introduces exploitation results, explains the plan from several important aspects, e.g. commercial v. academic exploitation, IP and other protection etc.

[3] MyHealthAvatar project, Description of Work (DoW) document.

3. The outcomes that can be the base of commercial exploitation are placed in three distinct categories: (1) MHA as a functional prototype; (2) tangible assets; (3) intangible assets. Apart from individual analysis the linkages between these parts are also uncovered.
4. Academic exploitation activities are examined from another perspective, the individual project partners activities and roles in the exploitation process. In this section we also consider possible cooperation with related European projects.

In addition to this exploitation plan a full business plan will be provided for the MHA sustainability longer term objective in M36. The business plan builds on the exploitation plan and also includes additional research results.

2.3 Scope of the document

The objective of this document is to present the various exploitation possibilities for the MHA project and also describe activities that are linked to these possibilities. Exploitation activities should spread the results among the internal and external communities to ensure sustainability after the official end of the project.

In order to ensure a successful project cycle, careful dissemination and exploitation strategies are essential. Dissemination activities have been performed from the start of the MHA project, the exploitation strategy concentrates on the project's results during the later stages and afterward to reach sustainability after the project ends.

The term sustainability means the following:

- the developed products are used as the basis for further research activities by (1) the partners; (2) new projects; (3) business entities; (4) public institutions;
- these products/services are used in real world contexts.

To enable the transition from an R&D setting to commercial use, important stability and ease of adaptation requirements should be met. During validation, specific activities will be undertaken to create a complete picture of all these requirements. The results should clarify the best way to exploit each result, including any need for further R&D.

Finally, this document aims to create a common view for all MHA partners of these exploitation activities. It states how the outcomes should be promoted to support the adoption and use of the product in different academic, educational, and commercial environments.

3 Market description

3.1 Industry – Health IT infrastructure

Citizens' health is a core EU priority. To achieve a high level of human health and quality of healthcare across the EU, a significant number of challenges must be overcome, some of the most important ones being: (1) sustainability; (2) an ageing population; (3) reducing the incidence of preventable diseases; (4) health inequalities[4]. The wider application of information technology (IT) in health care settings is an important tool in tackling all of these challenges (and more) and has therefore drawn significant attention and investment. Today technology is increasingly playing a role in almost all processes, from patient registration to data monitoring, from lab tests to self-care tools.

3.1.1 IT and Healthcare – so close yet so far apart

In the past four decades societies in general, and medicine and health care in particular, have tremendously changed, also by the developments of information technology (IT). Through this change health care has been significantly impacted and improved. We can hardly imagine diagnostic procedures without imaging tools, or therapeutic actions without the software that checks for medication interactions or uses computer-assisted tools for surgery, or without accessing and recording patient data in electronic records as part of computer-supported hospital information systems[5]. IT and health care are now inseparable.

On the other hand healthcare (together with education) is the domain worldwide least affected by information technology. Most of data recording in clinical trials is still paper based, personal pagers and analogue fax machines are still used widely in clinics and hospitals even in the most developed countries and it is not unusual for a patient to have to act as his or her own courier in hand delivering records while visiting different specialists[6]. Everybody agrees that the technology infrastructure is way behind what it should and could be.

But what is it that makes healthcare lag behind so much despite the number of high-tech electronic devices used in the industry? The answer to this question is in reality quite simple: lack of connectivity. Everywhere else in our lives, our information follows us. We can access our bank accounts online or at any ATM, we can keep in touch with friends from any corner of the globe through Facebook. But doctors can not send a patient chart to another doctor (or the patient for that matter) across town electronically. One of the biggest challenges that the health industry faces today is to establish links between separate and independent data silos containing a wealth of information that is extremely hard to access and share.

[4] http://europa.eu/pol/pdf/flipbook/en/public_health_en.pdf

[5] http://sgraham745.net/uni/Semester%201/Health%20Informatics/lectures/week%201/Medical%20Informatics%20Past,%20Present%20and%20Future%202010.pdf

[6] http://www.usatoday.com/story/cybertruth/2013/05/07/meaningful-use-electronic-medical-records/2142811/

3.1.2 Data interoperability – the future of healthcare

There are a multitude of initiatives around the globe to help solve the problem of connectivity. Although these initiatives have vastly different origins, aims and implementation methods, there are basically two main approaches. To understand these, we have to first understand the concepts of Electronic health records (EHRs) and Personal health records (PHRs):

- EHRs are built to go beyond standard clinical data collected in a provider's office and are inclusive of a broader view of a patient's care. EHRs contain information from all the clinicians involved in a patient's care and all authorized clinicians involved in a patient's care can access the information to provide care to that patient.
- PHRs contain similar information as EHRs - diagnoses, medications, immunizations, family medical histories, and provider contact information—but are designed to be set up, accessed, and managed by patients. Patients can use PHRs to maintain and manage their health information in a private, secure, and confidential environment.

In the EHR based approach data connectivity is built up by integrating originally independent EHR systems and then other capabilities are added to the base system. This is the preferred method in the Scandinavian countries; see more about it in chapter 2.7.1. The obvious benefit of this method is that it is built on clinically actionable data collected within a proven and robust data environment. Obviously the proper functioning of this integrated system cannot be working without years (or better still decades) of experience. Once the integrated EHR system is in place, it is possible to add PHR-like capabilities for citizens.

The PHR based approach places the patient in the centre from the beginning. There are many examples for these kinds of systems and applications which are described in chapters 2.7.2. and 2.7.3. The main disadvantage of PHRs is that the database needs to be built up from scratch. There are however several practical aspects of this approach:

1. The patient knows who he/she is, which facilitates accurate identification and disambiguation of conflicting identifiers.
2. The patient also knows whom he/she trusts, which forms the basis for granting authorization to access health information.
3. The patient is aware of his/her own medical condition.
4. It places increased responsibility on the patient for health maintenance. The patient will have responsibility for becoming educated and staying informed about his/her condition and for making good lifestyle choices.

It is not our job to prioritize one approach over the other as most likely these will coexist in the future and the best solutions will collect and harmonize elements from both EHRs and PHRs. What is certain however that a system has to meet a lot of important criteria to be successful and accepted by all stakeholders alike. The current e-Health environment and the industry's future will be analyzed in the following chapter.

3.2 Market overview

Most developed countries spend between 5% and 15% of their GDP on healthcare (in the US it is close to 20%), an enormous amount. In virtually all countries in the world the efficiency of healthcare spending is considered problematic. The second main promise of a robust e-Health system (the first being improved healthcare) is lower healthcare costs. In theory, these facts provide a solid foundation for the rapid advancement of e-Health but there are also two important barriers:

1. The financing of healthcare is usually based on a very intricate, deeply entrenched system that is very hard to balance. An extensive e-Health infrastructure concerns almost all aspects of healthcare financing, creating a need for a complete overhaul and affecting a multitude of stakeholders.
2. The costs of introducing e-Health are high and must be paid upfront while most of the benefits only follow later. This is true for financial and also other costs (and benefits), e.g. for many healthcare professionals e-Health in the beginning only means additional work.

For these reasons the e-Health initiatives must be embraced by political decision makers, viable and profit oriented business models only exist for small subsets of the e-Health infrastructure. This is why most serious initiatives exist on a national level as we will see later.

3.2.1 Market needs

E-Health systems have two main user groups: healthcare professionals and citizens/patients. Originally electronic health systems (mainly EMRs and EHRs) were developed based on the needs of healthcare workers. For decades no one has thought that the information stored in these systems could be (or should be) made accessible for patients. This affected the content and structure of the databases, even if patients could have a look they would have had serious difficulties in interpreting the content.

Things are changing however, today in the US about 40% of people are considered active in managing their health and navigating the health care system[7] and this number is constantly growing. There are an infinite number of products and services – from health portals to fitness applications – aimed at satisfying the needs of the health conscious, but isolated solutions only provide limited results. An e-Health system widely accepted by health consumers needs to be at a minimum:

1. Comprehensive: The system includes accurate and complete data from all settings of care.
2. Interactive and user friendly: Information flows easily both to and from the system.
3. Secure: The information in the system is accessible only by the patient or third parties authorized by the patient.

Citizen/patient needs will be analyzed by segments later in this document.

[7] http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/us_chs_InfoBrief_2012HealthCareConsumerSegments_011813.pdf

The needs and expectations of healthcare professionals somewhat differ from that of citizens. There is plenty of evidence for this, according to a recent report 'over three quarters (77%) of English patients think they should have full access to patient records but only 34% of doctors agree'[8] . In spite of this in the long term healthcare professionals also clearly benefit from a comprehensive system, where the complete medical history of a patient is available in one place.

The job of the MHA project partners is to ensure that MyHealthAvatar makes a good effort to possess all three capabilities listed above. This exploitation plan and the ensuing business plan shall make it clear how these goals are going to be achieved by the MHA consortium.

3.2.2 Market trends

As we already implied earlier, e-Health can be realized on several different levels:

1. EMRs or EHRs of a single provider are the easiest to build but their usefulness for the patient is limited by the amount of information it stores.
2. Most of the efforts today (as we will see later) are aimed at building national e-Health systems. These are large enough to reap most of the benefits offered by interoperability but the development of such systems is fraught with difficulties whether they are built from scratch or assembled by the integration of lower level systems.
3. A third group of solutions are mainly represented by untethered PHRs, which offer their (web based) services internationally. Unfortunately there are very few and limited examples of untethered PHRs being linked to medical data stored by health providers and mainly for this reason their active user base is low.

We will examine these levels later during competitor analysis. It must be noted however, that the complexity of the market is increased by the fact that these solutions exist in parallel which often only enhances the confusion without providing real advantages.

3.2.3 Market size

Since definitions and methodologies are extremely varied, it is very difficult to attach actual figures to the E-Health market. Also from the viewpoint of MHA at its current stage, dollar figures are not as relevant as will the case be later, during a detailed business analysis. It is however very important that we have an understanding about the monetary status of the industry where MHA will be a player. The collected figures are from well-researched reports provided by leading institutions.

The global IT-enabled healthcare market, in terms of revenue, was valued at USD 96.87 billion in 2013 and is estimated to grow at a CAGR of 11.8% during the forecast period from 2014 to 2020.[9] Software products are the largest segment of this with almost 75% of the total market share.

[8] http://www.computerweekly.com/news/2240215175/UK-shows-biggest-take-up-of-electronic-Health-records-in-Europe

[9] http://www.transparencymarketresearch.com/pressrelease/it-enabled-healthcare-market.htm

A somewhat narrower approach is to focus on the so called EHR market, these figures are also very relevant from our perspective. Despite slower-than-expected growth, the global market for electronic health records (EHR) is estimated to reach $22.3 billion by the end of 2015, with the North American market projected to account for $10.1 billion or 47 percent. In Europe, where a slow economic recovery has inhibited EHR growth in recent years, the market is expected to grow from $6.5 billion in 2014 to $7.1 billion by the end of 2015. Government-funded initiatives are expected to generate the region's most significant EHR growth in the Nordic countries (5.1 percent), United Kingdom (4.1 percent) and Germany (3.6 percent). Within Europe, the United Kingdom is expected to remain the largest EHR market, growing to $2.1 billion by the end of 2015.[10]

Another segment that is interesting is the mHealth market. Globally it was valued at USD 5.79 billion in 2013 and projected to reach USD 23.39 billion by 2020[11]. Europe is the fastest moving segment in this market with a year-on-year growth rate of 61.6%[12].

3.2.4 Regulatory environment

A thorough analysis of the regulatory environment is the topic of another deliverable within the MHA project. In fact, there is a complete work package dedicated to legal and IPR issues led by the University of Hannover. For our purposes however it must be mentioned that national and European legislations are lagging behind the development of the e-Health industry. In general, an e-Health system provided by a healthcare provider would fall under the European laws that protect medical privacy and set standards for maintaining the security of citizens' medical information. Other systems however that do not process personal data within the territory of the EU/EEA – and most untethered PHRs offered by commercial vendors fall into this category – are not covered by these regulations, the only privacy protections they offer are those in their own privacy notices and practices and the local law

The uncertainty of the legal situation affects business entities offering their e-Health services as well as patients and citizens who are the recipients of these services, mostly by increasing the risks involved. Providers can not know for sure how their offerings will be regulated in the future and user participation is obviously affected by the uncertainty of the situation. Although this uncertainty affects all stakeholders, there are proofs that multinational IT companies have a significant disadvantage when offering PHR services, several studies confirmed that people have a higher trust in national organizations or research institutions when entrusting their health data with them.

[10] http://newsroom.accenture.com/news/global-market-for-electronic-health-records-expected-to-reach-22-3-billion-by-the-end-of-2015-according-to-accenture.htm

[11] http://www.transparencymarketresearch.com/mobile-health-market.html

[12] http://www.bccresearch.com/pressroom/hlc/global-mHealth-technologies-market-projected-to-reach-nearly-$21.5-billion-2018

3.3 Customers and segmentation

If MyHealthAvatar is successful, there will be a huge number of people associated with it. The main stakeholder groups that we currently envision are the following:

1. Patients and citizens: The most important characteristic of the MHA platform is that it is citizen centred. Being able to provide tangible benefits to patients and citizens is the cornerstone of the project.
2. Healthcare providers: Similarly to citizens, healthcare providers also function both as primary sources and users of the information collected in the avatar and as such play a pivotal role in its operation.
3. Application developers: Given the constrains and limitations of a framework project, external actors will have to be involved in the project activities as soon as possible.
4. Researchers: Once the data builds up, the avatar will be a rich source of information for the international research community.

Good exploitation means that we examine how we can ensure a wide participation from each stakeholder group and perform our actions accordingly. Careful planning is necessary as the involvement of different participants is interdependent, for example we cannot hope for serious involvement from citizens unless providers share their data with MyHealthAvatar and we cannot attract the attention of researchers until we build a meaningful database of health related data. In the following we divide the mentioned stakeholder groups into meaningful segments and describe what MHA can offer to each of these segments.

3.3.1 Patients and citizens

Not everyone uses MHA for the same purpose and there are large differences in usage intensity, tools used, demands, expected results etc. The following tables summarize citizen groups that may be considered homogeneous for our purposes.

Group name	Healthy adults
Definition	People with no (or minor) health issues and only little or moderate desire to manage their own health
Features	This is by far the largest target group but also the most difficult to involve. Most healthy people do not really care that much about their health. Healthcare for most people is about having someone else "make it better," not about personal responsibility. Furthermore, even if they care, most people are lazy to collect and maintain their health information regularly if it involves manual work.
Important requirements	The system must be comprehensive: containing all health related information for the particular person. Only this provides tangible benefits for healthy adults.
	Automated data entry
Most important features used	Maintain a list of all healthcare encounters
	Import, export and share health information
	Find information within the PHR

Group name	Health-conscious
Definition	Having an active interest in one's health, concerned with living healthily
Features	The main difference between healthy adults and the health-conscious is the level of motivation to engage in health management. Identifying this group is important as they can be early adopters of MHA.
Important requirements	Comprehensive functions to monitor lifestyle: exercises, diet etc.
	Automated data entry
Most important features used	Managing exercises
	Managing diet
	Import, export and share health information

Group name	Worried well
Definition	People who do not need medical treatment, but who visit the doctor to be reassured.
Features	Although originating from a different need, these people are also willing to be more involved in their own health management just like the health-conscious. Another possible group of early adopters for MHA.
Important requirements	The system must be comprehensive: containing all health related information for the particular person.
Most important features used	Search and share health related data

Group name	People with chronic diseases
Definition	A chronic disease is one lasting three months or more, by the definition of the U.S. National Center for Health Statistics. The most important types are: arthritis and related conditions, cardiovascular disease, cancer and diabetes.
Features	This segment primarily uses a PHR for the self-management of one (or more) chronic disease with the aim of improving patient health and reducing the number of hospital visits.
Important requirements	Enhanced communication options between patient and caregiver
	System focused on a particular disease
	Easy to use
Most important features used	Disease management
	Progress notes
	Medication record

Group name	Senior citizens
Definition	People over 65 years of age
Features	There is a large overlap with chronic diseases, as some 85-90 percent of people (living in developed countries) over 65 years of age have at least one chronic health condition.
Important requirements	Easy to use
Most important features used	Medication record

It is the task of the exploitation process to further elaborate these customer segments and their needs. We need to link the segments to the possible product/service offering of MyHealthAvatar. This will be a major element in the preparation of the business plan.

3.3.2 Healthcare providers

Engaging healthcare providers is one of the main cornerstones of a successful PHR. In fact, the main reason why the uptake of untethered PHRs is so low is their inability to involve providers. This is true for even the biggest international players: while according to the HealthVault website "a growing list of labs, pharmacies, hospitals, and clinics" will send patient records to HealthVault upon request, Microsoft has not made any big announcements about this in years[13].

The supply side of healthcare is not much simpler compared to the demand side. It is important to make a clear distinction between different segments in order to provide the best of MHA to these stakeholders. The following table contains a basic division of the sector. This has to be better defined and analyzed in the business plan.

Group name	Definition	Examples
Primary care	Health professionals who act as a first point of consultation for all patients within the health care system	general practitioner, physiotherapist, nurse practitioner
Secondary care	Medical specialists and other health professionals who generally do not have first contact with patients.	hospital
Tertiary care	Specialized consultative health care in a facility that has personnel and facilities for advanced medical investigation and treatment.	cancer management, neurosurgery, cardiac surgery, plastic surgery

[13] http://www.informationweek.com/healthcare/patient-tools/cloud-services-may-replace-ehr-portals/d/d-id/899803

We need to understand that we can only be successful if we clearly identify the benefits that MHA can offer for healthcare providers and convincingly prove that cooperation with MHA and its platform is in the best interest of their institutions and their patients. Some of these benefits include:

- Patients more engaged in their health
- Individual health data is available in a structures, comprehensive and secure format
- Chronic disease management is better facilitated
- Care coordination is made easy
- Health information is combined with nutrition and fitness data, enabling more informed decision making

Our intention is to encourage healthcare providers to link their existing electronic records with the avatar. The provider gets the benefit of becoming a part of a comprehensive system while the avatar becomes richer with each participating provider.

3.3.3 Application developers

External application developers should play a major role in the expansion of the MHA platform. The main idea is that we provide a base containing the data and some basic tools while third parties create applications that are linked to the platform and utilize its resources. Our aim is to create a win-win situation where developers gain users by leveraging the information content of the platform while the MHA platform will be more engaging to users with every new linked application. Ideally this starts a snowball effect of attracting users, developers and also healthcare providers.

We have collected MHA partners' ideas about the type of developers that could be interested in the collaboration:

- PHR developers
- Data repository developers
- eHealth Apps Developers
- HIS developers
- HIS administrators

During the next phase we are going to specify the developer communities that could be targeted and tailor some of the platform capabilities to attract their attention.

From a business model standpoint this works by channelling revenues generated by the application to both developers and the provider of the MHA platform. This model is part of the business model canvas outlaid later in chapter 5.1.2.

3.3.4 Researchers

The information collected in the repositories of the avatar can be the base of a variety of health and/or wellbeing related research. The quantity, accessibility and structure of the data define its usability for research purposes. This approach has one great promise but also possesses some very real dangers.

The promise is revenue generation. Most existing PHRs found that users are not willing to pay for the provided services, practically all major PHRs are available free of charge. As there are limited options for revenue generation from other sources, some publicly available PHRs have clearly indicated that this is their chosen business model. This is not only true for small players, 23andMe has recently stirred some huge waves by opting to let pharmaceutical companies utilize their collected database of some 800,000 citizens[14].

The danger of this approach is of course the potential for misuse of very sensible data. Very serious legal and ethical issues arise from leveraging even anonymous data for other purposes. The MHA project has a well prepared team (led by the University of Hannover) to ensure that only the safest and most reliable options will be examined.

So far we have identified the following types of researchers that could be interested in working with the consortium:

- Epidemiologists
- Psychologists
- Biologists
- Data Management Researchers
- Biochemists
- Statisticians
- Pharmaceutics

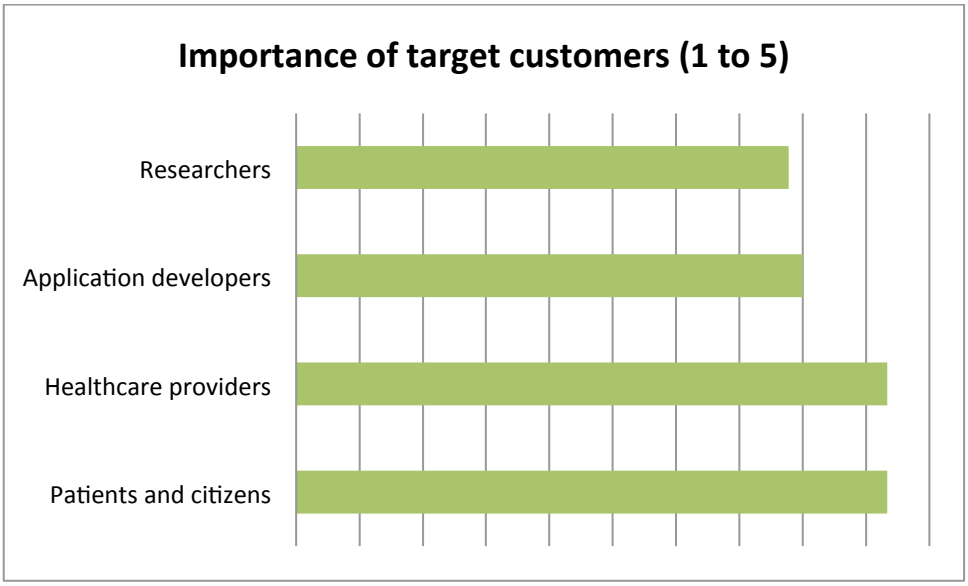
We will continuously examine the possible partners and obviously the possible avenues of exploitation in collaboration with researchers.

3.3.5 MHA partners input

Apart from conducting a literature research, we also included several questions about customers in the exploitation questionnaire. The following graphs summarize the answers provided by consortium members.

We asked consortium members to rate the importance of the main target customers; the following figure contains the results.

[14] http://www.forbes.com/sites/matthewherper/2015/01/06/surprise-with-60-million-genentech-deal-23andme-has-a-business-plan/



These target groups are obviously not heterogeneous and some sub-groups need to be identified for a better result. These are specified in the following table.

Main target group	Subgroup	# of partners mentioned
Patients and citizens	Patient organizations	3
	Patients with chronic disease	2
	Patients with a specific disease	2
	Sports clubs	2
	Young to mid-aged citizens	2
Healthcare providers	General practitioners	8
	Caregivers	2
	Hospitals	2
	Sports medicine	1
	Secondary care providers	2
Application developers	PHR developers	2
	eHealth Apps Developers	2
	HIS developers/administrators	2
	Data repository developers	2
	Web application developers	2
Researchers	Epidemiologists	1
	Psychologists	1
	Biologists	1
	Data Management Researchers	3
	Biochemists	1
	Statisticians	1
	Pharmaceutics	1

We are aware of the fact that there are additional target groups that may be attractive. Together with the partners we have identified some of these.

Target group	# of partners mentioned
Pharmaceutical industry	4
Wearables Industry	1
Food industry	1
Insurance industry	4
Policy makers	2
Health & wellbeing	1

3.4 Competitors

There is no shortage of initiatives, applications and comprehensive systems trying to make eHealth a successful reality. Some are aimed at particular user groups, some never want to go outside a provider setting, some strive to be a national solution and some even want to be openly global. Results are mixed but most experts agree that we are still no closer to a universally accepted system than we were five or ten years ago. There are certainly organizations that have had success providing patients with access to portions of their health information, but actual PHR use is still low and any potential benefits are limited by the amount of clinical information available electronically. In the following chapters we present the current state of EHRs and PHRs. Given the complexity of the issue and the huge amount of initiatives, it is impossible to give a thorough analysis but we tried to summarize the main approaches taken.

3.4.1 Provider populated EHRs/PHRs

These are tethered to a hospital, physician practice or other health delivery organization that is populated with data from the provider's clinical or financial information system. In more advanced systems patients may have access to medications, immunizations, allergies and lab results, and in some cases even the problem list. Provider-populated EHRs/PHRs sometimes also include transactional services, such as the ability to email with providers, request a prescription refill or schedule an appointment.

The proliferation and development of these systems is welcome news from the perspective of patients as well, but as we noted earlier the growing number of independent systems also have real disadvantages. Booming EHR adoption only increases problems associated with data sharing. According to a recent report from the US "Electronic health information is not yet sufficiently standardized to allow seamless interoperability, as it is still inconsistently expressed through technical and medical vocabulary, structure, and format, thereby limiting the potential uses of the information to improve health and care" [15].

Some figures from the same report further highlight the issue: in 2013, 14% of office-based physicians shared patient information with providers outside their institutional walls; 39% shared

[15] http://www.modernhealthcare.com/article/20141009/NEWS/310099939

information with any physician, even those inside the same institution. According to a recent KLAS report[16], just 14 percent of EHR-tethered portals included information from health information exchanges (HIEs), and 11 percent included data from other EHRs[17]. Recently, the Rand Corporation released the report "Redirecting Innovation in US Healthcare," which found that several technologies would reduce costs and improve outcomes -- if interoperability improved[18].

The real benefit of PHRs for citizens comes from the comprehensive nature of these systems and none of them fulfils this criteria. As a result, provider populated EHRs/PHRs are currently very far from satisfying the need of citizens.

3.4.2 Payer populated PHRs

This type of PHR is tethered to an insurance provider or employer that is populated with claims information. The best examples for this approach are in the US. PHRs in this model rarely include any clinical information directly from health care providers, but some allow members to enter basic information. Specific capabilities vary, but most large health plans such as Aetna and Cigna offer some type of payer-populated PHR[19].

Large employers are increasingly looking at payer-populated PHRs as well. The most well known example is Dossia, a nonprofit consortium offering a PHR that can be populated with claims information. Dossia first rolled out its personal health record (PHR) platform in 2008. It's members include a number of Fortune 500 companies: Walmart, Intel, Applied Materials, Pitney-Bowes and BP America among them[20].

Due to the lack of real clinical data collected and stored payer populated PHRs can only provide limited benefits for users. Some of these are aware of this fact and insist on a mission to change it. Dossia for example tries very hard to reach out to new stakeholders, in an attempt to attract the attention of researchers, it has recently rolled out a suite of population health management tools that aggregate its members' PHR data.

So far no payer populated PHR has demonstrated its ability to become a comprehensive tool used outside the boundaries of its inception.

[16] http://www.klasresearch.com/Login.aspx?ReturnUrl=%2fmyklas%2f#/krms/53/0

[17] http://www.informationweek.com/healthcare/patient-tools/cloud-services-may-replace-ehr-portals/d/d-id/899803

[18] http://www.informationweek.com/healthcare/electronic-health-records/senate-committee-seeks-ehr-interoperability-investigation/d/d-id/1297580?page_number=1

[19] http://assets1.csc.com/health_services/downloads/CSC_A_True_Personal_Health_Record.pdf

[20] http://www.forbes.com/sites/johnnosta/2013/11/27/for-dossia-digital-health-isnt-just-personal-anymore/

3.4.3 National systems

There are many countries in the developed world where electronic health data storage and transfer are built on decades of experience, the best examples being the Scandinavian countries. National e-health systems are typically based on EHR and these are now being complemented with PHR capabilities. We will first describe these solutions through the examples of Denmark and Sweden and then look at two more countries (Australia and the US) where the conditions are somewhat different. All of these examples provide lessons for the MHA project.

Denmark

The unified national e-health system is created mainly through the integration of the various EHR systems that have been operational for over two decades. In 2007 there were 27 different EHR systems in use across all public hospitals. This has been reduced to five coherent EHR landscapes last year. The system is based on the following main elements[21]:

- MedCom messages (established in 1994)– digital exchange of health data (e.g. discharge letters, referrals, lab test orders, e-prescriptions and reimbursement) between public hospitals and general practitioners as well as private companies linked to the health care sector (e.g. pharmacies). Today practically all frequent documents in the health care sector are transferred electronically between health care professionals.
- The e-Journalen system gives patients and health care professionals digital access to information on diagnoses, treatments and notes from EHR systems in all public hospitals. By the end of 2011, the system contained health data on more than 85 per cent of the Danish population.
- Sundhed.dk (the official web portal of the public health services) is providing access to information for citizens, patients and health care professionals. Through the web portal the patient has access to: (1) personal health data on treatments and notes from hospital records etc.; (2) various e-services including making appointments with GPs, prescription renewals and electronic communication with the GP; (3) information on waiting times at all public hospitals and ratings of hospitals; (4) patient networks; (5) a comprehensive handbook with 3.000 articles with information on diseases and treatment.
- The Shared Medication Record – a digital overview of a patient's current medication, the source of the information are doctors, GPs and pharmacies.

The main focus of the last years has been on integration of the various systems. This is led by two important projects:

1. The National Patient Index is an infrastructure project that makes it possible to search for existing data on a patient in the data sources that are integrated into the index. Furthermore, it contains a number of security measures to ensure secure use of the system.
2. The National Health Record (an expansion of e-Journalen) will display data from the data sources in The National Patient Index in a coherent and intelligent user interface.

[21] http://www.sum.dk/~/media/Filer%20-%20Publikationer_i_pdf/2012/Sundheds-IT/Sundheds_IT_juni_web.ashx

Although these systems together provide a wealth of information about patients that are available for patients themselves, the emphasis is clearly on medical data provided by healthcare professionals. Decision makers realise changes in the relationship between health care professionals and patients with respect to supporting the patient's management of a healthy lifestyle, disease prevention and a stronger connection between treatment and the patient's own efforts. Therefore future plans include for example giving the patient the possibility to register various health data directly in the web portal.

Sweden

The Swedish system has travelled a road very similar to Denmark. The actual implementation of the health care system is through 21 county councils. The 21 independent health care systems have coevolved over decades. The services they provide are comparable, but the systems differ significantly across regions[22].

In 2008 Sweden launched an initiative for the development of a national EHR that would provide electronic access to health records for patients, health care professionals, and health care facilities in the nation. The National Patient Summary (NPÖ) gives authorised care staff access to critical patient information from other caregivers[23].

There are two important lessons that can be learned from these Scandinavian experiences:

1. It takes years, if not decades, to grow a functioning health data infrastructure from the seeds of EHRs, but once there is sufficient buy-in and cooperation, then progress can be rapid.
2. The need for early design of security and privacy measures, beginning at the concept phase should not be underestimated. Sweden saw late-stage delays because of a lack of effective security controls.

Australia

In contrast to the above examples, there is a country which has decided to take the fast lane of e-Health adoption. Australia has recently rolled out a system called Personally Controlled Electronic Health Record - PCEHR. Through intensive media campaigns the number of registered users has been pushed over one million but the actual usage rate of the system is very low. A high profile PCEHR review panel recently found that while an electronic health record remains a critical part of the future health infrastructure for Australia, it requires "intervention and correction"[24]. The main reason for the lack of success, that there was very low buy-in from health industry players. The following comments collected from medical professionals are telling:

[22] http://healthit.gov/sites/default/files/ptp13-700hhs_white.pdf
[23] http://www.cehis.se/images/uploads/V%C3%A5rdtj%C3%A4nster/NP%C3%96/451-2569%20NP%C3%96%20produktblad_EN_HI.pdf
[24] http://www.health.gov.au/internet/main/publishing.nsf/Content/46FEA5D1ED0660F2CA257CE40017FF7B/$File/FINAL-Review-of-PCEHR-December-2013.pdf

- The Australian Medical Association said the key to getting clinicians enthusiastic about turning to health records was to make sure they are full of helpful information and not sporadic and incomplete like at present.
- Usability issues are central to the mission to sign-up clinicians.
- Once inside, the PCEHR itself has been described as "a 'dumping ground' for information" which makes it "difficult to find and locate information required".
- There was a perception that NEHTA (the governmental coordination body) had been seeking but not listening to advice from the clinical community. It resulted in a reduction in confidence of the private sector "to invest in product development and evolution[25].
- The most critical requirement is that the system must be clinically useful and if not, it will not be used. "I believe this review document and the PCEHR model fails to meet this final requirement."[26] (Consultant physician and University of Tasmania clinical associate professor Terry Hannan)

The health minister for the Commonwealth of Australia has acknowledged that: "It's clear many of the existing problems with the PCEHR system stem from the rushed early implementation."[27]

The lesson here is obvious: without healthcare professionals joining the system and uploading data, the PHR only provides marginal benefits for patients and citizens and these benefits are certainly not enough to attract the crowds.

USA

The US is the largest economy of the world has certainly a huge influence on the e-Health landscape. They have decided to create a system based on existing EHR capabilities (like Denmark or Sweden) but in building a nationwide system they face a much greater challenge for two basic reasons:

1. The sheer size of the population. Sweden has less than 10 million inhabitants, the US has 318 million.
2. The health system is extremely fragmented compared to most European countries. For example in the US there is no unique identifier for each patient, and the US system of both private insurers and public insurance Medicare and Medicaid) provides many more payment models and incentives[28].

The US government is well aware of these issues and has taken an extra step of providing incentive payments to increase physician adoption of electronic health record (EHR) systems. The Medicare and Medicaid EHR Incentive Programs are staged in three steps, with increasing requirements for participation. To receive an EHR incentive payment, physicians must show that they are "meaningfully using" certified EHRs by meeting certain objectives. The initiative has resulted in a significant uptake in recent years:

[25] http://www.itnews.com.au/News/385870,review-recommends-new-name-direction-for-pcehr.aspx
[26] http://www.pulseitmagazine.com.au/index.php?option=com_content&view=article&id=1882:the-good-and-the-bad-in-the-pcehr-review
[27] http://www.medicalobserver.com.au/news/my-health-record-bumps-off-unpopular-pcehr
[28] http://healthit.gov/sites/default/files/ptp13-700hhs_white.pdf

- In 2013, 78% of office-based physicians used any type of electronic health record (EHR) system, up from 18% in 2001.
- In 2013, 48% of office-based physicians reported having a system that met the criteria for a basic system, up from 11% in 2006.
- In 2013, 69% of office-based physicians reported that they intended to participate (i.e., they planned to apply or already had applied) in "meaningful use" incentives[29].

There are of course many more other (mainly bottom-up) initiatives that are aimed at enabling citizens to manage their personal health data. Of these probably the most important and successful is called Blue Button. Originally a tool used by several Federal agencies, including the Departments of Defense, Health and Human Services, and Veterans Affairs, it has now pledges of support from numerous health plans and some vendors of personal health record vendors across the United States. Data from Blue Button-enabled sites can be used to create portable medical histories that facilitate dialog among health care providers, caregivers, and other trusted individuals or entities[30].

It is clear that federal agencies as well as many players (both public and private) within the health industry across the US embrace the notion of e-Health but the road that will lead there is not as easy as many originally thought. Advocates are currently trying very hard to reach the tipping point when justifiable results provide clear evidence for the majority of stakeholders that electronic health systems are for the present.

3.4.4 Untethered PHRs

Untethered PHRs are controlled by the patient rather than by the provider, employer or health plan. The patient can manually populate the record or authorize certain payers, pharmacies, providers or other organizations to do so with information from their systems (provided those organizations have an agreement in place with the PHR vendor). Untethered PHRs also allow users to integrate third-party solutions into their record.

Until recently, the two most well-known entrants into the untethered PHR space were Microsoft HealthVault (launched in 2007) and Google Health (launched in 2008). In June 2011, Google announced it was discontinuing the Google Health service. As of October 2014, the HealthVault website lists links to 23 applications and 185 devices.

Apart from these giants there is a multitude of untethered PHRs available for consumers. The following list shows some of the better known examples:

[29] http://www.cdc.gov/nchs/data/databriefs/db143.htm
[30] http://en.wikipedia.org/wiki/The_Blue_Button

While some of these systems have started up with great promises, in reality, none have really gained any traction with consumers. Microsoft publicly acknowledged abandoning efforts to make profits in the US and its role would be simply to increase the brand relationship[31]. The main reason for their collective unsuccessfulness is that there are hardly any partnerships between untethered PHR vendors and provider organizations to date. Many systems have been designed based on "good IT principles" rather than "good clinical principles". The net effect is a system that meets all the technical requirements but provides no value for the doctor and patient in improving their communication, and thus remains unused[32]. There is a strong consensus among industry players that PHRs will never see widespread adoption until full cooperation between patients, insurers and healthcare providers is achieved[33].

Most PHRs currently act as a repository of information. As it turned out, few consumers are interested in a digital filing cabinet for their records only. What they are interested in is what that data can do for them[34].

Some analysts now consider untethered PHRs as phase in the evolution of electronic healthcare. They are seen to have a limited, but important, role to play as a driver of innovation and change, but that many of the benefits they might bring would be better archived through patient access to existing records and by a step-by-step evolution from siloed institutional records to a single logical record under share curation and governance[35].

[31] http://www.ft.com/cms/s/2/6e10b422-f58d-11df-99d6-00144feab49a.html#axzz3GDzHFbut
[32] http://thehealthcareblog.com/blog/2014/01/11/in-search-of-a-really-usable-phr/
[33] http://blog.zesty.co.uk/phr-market-past-present-future-personal-health-records/
[34] http://techcrunch.com/2011/06/26/why-google-really-failed-money/
[35] http://www.woodcote-consulting.com/category/phr/

3.4.5 MHA partners input

Similarly to the customer analysis part, as a part of market research we also collected project partners' opinions about the competition. Specifically we asked consortium members to compare the MHA platform to the following possible competitors. The following table contains the answers. The numbers in brackets indicate how many partners mentioned the particular feature.

Future competitors	MHA advantages	MHA disadvantages
National EHR systems	Based on user needs and requirements (6) Transparent (2) Knowledge and data in National EHR systems is fragmented (2) No interoperability functionality (1)	Research prototype only (2) MHA may not be able to provide a completed medical data (3) Missing the huge database of EHR systems (1)
Untethered/patient populated PHR systems	More trustworthy (3) Adaptable to the individual needs (2) Transparent (1)	There is no financial background after the end of the project (2) There is no clear ownership of the product (1)
Payer-populated PHRs	More trustworthy (6) Offering basic services for free (4) Better scientific base (1)	Less money is in MHA (4)
Research database	Heterogeneous (8)	MHA may not have sufficient amount of data for a specific purpose (2)
Data management applications linked to a single device	Extended functionality (6) Linked to several devices (3)	

4 Exploitation framework

4.1 Creating the exploitation strategy

An exploitation plan contains partners' ideas about how to use the project product and results at local, regional, national, European, and/or international levels. The three main sources of the plan are:

- market research
- exploitation questionnaire completed by all partners
- observations and experiences from test applications during the project lifetime

Based on these inputs we will follow a mixed approach for developing the exploitation strategy by:

- Asking partners about their ideas and individual plans for the exploitation of the MHA results. This method includes a questionnaire and discussions (either via e-mail and phone conferencing or during the project meetings).
- Adapting ideas and results from and to other contexts (national, European, or international). In particular, MHA aims to bring together existing VPH models and data across the VPH community in Europe.
- Identifying gaps/opportunities in the topic that MHA is dealing with. Our platform has some strong and innovative characteristics compared to similar initiatives.

4.2 Exploitable results

We list and shortly present the project results that can be the subject of the exploitation process. The results that are introduced here will be described in detail in chapter 4.

1. MHA as a functional prototype. A personal companion that follows the citizen and will empower them to look after their own health records
2. Tangible assets - these are parts of MHA that are exploitable in their own right. The development of these elements can be linked to work packages. Tangible assets include ontology, visual analytics tools and risk assessment tools.
3. Intangible assets are based on experience and information gathered through the course of the project. Intangible assets include consulting services, training services and customization.

4.3 Academic and commercial exploitation

We differentiate between non-commercial and commercial exploitation. The former can basically take three different forms:

- Developments are carried into future national and international research projects, deeply rooting the MyHealthAvatar results in their research and development activities.
- Technical developments will be integrated quickly into partners' teaching curricula and research agendas, giving themselves and their graduates a competitive edge.
- Individual training sessions will be provided about technology supported innovation and creativity.
- Pilot projects - About half of the partners plan a pilot project in relation to MHA. Some already have an idea about its content and links with specific project elements but no pilot projects have started as yet.

Another possibility of exploitation is to carry the developments of MHA into future projects. Basically all academic partners are willing to take this direction. Most partners have only expressed their unspecific intent in this regard but some already have specific ideas about it. Further details about all aspects of non-commercial exploitation will be presented in chapter 5 (Individual exploitation). Commercial exploitation is described in chapter 4.

4.4 Intellectual property rights

We need to define rules of ownership and sharing of knowledge or project result and how the consortium agrees on the use and dissemination of the project results.

The strategy for the protection, use, dissemination and intellectual property rights and management of knowledge that will be generated under the project is incorporated in the Consortium Agreement and is based on the following basic principles: (i) foreground shall be the property of the beneficiary carrying out the work generating that foreground; and (ii) the full consortium members grant mutual access rights on a royalty–free basis to knowledge or background for the purpose of carrying out their own project work or for using their own knowledge. The Consortium Agreement addresses the adequate protection of knowledge, the allocation of the cost of protection, the responsibility for the extension of the protection rights, the protection and enforcement against infringement rights by third parties, the licensing of knowledge, the internal procedure of information and consultation to deal with potential problems arising from access rights and protection and use of both foreground and background.

4.5 Patents & protection

The consortium structures standards so that a reasonable patent strategy can be pursued by all partners, whereby possible essential patents not owned by a partner can be outbalanced by patents owned by partners to avoid standards become hostage to non-participants' demands for excessive compensation and thus preventing implementation of the standard. With respect to legal aspects of IPR management inside the consortium such as ownership and access rights, we will of course comply with the rules for EC projects.

4.6 Defining business models

Ensuring sustainability after the project's official end can happen in a variety of ways. The most important indicator of sustainability of the project is weather the MHA platform we build should turns into a tool used by a large number of people. We are exploring the different possibilities that help us attain this goal. The most likely possibilities are the following:

1. MHA will be open source. In the past decade, there has been an inexorable adoption of open source in most aspects of computing. If we choose this option, sustainability of the platform can be reached with or without further efforts from the consortium members:
    A) A successor of the MHA consortium remains in charge of operating the software. Revenue comes from charging a support fee to those customers who rely on the avatar for maintenance and support.
    B) Some other entity takes on the above responsibility or the open source community itself provides the required accessories.
2. We sell an exclusive licence to a particular industry partner who wants to take this platform for commercialisation.
3. A successor of the MHA consortium packages the core platform and its additional elements into a service as in cloud computing or software-as-a-service. Providing cloud computing services or software as a service (SaaS) without the release of the open-source software itself, neither in binary nor in source form, conforms with most open-source licenses. Many of today's most successful companies rely on an ecosystem of standardized open source components that are re-used and updated by the industry at-large. In fact, these open source building blocks are the foundation of all modern cloud and SaaS offerings. In the long term we may develop more open source software specific to the platform or build some amount of proprietary software to complete the offering.

The details of these options will be the main subject of the following chapter: commercial exploitation. There are additional sources of revenue that can be utilized; these will also be mentioned in the following chapter.

5 Commercial exploitation

Exploitation outcomes of MyHealthAvatar rest on three inputs: market context; project capabilities and constraints; and project partner's aims and potential.

The market context helps participants identify and examine exploitation opportunities, puts the project in context with other initiatives (research or commercial) and moves the project towards a stable market position.

The project's capabilities and constraints evidently affect project exploitation. The performance, capabilities and limitations of our system define the level that can be reached. The innovation aspect of the components provides the specialty that will give the project results potential in a commercial environment. This input also contains the limitations of the licensing decisions followed by the project and the ability of the partners to create new commercial initiatives after the end of the project.

Finally, each partner's opportunities and interests must carry exploitation forward. It does not matter how appealing a MyHealthAvatar business case might look on paper, if this is outside the strategic considerations of the project members, it will be impossible to ensure buy-in and investment. During the definition of the exploitation we do not want to be limited to instant opportunities, we strive to explore the potential for more collaborative exploitation. The strategy for individual partners is lead by the short-term goals of partners and the longer term vision shaped by strategies. This long-term vision is just as important for guiding the project towards value and impact creation. Project outcomes can be placed in three categories:

1. The final result of the project is a functional prototype that already has some benefits. We encourage end users to engage with the MHA platform and this process should lead us from prototype to the product stage by collecting information and enhance the functionalities of the avatar through these interactions.
2. Parts of the MHA platform can be utilized independently of the complete system.
3. Other than tangible assets, services can be offered by the consortium members based on the knowledge accumulated during the project.

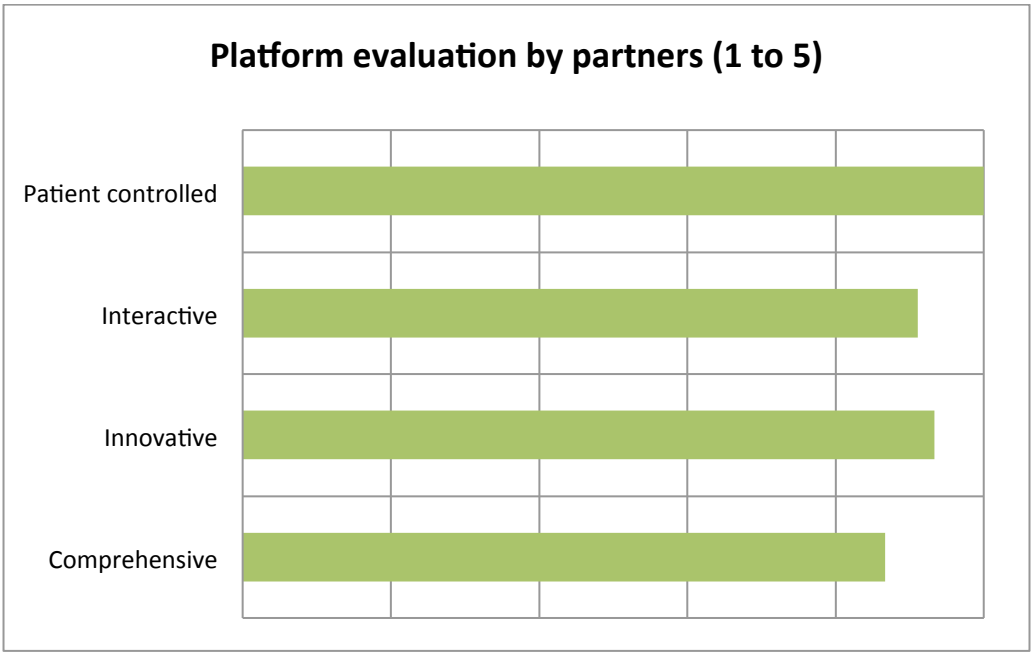
5.1 MHA as a functional prototype

MyHealthAvatar is a solution that offers access, collection and sharing of long term and consistent personal health status data through an integrated digital representation of an in silico environment, which helps to deliver clinical analysis, prediction, prevention and treatment tailored to the individual citizen. MyHealthAvatar can be described as a personal bag carried by individual citizens throughout their lifetime. It is a companion that will continually follow the citizen and will empower them to look after their own health records.

The core of the project is the MHA platform where the data is stored and managed. The platform however follows a modular design, most of its capabilities can be utilized through applications that are linked to the platform but are not an integral part of it. This is already true for most tools developed by project partners but it will reach its real significance when it will provide an opportunity for third parties to link their applications to the platform.

5.1.1 Platform usability

At this stage of the project, there are about 50 users testing the platform, most of them work for consortium members. Although it is not a large sample, extensive testing means that their opinion is extremely valuable. The following figure shows what users think about the platform along four major dimensions.



The exploitation process places a special emphasis on the collection of user input for the remainder of the project. These inputs will be continuously analyzed to provide a base for further improvement.

5.1.2 Business model options

Providing an implementable business model is a major ambition of the project. There are two distinct options for commercial exploitation:

1. The consortium finds a way to provide the services of the platform to the users. It will stay and be maintained after the duration of the project. Citizens will be offered services to use MHA as a platform to store their health and lifestyle data.
2. We exploit the source code of the MHA platform. In this case we can either sell an exclusive licence to a particular industry partner who wants to take this platform for commercialisation or we can make the source code as an open source.

We have prepared a preliminary canvas for each of the above options that should serve as a base for our future business model(s). Below are the preliminary models in an easily understandable format.

<table>
<tr>
<td rowspan="2">Key partners

Healthcare providers
1. Household and community health care
2. Health centres/clinics
3. Hospitals

Application developers

Wearable device developers</td>
<td>Key Activities

Integrate data from several sources

Present and manage data in a meaningful way</td>
<td rowspan="2">Value Proposition

Convenience

Strong scientific base

Patient empowerment

Legal and ethical framework

Data protection and security</td>
<td rowspan="2">Customer relations

Automated Services and Communities

Dedicated Personal Assistance

Channels

MHA platform

Personal selling</td>
<td rowspan="2">Customer Segments

Citizens
1. Healthy adults
2. Health-conscious
3. Worried well
4. People with chronic diseases
5. Senior citizens

Research
1. Pharma
2. Biotech
3. Non profit

Insurance companies</td>
</tr>
<tr>
<td>Key Resources

MHA project partners</td>
</tr>
<tr>
<td colspan="2">Cost Structure

System development and maintenance

Database development and maintenance</td>
<td colspan="3">Revenue Streams

License fee from citizens
1. Premier subscribers of the MHA platform
2. Users of APIs

Selling data for research</td>
</tr>
</table>

1. *Platform maintained by a successor of the consortium*

<table>
<tr>
<td>Key partners

Healthcare providers
1. Household and community health care
2. Health centres/clinics
3. Hospitals

Application developers

Wearable device developers</td>
<td>Key Activities

Activities performed during the MHA project

Key Resources

MHA project partners</td>
<td>Value Proposition

MHA source code – proprietary

MHA source code – open source</td>
<td>Customer relations

Dedicated Personal Assistance

Communities

Channels

Personal selling

Online distribution</td>
<td>Customer Segments

PHR developer company

PHR developer community</td>
</tr>
<tr>
<td colspan="2">Cost Structure

Zero costs after project’s end

Customer service department</td>
<td colspan="3">Revenue Streams

License fee

Consultancy fees</td>
</tr>
</table>

2. *Platform maintained by an outsider*

If we choose the open source model we will have to define what components will go into the exploitable part, what parties have developed the components and what external codes/licenses they use. On the basis of these data we can build one (or more) specific licensing model(s) in the following months. This work is coordinated by partner LUH.

There are obviously many potential avenues to secure long term sustainability of project results. Our task is to examine the available opportunities in order to provide the necessary answers. During the remainder of the project we will continuously monitor the scientific and business environment and based on the collected information we will detail and update canvas elements. We will investigate the possibilities of elevating the results to a market ready phase through our industrial project partners or open the way of a more open and collaborative strategy that would involve a host of external stakeholders. The business model will be a central theme of the exploitation process and the related business plan.

5.1.3 SWOT analysis

The following table of Strengths, Weaknesses, Opportunities and Threats (SWOT) has been prepared to systematically consider aspects of MHA in terms of these characteristics. The elements of the SWOT analysis have been provided by the project partners.

Strengths

- Patient empowerment (6)
- Appropriate legal and ethical framework (4)
- Transparency (2)
- Integration of heterogeneous data sources (3)
- Strong scientific base
- EU wide approach
- Strong technical background (2)
- Health status assessment and risk analysis (3)

Weaknesses

- Very limited financial resources (3)
- Uncertainty about how to proceed after the project (7)
- Lack of interoperability with third-party systems (4)

Opportunities

- Enable and encourage the public to be more active in disease prevention (3)
- Utilize the variety of the consortia background
- Utilize specific use cases (3)
- Working with patient associations and clinical societies (2)

Threats

- Increasing competition from national systems as well as large corporations (5)
- Ethical and legal issues (3)
- Low acceptance from main stakeholders: citizens and healthcare professionals (4)
- Developed scenarios are not addressing the needs of the users
- Simply disappears after the project
- Increasing competition from national systems as well as large corporations (5)

During the last year of the project we will further refine the listed elements and will be matching up internal and external factors to identify potential actions based on the SWOT analysis. This will significantly help us in the development of the final business plan.

5.2 Tangible assets

Tangible assets are parts of MHA that are exploitable in their own right. The development of these elements can be linked to work packages. We asked partners how they rate the different assets from an exploitation perspective. The following table summarized the results.

WP # and description	# of partners say WP is exploitable	What exactly is exploitable
WP2 – User needs	0	
WP3 – Architecture and integration	3	a) Architectural elements b) Structure of architecture c) Methodology for the integration with external sources
WP4 – Semantic interoperability	3	a) Semantic core ontology
WP5 – Models and repositories	4	a) Single models b) Design of the repository c) Tool for user management and access management d) Model execution engine
WP6 – Data and repositories	0	
WP7 – Use cases	2	a) Linked to 'Models and repositories'
WP8 – Visual analytics	4	a) Software tools for visual analysis of the avatar and its data

Based on these results and a thorough analysis of the available information we describe the most promising assets to be exploited. With the progress of the project this list can grow and its contents can change, it is important to constantly monitor the status of these assets.

5.2.1 Ontology

As we already mentioned, effective healthcare depends very much upon having high-quality information about a patient. This information currently lives across multiple providers and institutions and in a multitude of vocabularies, formats, and systems. As long as the industry does not conquer the challenge of exchanging this information, it will remain the single biggest obstacle in the existence of integrated healthcare.

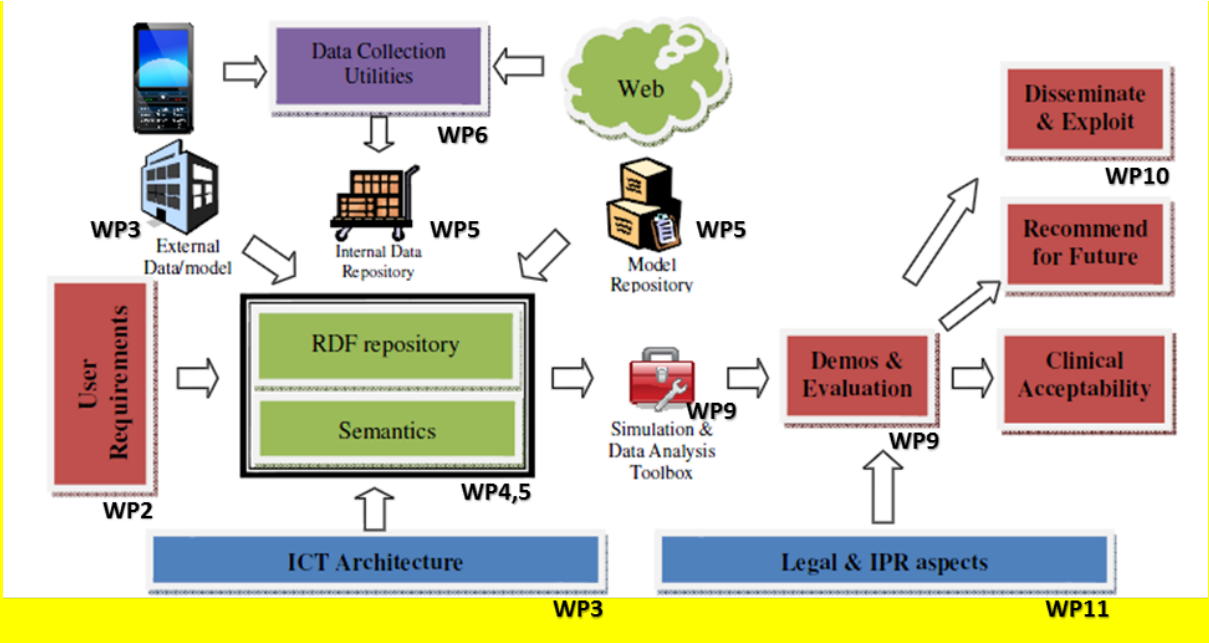
There are a multitude of initiatives globally to tackle this challenge. The development of new ontologies however does not necessarily tap the full potential of existing domain-relevant knowledge sources. Therefore the tendency is not to create new ontologies from scratch but to try to integrate high quality, domain-specific ontologies that have already prove their value. MyHealthAvatar's target is a modular high-level ontology being able to integrate through mappings a set of high quality already existing domain ontologies.

Since the MHA Semantic core ontology includes 35 sub ontologies, exploitation of the ontologies must be based on individual consultation. During the remainder of the project we will actively look for opportunities where the MHA Semantic core ontology is able to benefit any commercial or non-commercial initiatives.

5.2.2 Architecture structure

MHA system context provides an overview of the system and the actors and other systems that it interacts with. The latest deliverable D3.8 provides a detailed description together with context diagrams for MHA system, when considered a single, unified system. The key components of the architecture design and structure include: 1) user requirements – objective 1; 2) Internal data repositories and an internal model repository – Objective 2.1-2.2; 3) ICT architecture that support data access to internal and external resources and data management – Objective 2.3; 4) Data collection utilities – Objective 2.4; 5) Semantics and RDF repository to support data search and reasoning – Objective 2.5; 6) Simulation and data analysis toolbox – Objective 2.6, 2.7 and 2.8; 6) Demo & evaluation – Objective 2.9; 7) Investigation of the legal and IPR aspects of the avatars – Objective 3; 8) Understanding of clinical acceptability – Objective 4; 9) Recommendations for the future work – Objective 5 ; 10) Dissemination and exploitation of the results to influence the future healthcare system – Objective 6. It is our goal that the requirement analysis of MyHealthAvatar will clearly delineate the borders of the system architecture. According to these requirements, the following are external entities are currently considered for the system under development:

- HIS, EHR and PHR systems
- Drug data
- Social Networks and other sources of online activity of the users
- Model repositories that contains simulation models
- PubMed Repository, Clinical Trials information, news articles, etc.
- Clinical processed data and data from external Warehouse (lab results, images etc.)
- eCRF with filed in data from ObTiMA. Health Avatar with clinical trial related data (i.e. laboratory results, pre-operative state, etc.)
- Third party application (external to MyHealthAvatar) data
    - Diabetes and Emergency Demo
    - Personalized CHF Related Risk Profiles and "Real-Time Monitoring" (CHF)
    - Osteoarthritis (OST)
    - Nephroblastoma (Wilms Tumour) Simulation Model and Clinical Trial (UC-NEPH): In-silico Profiling of Patients and Predictions



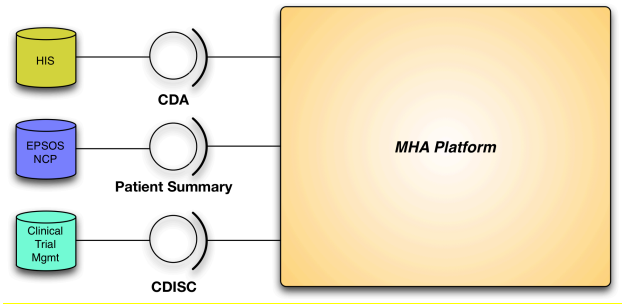
MyHealthAvatar platform as a unified system and its interactions with external entities

5.2.3 Link with external HER/Warehouses and Clinical management systems

The platform of MHA aims to support the 4D digital representation of a given patient but of course parts of the patient's clinical and social history are already stored and managed by third party systems. For this reason proper mechanisms and infrastructure should be in place for retrieving relevant user information from these external data sources. Whenever it's possible such "linking" with the third party systems should be based on available standard interfaces since they allow the building of generic ports and interfaces and the reuse of existing code bases. The below figure shows some notable examples for the realization of these links to external resources: Clinical data can be retrieved from Hospital Information Systems (HIS) through the Clinical Document Architecture (CDA[36]) guidelines and set of specifications, clinical trial specific patient data can be acquired using the Operational Data Model (ODM) of the Clinical Data Interchange Standards Consortium (CDISC[37]), whereas cross-border healthcare provisioning is supported by the adoption of epSOS[38] Patient Summary interfaces. Additional well-known and widely supported standards and quasi-standards include Digital Imaging and Communications in Medicine (DICOM[39]) and the "transactions" defined by the Integrating the Healthcare Enterprise (IHE[40]) initiative. eCRF with filed in data from ObTiMA. Health Avatar with clinical trial related data (i.e. laboratory results, pre-operative state, etc.). The components belonging to this layer interact with the main backbone of the MHA platform i.e. the Cassandra based data repository, the semantic infrastructure, and other repositories. In this figure

[36] http://www.hl7.org/Special/committees/structure/index.cfm
[37] http://www.cdisc.org/
[38] European Patients Smart Open Services (epSOS), http://www.epsos.eu/
[39] http://dicom.nema.org/
[40] http://www.ihe.net/

we emphasize also in the semantic integration layer and the semantic transformation of these data in order to be uniformly accessible, through MHA common information data model, via MHA published APIs. A detailed description is included in the second's year architecture deliverable D3.8.



Linking MyHealthAvatar with external systems through well-defined interfaces

5.2.4 Visual analytics tools

WP8 has built a range of visualization tools such as timeline, diary, map-based visualization, dash-board. This suite supports interactive visual data analysis through a number of means:

- Data selection schemes
- Curves and histograms
- Visual pattern exploration
- Matrix views
- Subspace clustering
- Graph techniques

The suite is capable of visualizing a variety of health related data. While it is originally a part of the avatar, modifications can make it possible to work independently of it. We must examine the possibility of utilizing the visualization suite as a standalone module that may be linked to other health databases.

5.2.5 Data collection utilities

The Data Collection Utility (DCU) project of MyHealthAvatar (MHA) is a platform utility for user to gather, store health information in a style of life logging. DCU's data collection enables users to establish connections with Software-as-a-Service (SaaS) providers, to retrieve data on behalf of the user automatically. For other type of data formats, DCU has created generic data collection interfaces which allow DCU to collect data from various sources, which includes user's own input, devices without public APIs and some datasets exported from other applications. WP6 has built a range of visualization tools from different sensors and from mobile phones. This will also allow the avatar to be collected to social media for dissemination purpose.

DCU module is currently an integral part of MHA but it is basically it is itself a web based application which support user to interact from various devices and operating systems and as such it could be utilized in a different system.

5.2.6 Data processing, fusion and analysis tool

The Data processing tool in MyHealthAvatar aims to analyse the data collected through DCU. This includes missing/incomplete data imputation; noisy data processing and data aggregation from different sources (e.g. wearable sensors, mobile phones, etc). A number of advanced data mining technologies have been developed to provide deeper knowledge representation and retrieve information that is valuable to each individual.

The current data processing tool also has functionality to estimate /predict people's overall daily active levels (i.e. from level 0 to level 4 with the 4 being highly active) from the collected life-logging data (i.e. walking step, duration, distance) . This provides user a summary/ indication of general active status.

5.2.7 Data repository

Within MyHealthAvatar, collecting, accessing, managing and possibly sharing healthcare related data is a very important area. The design of repositories takes into account the consideration that the data will be large and likely to fall into the category of Big Data, bearing in mind the number of users and the quantity and types of the information that will be stored on daily basis for the duration of a person's entire life. WP6 has built the MHA cloud, which hosts the data repository. This is scalable to host future big data of the platform. Similarly to other parts of the MHA framework, it is an asset that is valuable and also utilizable in its own right.

5.2.8 Model repository

Following the predictive approach of the MyHealthAvatar, as well as the drive for patient empowerment, the need for an infrastructure that will host pertinent models and tools for predicting the progress of a disease, educating the public and aiding in self-risk assessment is a sin qua non feature of the final product.

With these principles in mind, MyHealthAvatar contains a clinically oriented model repository, tailored to the needs of the MyHealthAvatar project, containing models of special biomechanisms such as tumour growth and response to treatment. It is also accompanied with an execution engine to ensure that all predictive simulations and tool executions will be carried out in an orderly manner. At the same time, they are designed to be generic enough to be usable in the context of several different medical scenarios.

There has been a significant amount of provision in the repository's design for further compatibility and capability to store models, stemming from results of the past, the present and the future of modelling research, associated not only with cancer, which is currently being represented by a set of

Nephroblastoma models covering three different treatment scenarios, but to other diseases as well. Furthermore, its set of internal web services for communication with the outside world and the built-in dual user management system facilitate its potential for independent operation (through their internal web services), thus making it able to serve future projects with its ever evolving form.

The aforementioned solidify the model repository's characterization as a highly exploitable and exportable part of the project.

5.2.9 Reminder service

The reminder services will be made available to patients as part of behaviour intervention measures, especially for those suffer memory problems.

5.2.103D avatar /visual annotation

A web-based 3d avatar rendering suite has already been integrated into MHA platform. The evaluation of suite has also been carried out, responses show that the avatar rendering suite is an effective and efficient tool for visual analytics of 3d human anatomy. We are continuing our effort to improve the integration of the web-based 3d avatar rendering suite with future MyHealthAvatar functions. The rendering of 3D avatar is available as a data browser as well as an educational tool.

5.2.11Patient Summary

The data push/pull model will make the patient summary available as part of user profiling. This will be able to potentially solve the data sharing problem in the current healthcare system and the patient will be able to travel across different countries with a consistent medical summary information. For more details there is detailed description in D3.8 deliverable.

5.3 Intangible assets

Intangible assets or outcomes arising from MHA are based on experience and information gathered through the course of the project. Members of the MHA consortium may provide services to third parties that are partly or entirely based on knowledge generated through the project. Services have the advantage of not generating IPR issues and also they are more in line with the usual activities of academic partners. In this section we consider consulting services, training services and customisation as intangible assets arising from the project.

5.3.1 Consulting services

Based on the learning and outputs of the MHA development, project partners can provide advice to organisations with regards to health and fitness data management. Partners can entail advisory roles on the following:

- Architecture of a complex health data management system. As a standalone system has minimal chance for success, it is crucial to have a solid methodology for the integration with external sources such as hospital records, existing data and model warehouses etc. The knowledge accumulated during the MHA project can provide a significant asset for a new commercial or academic project.
- Our experience in developing a core Ontology describing multi-scale medical data, social activity and models is extremely valuable. We can advise on mapping formalism, query translation or Semantic Reasoning for Decision Support.
- Building scenarios and use cases based on the user needs. This is a critical element of a any health records system where being comprehensive is a major requirement.
- Health related visual analytics with a special emphasis on a multi-layered geometry model to portray human anatomy.
- Legal consulting. Data protection is not the only legal framework of relevance, issues of intellectual property (on data, software, algorithms and concepts) is of equal importance. Procedures of collecting, saving and sharing data from third party social networks and related projects must be considered during the planning and development phase.
- With respect to open source software, there is a need for consulting services to provide the necessary expertise, configuration and customisation that would typically also be offered as professional services by commercial companies. The insight and experience of MHA has resulted in a large pool of expertise that can be focussed on use of these tools.

These consulting services can be provided by research partners. They will have to find a way to fit this new knowledge into their institution's current consultancy offerings or have to develop, maintain and market this service as a new endeavour.

5.3.2 Training services

MHA consortium members have the opportunity to integrate new elements into their existing training activities based on the project work. The subject of the thematic training offered by partner institutions broadly covers the same areas discussed in the previous section (5.3.1. Consulting services). They need to establish on an individual basis what would be the best format and subject of training offerings. Exploitation activities should provide assistance for partners in utilizing these opportunities.

5.3.3 Customization

Potential users may want to work with a modified version of the avatar or a part of the avatar. We need to establish how these requests are handled especially given the constrains of the project. The adaptation of MHA portal elements to a specific context, such as a new customer environment can be offered as a service. Partners should be able to offer customisation services for a third party depending on the requirement. This is a capability which did not exist before the project and it can clearly create new revenue streams for partner organisations.

5.4 Individual exploitation by the commercial partners

There are two SMEs within the consortium, Larkbio and ANS, their main role will be the coordination of all the project's commercial aspects. Their main tasks in the last year of the project are:

1. Elaborate the outlined business models and prepare the related detailed roadmaps with a clear description of the roles of partners.
2. Take a leading role in managing the commercialization process by negotiating with internal and external stakeholders. In case the source code is offered (or sold) to third parties, Larkbio should lead negotiations and work out the details of the process.
3. Provide assistance for partners in defining tangible and intangible assets and turning them into standalone product and service offerings. This assistance includes consultation with regards to marketing and sales functions if required.
4. ANS currently hosts the MHA platform by renting in a public cloud (Linode). It is planned that this activity will continue beyond the duration of the project in order to maintain the service.

If the consortium chooses the option of creating a start-up with the task of managing the MHA platform, Larkbio and ANS will be instrumental in launching this initiative. One of them can either explicitly take on the role of managing the platform. In this case new agreements must regulate how consortium members benefit from this setup. Another possibility is creating a new company with joint ownership of the interested partners. In this case Larkbio and ANS should take on a leading role in the management of this new organization.

6 Academic exploitation

6.1 Connections with other related projects

MHA fits into a network of more or less similar projects, most of which are connected to the well-known VPH network. Our results can only be enhanced by identifying and utilizing synergies with these projects. For this purpose we reached out to some of these initiatives and started negotiations about possible cooperation. At this stage MHA consortia members identified potential links and this is summarized in the following table. With the progress of MHA and these related projects the exact extent and form of cooperation will be continuously evaluated, planned and later realized.

Project name	Number of MHA partners recommending		
	Consultation	Share data	Build common elements/applications
Discipulus			2
VPH Share	3		
P-Medicine	2	2	3
ACGT		2	2
Tumor		2	2
EURECA			3
CHIC		1	1
eHealthMonitor			1
Reaction			1
iManageCancer			3
MyLifeHub			2
CARRE		2	

The outcomes of MHA are expected to be used differently within these projects. Details can be found in the following subchapters.

6.1.1 iManageCancer

iManageCancer project will provide a cancer disease self-management platform designed accordingly to the specific needs of patient groups and focusing on the wellbeing of the cancer patient with special emphasis on psycho-emotional evaluation and encouragement. The platform will be centred in a Personal Health Record that will exploit recent advances on Health Avatars for the individual cancer patient surrounded by m-health applications designed to encourage the patient to become more involved in their treatment management, enhance clinician-patient communication, maximise compliance to therapy, predict, detect and manage side effects, inform about drug interactions and contribute to pain management through minimisation of patient's anxiety. The Health Avatar PHR will regularly monitor the psycho-emotional status of the patient and will record in a timeline fashion everyday life experiences of the cancer patient regarding pain status

and drug side effects while different groups of patients and their families will share information through diaries. The clinical view of the PHR will be used to provide valuable information about his/her patients to the clinician, to assess the adherence of patients to therapy and their psychological status while the platform will recommend specific informative applications and serious games according to the disease type and psycho-emotional status of the patients. This will promote encouragement, awareness and reduce anxiety and depression from them. The disease management platform will be further complemented by an integrated expert system with formal self-management models executed by a Care Flow Engine and oriented to decision support, adherence to therapy and guidance for patients including drug doses self-adjustments. The Care Flow Engine will seamlessly integrate with the Health Avatar PHR. It will allow experts to model management plans that are personalised in cooperation with the patient.

In iManageCancer, we are looking into the possibility of extending the core work of MHA in its architecture as well as building an external cancer specific service that will make use of the MHA data repository. For the former, a licence agreement will be needed and an open source from MHA will be able to allow this work to happen. For the latter, the work will depend on the availability of the MHA APIs. This is less problematic since there isn't clear restriction on the use of APIs in IPR terms at the moment. The guidelines from the legal framework will be used to define the approach with respect to how to check any third party developers in the future.

Notably, partner FORTH and USAAR are also involved in this project.

6.1.2 MyLifeHub

MyLifeHub is an UK EPSRC project and it is such an attempt with focus on the interoperability of the IoT assets, aiming at a common, interoperable and internet-based environment for long-term lifestyle information for individuals. The system will keep users well informed about their daily activities, diet, sleep, mood, blood pressure, pulse, etc., enhancing self-awareness in health and encouraging positive attitudes towards lifestyles. Data sharing among different users will also be enabled to allow for experience exchange and to build healthcare social-networks among users. Especially, MyLifeHub will feature new techniques enabling simultaneously and long-term quantifying the functional impairment related to vision underpinned with smart glasses (e.g. Google-Glass), which provide wearable sensors to connect with the environment through RFID, infrared, Bluetooth or QR code, allowing for a constant monitoring of the behaviours of people's vision. MyLifeHub will be utilized as a platform to assess the impact of visual impairment on the QoL of ophthalmic patients both in general health terms and in vision specific terms. The research will be conducted "in the wild" through direct exposure to potential beneficiaries. Our clinical collaborator, Moorfields Eye Hospital (MEH), is the largest eye hospital in the UK and earns a reputation worldwide. The outcome of MyLifeHub will be evaluated by the end users (namely MEH and its patients).

In MyLifeHub, the MHA platform will be used as the main platform to collect patient information from the participants from MEH. LUH has already offered a legal framework to allow this to take

place. This will be a very good example of applying the MHA in a clinical setting. Currently this is going through an ethical clearance at MEH.

6.1.3 CARRE

CARRE is a EC FP7 project that addresses comorbidity management via an approach that first fosters understanding of the complex interdependent nature of comorbidities in general and as specialized for the specific patient, then calculates informed estimations for disease progression and comorbidity trajectories, and finally compiles a variety of personalized alerting, planning and educational services so that patients (and professionals) are empowered and can make shared informed decisions. CARRE research aims at a technological infrastructure for visual understanding of disease progression pathways and comorbidity trajectories, enriched with medical evidence and personalized for the individual patient. Based on this, CARRE will develop personalized shared decision support services for the patient & the professional. CARRE innovation lies in semantic interlinking of 3 types of data (a) medical ground knowledge; (b) up-to-date medical evidence; and (c) personal patient data, in order to create a personalized model of the disease and comorbidities progression pathways. Visual presentations of this personalized model (against ground knowledge and against statistical views of 'similar' patient groups) will form the basis for patient empowerment services. Finally, the personalized model of comorbidities will be used for shared decision support services targeting personalized education, complex risk calculation for disease & comorbidities progression, alerts for adverse events of multiple treatments and personalized planning. The ultimate goal is to provide the means for patients with comorbidities to take an active role in care processes, including self-care and shared decision making, and also to support medical professionals in understanding and treating comorbidities via an integrative approach. CARRE will address the specific medical domain of cardio-renal disease comorbidities and will provide proof-of-concept via deployment and validation in two different healthcare settings.

However, despite the potential links, the role is MyHealthAvatar in CARRE is still not very clear. Further discussions with the CARRE consortium are still needed. The possible engagement could be at the platform level (using the platform), and at the source code level (subject to the open source licensing).

6.2 Individual exploitation

This section collects all the individual exploitation plans for the MHA partners. They have different interests on MHA outcomes and due to their respective nature (industry, academic, research or community) their business goal is completely different and the benefits they expect from MHA as well. We have classified the exploitation plans according to this nature and the requested information is slightly different.

6.2.1 University of Bedfordshire (BED)

The results of MHA will be utilized in the following projects where BED is also a consortium member: IManageCancer (H2020), MyLifeHub (UK EPSRC), CARRE (FP7). For details see the previous chapter.

6.2.2 Foundation for Research and Technology – Hellas (FORTH)

FORTH's exploitation actions focus primarily on transferring basic research results to more applied research endeavours with the prospect of providing prototypical (open-source) implementations of algorithms, methods and systems to consortium partners, other labs and institutes within FORTH and to the relevant research and industrial community. Some of Forth's particular endeavours include:

- Share semantic integration, model evolution and summarization with EURECA, p-Medicine projects
- Share semantic backbone with iManageCancer project
- Semantic Integration, Model Evolution & Summarization are enabling technologies for new H2020 proposals

Forth is also planning to provide open-source implementations for exelixis and RDFDigest.

The course "Advanced Database Topics" in Computer Science Department of University of Crete, started in the spring of 2014, included lectures about schema matching, model evolution and data integration. The course "Semantic Web" in the Department of Informatics Engineering at the Technological Educational Institute of Crete started in the fall of 2014 included lectures about ontology evolution and summarization. Both courses are continued in 2015 and beyond.

In the future FORTH aims to participate in future projects to develop the following: Smart PHR systems, Personalized Health Systems, Semantic Interoperability mechanisms, Semantic Summarization algorithms and toolsPHR systems and effective health computing applications.

6.2.3 Universitaet des Saarlandes (USAAR)

USAAR was instrumental in the development of the MHA use cases. They plan to utilize use cases in order to demonstrate the existing need for these. The effect of the use cases will be a better understanding of IT as a need for healthcare of today. The institution aims to develop a summer School for teaching medical students and others how important IT, patient empowerment, etc.

USAAR is also a consortium member of iManageCancer and will exploit MHA within iManageCancer.

6.2.4 Institute of Communication and Computer Systems (ICCS)

The institution's main focus will be the development of cancer model repositories. Knowledge acquired through the project will be incorporated into postgraduate course entitled "Multi-scale Cancer Modelling and In Silico Medicine", started in autumn-winter semester 2014

(http://www.vph-institute.org/news/new-postgraduate-subject-on-multiscale-cancer-modelling-and-in-silico-medicine-mscm-ism.html). This course has been proposed and is taught in the School of Electrical and Computer Engineering, National Technical University of Athens (NTUA) by Georgios Stamatakos, ICCS-NTUA. This course will extensively exploit the outcome aspects of research projects funded by the European Commission. As a further extension of the work done in WP5, future PhD or post-doctoral research positions will be designed in ICCS-NTUA in the field of in silico oncology/medicine.

In addition, the work done for the creation of the model repository in WP5 can be further exploited in the framework of future EU-funded activities.

6.2.5 Leibniz Universitaet Hannover (LUH)

LUH has deep expertise in data protection in medical context, as well as in legal informatics and intellectual property. MHA and similar projects combine these diverse areas and permit LUH to provide highly specialised legal counsel.

The best practices developed can also be carried on to future projects. The legal principles are applicable to all types of medical projects through the nexus of sensitive (health) data. Similarly, the specificities of a cloud based platform and health services provided over the internet can be transferred to other similar projects.

6.2.6 Technological Educational Institute of Crete (TEI-C)

As a research and academic organization TEI-C's exploitation actions focus primarily on transferring research results to prototypical (open-source) implementation, methods and systems to consortium partners, other labs and academic communities.

The institution has already started the academic utilization of MHA results. The courses "eHealth multimedia services", eHealth and Bioinformatics and "Modelling of physiological systems" in Computer Engineering Department of the Technical Educational Institute of Crete, during 2014, 2015 include the lessons learned in WP3 about architecture and integration. The tools developed in the context of MHA project will be used for the training of students and the conduct of experimental evaluation. The goal is to train student in state of the art technologies about architecture design, iterative system modelling and building and integration.

In the future TEI-C aims to participate in future projects to develop smart PHR systems and effective health computing applications.

6.2.7 University of Lincoln (LIN)

The results of MHA will be utilized in the MyLifeHub (UK EPSRC) project where LIN is also a consortium member. LIN's main focus in the project is to analyse a large scale data collected from heterogeneous sources, using advanced data mining technologies to provide deeper knowledge

representation and retrieve information that is valuable to each individual. Knowledge acquired through the project will be incorporated into our postgraduate courses.

The results of MHA will be utilized in the MyLifeHub (UK EPSRC) project where LIN is also a consortium member. For details see the previous chapter.

LIN will also exploit the outcome of MHA to other areas of healthcare, such as personalized pregnancy care in term of nutrition, exercises, lifestyles, where MHA will be tailored for self-management of maternal health.