Active Older Adults @ Workplace

D2.01 – Report with the major market-driven requirements

Project Deliverable

D2.01 Report with the major market-driven requirements

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0.2	26/02/2015	INOV	Added the market analysis contribution sent by MSIC
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0.5	30/04/2015	INOV	Final revision/improvements
1.0	30/04/2015	ATOS	Final version submitted to the AAL CMU

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1. Executive Summary

This document is the deliverable “D2.01 - Report with the major market-driven requirements” for the Active@Work project. This document contains a precise description of the potential hurdles and enablers inherent to the implementation of the intended platform, an analysis of risks, and specification of a mitigation plan. It also includes all ethical issues that must be guaranteed during the project. It is the output result from the task “T2.01 - Stakeholders/Sector/Social/Ethical concerns, market analysis, standards and regulations” within Work Package 2 (End-User Requirements).

1.1. Acronyms

.LRN	Learn, Research, Network
AAL	Ambient Assisted Living
ADL	Archetype Definition Language
ANSI	American National Standards Institute
API	Application Programming Interface
AQL	Archetype Query Language
ASHAE	American Society of Heating and Air-Conditioning Engineers
ASTM	American Society for Testing and Materials
CBE	Center for the Build Environment
CCR	Continuity of Care Record
CDA	Clinical Document Architecture
CEN	European Committee for Standardization
CEO	Chief Executive Officer
CGM	Continuous Glucose Monitor
CIMM	Clinical Information Model Manager
CKM	Clinical Knowledge Manager
DSR	Design Science Research
DSTU	Draft Standard for Trial Use
ECG	Electrocardiograph
EHR	Electronic Health Record
EU	European Commission
FDA	Food and Drug Administration
FHIR	Fast Healthcare Interoperability Resources
FOPL	First-Order Predicate Logic
HAPI	HL7 API
HDP	Health Device Profile
HL7	Health Level Seven
HMD	Hierarchical Message Descriptor
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
HVAC	Heating Ventilation And Air Conditioning
IAQ	Indoor Air Quality

ICD	International Classification of Diseases
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
IEQ	Indoor Environmental Quality
ILQ	Indoor Lighting Quality
INR	International Normalized Ratio
IOS	Information On the Spot
IrDA	Infrared Data Association
ISO	International Organization for Standardization
ISQ	Indoor Sound Quality
IT	Information Technology
ITQ	Indoor Thermal Quality
JSON	JavaScript Object Notation
L2CAP	Logical Link Control and Adaptation Protocol
LMS	Learning Management System
LOINC	Logical Observation Identifiers Names and Codes
MCAP	Multi-Channel Adaptation Protocol
MERV	Minimum Efficiency Reporting Value
NFC	Near Field Communication
OS	Operating System
OSI	Open Systems Interconnection
PC	Personal Computer
PDF	Portable Document Format
PHR	Personal Health Record
PLM	Product Lifecycle Management
PMV	Predicted Mean Vote
PPD	Predicted Percentage of Dissatisfied
R&D	Research and Development
REST	Representational State Transfer
RFC	Request for Comments
RIM	Reference Information Model
SaaS	Software as a Service
SABTE	Sleep Apnoea Breathing Therapy Equipment
SDK	Software Development Kit
SDP	Service Discovery Protocol
SGML	Standard Generalized Markup Language
SIG	Special Interest Group
SME	Small and Medium Enterprises
SMS	Short Message Service
SNOMED CT	Systematized Nomenclature Of Medicine - Clinical Terms
SOAP	Simple Object Access Protocol
SQL	Structured Query Language
TS	Technical Specification
UK	United Kingdom

UML	Unified Modelling Language
UNED	*Universidad Nacional de Educación a Distancia*
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
USA	United States of America
USB	Universal Serial Bus
USD	United States Dollar
VOC	Volatile Organic Compound
W3C	World Wide Web Consortium
WP	Work Package / Working Party
WSDL	Web Services Description Language
XML	Extensible Markup Language
XSD	XML Schema Definition

2. Introduction

Active@work is an EU project with the main goal of supporting senior employees to perform their job efficiently without risking their health condition. The Active@work focus is an integrated approach to manage the negative impacts of aging both physiologically and psychologically, while taking the advantage of senior employees' valuable experiences. Elderly employees who are close to their retirement age are concern with realizing some changes in their psychological and physiological systems. Most of the time these changes are not easy to realize from outside and even the person himself ignores these signs and changes. The fact that it is not easy to accept these changes would be the reason of this ignorance. Thus, Active@work as an assistant system has the goal to help the senior employees who are going through this phase of life to spontaneously do their daily duties at work and deal with psychological and physiological demands of normal aging.

The main scientific challenges for Active@work are the management and extraction of useful information from vast amounts of environmental and physiological data, the development of a customized system to influence behavioural change, and developing a solution applicable in differing working environment. In order to meet these challenges, Active@work will investigate: (i) how best to provide the dynamic accurate measurement and data transfer of useful information about end-user, (ii) how best to use physiological and environmental data to improve the senior employees well-being and influence end-users to modify their behaviour, (iii) how to arrive at the best business model to convert a promising technology into a useful and cost-effective product, and (iv) how to demonstrate and validate the new methodologies on two case studies in Spain and Belgium.

2.1. Project Overview

The Active@Work project consists of a modular solution with a Virtual Assistant tool able to assist adult workers, in particular those close to retirement age, to continue executing their daily work or to continue active despite their age. It will be a multi-modal solution (e.g., PC, tablets or smartphones), capable of interacting with the end-user in a very natural and personalized way. Usability requirements are therefore a major concern to dynamically adjust interaction and notifications in conformity to each end-user profile, providing information to assist senior workers to keep active and healthy, both physical and mentally.

The solution will incorporate an "intelligent agent" that will assist the user at accomplishing his/her work without compromising health and preventing any other risk derived from fatigue or stress at work. One of the main characteristics of the solution will be the capability to actively intervene, in response to identified potential health threats that could compromise workers health status or compromise their role within the organization. Advanced multi-sensors will be provided to monitor each individual health status.

The solution will also provide support for the worker to engage in new and rewarding activities, where his/her knowledge and experience will be an important and recognized asset. Team management and tutoring of younger elements by older adults will be, together with the training environment, some of the innovative features within the project.

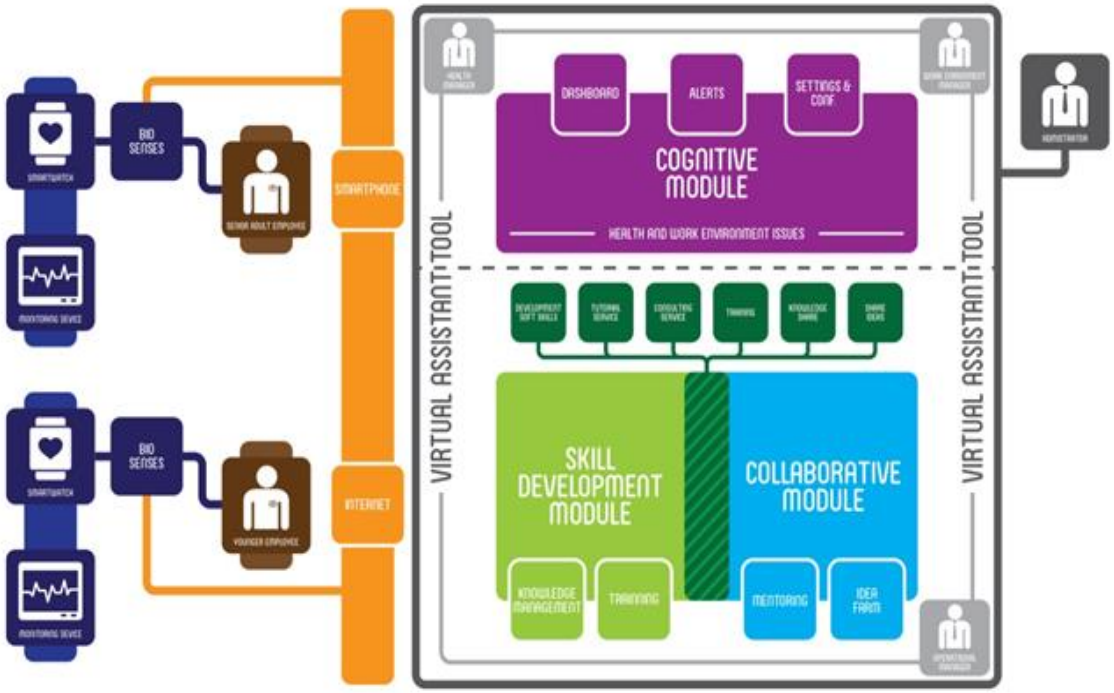


Figure 1 – Active@Work Architecture Overview

2.1.1. Project Objectives

As seen in *Figure 1*, the Active@Work project will provide a modular solution with a Virtual Assistant tool able to assist adult workers in particular those close to retirement age, to continue executing their daily work. This solution consists of:

- A Cognitive module capable to represent the conditions of the work environment providing a catalogue of services to assist the user in their daily work.
- A Collaborative module to promote active participations and interactions between employees, sharing of experiences amongst older and younger employees. Provides a collaborative environment to endorse innovative ideas as well as the establishment of mentoring services.
- A Skill Development module addressing a training environment to provide support for workers to engage in new activities, where their knowledge and expertise can be an important asset.

Using a Design Science Research (DSR) approach, end-user concerns will be considered from multiple perspectives. To warrant that the Active@Work prototype addresses market needs, the end-users will be involved during the project development and test phases. Active@Work pilots will cover heterogeneous organizational processes on various working environments. The solution will be tested in two pilots. The organization of the first pilot study will be led by Atos - an international leader in digital services and will take place in the main headquarters of the company in Madrid. The second pilot project will be deployed in Belgium and the organization will be led by IOS International and Sensolus. This pilot experiment will take place at a large leisure site with over 200 vacation homes and a tropical swimming pool.

2.1.2. Expected Results and Impact

The expected results and impact of the Active@work project include:

- Capability to detect and monitor a set of bio-parameters through the use of multi-sensor wearable devices.
- Assist the user at accomplishing his/her work without compromising health and preventing any other risk derived from fatigue or stress at work.
- Assist senior workers to keep active and healthy, both physical and mentally. Including the capability to intervene, in response to identified potential health threats that could compromise workers health status or their role within the organization.
- Support for the worker to engage in new and rewarding activities, where his/her knowledge and experience will be an important and recognized asset.
- Senior workers will have the possibility to exercise and raise their cognitive skills or recover their skill levels within a training environment.
- Provide operational intelligence with a proactive model and predictive algorithms for recognition of behavioural trends and early detection of personal health risks, triggering alert messages whenever individual health thresholds conditions are exceeded.

2.2. Introduction WP2

The objective of WP2 has been three folded: First, to review the current situation with respect to the drivers and barriers to implement the intended system as well as to analyse the market standards and regulation (task 2.01). Secondly, the work package focuses on collecting information from (potential) stakeholders to understand their needs and concerns and to translate these needs into requirements to smoothen the translation of the collected and analysed needs into the system (task 2.02). Thirdly, consolidate the requirements and evaluate them by senior employees (task 2.03). As such, work WP2 plays a central role in the project as it feeds into all other work packaged throughout the entire duration of the project.

2.2.1. Introduction Task 2.01

This task addresses a precise description of the potential hurdles and enablers inherent to the implementation of the intended platform, an analysis of risks and specification of a mitigation plan. This task also addresses all ethical issues that will need to be guaranteed during the project.

This document is organized in the following way:

- Chapter 3 presents a brief summary of other Ambient Assisted Living (AAL) Joint Programme approved projects in the same field as the Active@Work project.
- Chapter 4 presents a market analysis performed in order to find solutions similar to the Active@Work project idea (explore the business potential).
- Chapter 5 identifies and describes relevant standards and quasi-standards available on the market (from the interoperability point of view) that might be used.
- Chapter 6 lists regulatory requirements related to health monitoring solutions (privacy, ethical concerns) and indoor environmental quality that should be taken into account.
- Chapter 7 performs a risk analysis and describes mitigation strategies chosen to reduce the identified risks.
- Chapter 8 presents the document conclusions.
- Finally, chapter 9 contains the references list.

3. Related Work

Since this document is the first Active@Work project deliverable we decided to include a chapter that presents a brief summary of other Ambient Assisted Living Joint Programme approved projects in the same field as the Active@Work project. The main goal of this survey is to have a better understanding about the state-of-the-art in the field of ICT-based solutions for supporting occupation in life of older adults – the subject of Call 6 (http://www.aal-europe.eu/our-projects/call-6/), the same of the Active@Work project.

ANIMATE
Start: April 1, 2014 Duration: 36 Months http://www.aal-europe.eu/projects/animate/ http://www.animate-aal.eu
ANIMATE provides a cross-generation community based service exchange system where companies employing qualified older adults can offer workshops and learning experiences to the younger professionals of other companies and in turn get back the experience that they have provided as working hours or weeks from the workforce available in the community companies. This would enable the transfer of knowledge in the local network between aged professionals and younger or newly employed workers and this will also keep senior workers more active and motivated in their workplace as they are involved in stimulating environments with younger professionals. End users will test an initial prototype which will be refined in successive iterations (prototypes) with the observations that they provide so end users will be involved in all the project phases. More than 100 tests will be carried in UK and Romania with elderly working and unemployed between 60-75 and with companies.

CogniWin
Start: May 1, 2014 Duration: 30 Months http://www.aal-europe.eu/projects/cogni-win/ http://www.cogniwin.eu
CogniWin will primarily help older adults adapt cognitively with their tasks based on information collected implicitly through their interactions with the system (intelligent mouse interactions, eye tracking, navigation clicks) as well as explicitly provided personal and cognitive characteristics (e.g., well-being issues, cognitive processing abilities). The Adaptive Support and Learning Assistant is a new mean for learning offered to older adult workforce. Furthermore, CogniWin provides a smart advising tool delivering to the older adults personalized well-being guidance to improve their occupational lifestyle. The advisor considers personal well-being characteristics, and also light age related cognitive and physical limitations, like getting easier tired. CogniWin test-phase will involve two test beds for a total of 70 end users working in highly computerized environment and who are dealing daily with complex tasks. The system is configured to be multilingual and to be adaptable to different IT environments.

ExpAct – Experience keep people Active

Start: September 1, 2014
Duration: 24 Months
http://www.aal-europe.eu/projects/expact/
http://www.expact.eu

When older people retire, valuable skills and expertise are lost to society and the labour market. For those affected, the step into retirement often proves difficult. The ExpAct project aims to develop a software framework with which to create and operate platforms that support older people by making it easy for them to offer first-hand professional and life experience, while participating in social and professional activities. This experience can be of great benefit to profit or non-profit organizations, associations, and private individuals. To facilitate successful matches and bring together those who offer experience with those who demand it, innovative matching algorithms and a sensitive taxonomy are being developed, enabling different kinds of experience to be entered and retrieved. To understand the needs of providers and beneficiaries of experience with regard to the system, users are integrated along the whole development process. This ensures a solution that is needs-based as well as oriented to its target-group and market.

Elders-Up!

Start: July 1, 2014
Duration: 30 Months
http://www.aal-europe.eu/projects/eldersup/
http://www.eldersup-aal.eu

The objective of the Elders-Up! project is to create an ecosystem for collaboration between seniors and small companies, in order to bring the valuable experience of elderly to them, thus addressing intergenerational knowledge transfer. SME may struggle to cover all the areas of knowledge that a company needs to bring their products to the market. For them, the knowledge transfer from experienced employees is vital. On the other hand, seniors are sometimes set apart in the work environment due to the fact that they are considered less efficient and productive. Their jobs represent the way of feeling useful.

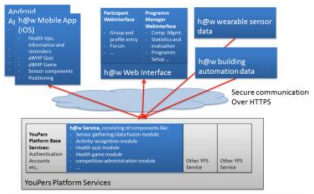
Fit4Work - Self-management of physical and mental fitness of older workers

Start: 36 Months
Duration: June 1, 2014
http://www.aal-europe.eu/projects/fit4work/
http://www.fit4work-aal.eu

The Fit4Work project will develop an innovative easy-to-use and unobtrusive system that will support older workers in reducing and managing physical and mental stress resulting from their occupation. The system will provide ambient ways of monitoring physical and mental activities at work. Smart algorithms will provide context-sensitive personalized recommendations for adjusting the workplace and behaviour at work, as well as define mid- and long-term lifestyle plans to meet the demands of the work taking into consideration the worker's age.

healthy@work

Start: April 1, 2014
Duration: 24 Months
http://www.aal-europe.eu/projects/healthywork/
http://www.youpers.com/en/



The healthy@work project wants to increase occupational health maintenance and well-being especially for older caregiving professionals and office workers. The project helps to establish healthier behaviours in occupation and at home. It addresses the often-experienced gap between just knowing what would be good for your body and mind and actually starting to change your daily behaviour. The personalized adaptive workplace health promotion programme (healthy@work) is a mobile application platform and associated infrastructure that promotes healthy behaviour through small daily inputs, activities and monitoring.

PEARL - Platform for Ergonomic and motivating ICT-based Age-friendly woRkpLaces

Start: May 1, 2014
Duration: 30 Months
http://www.aal-europe.eu/projects/pearl/
www.pearl-project.eu

The objective of PEARL is to create motivating and age-friendly smart workplaces. PEARL wants to support the extension of the working life and the intergenerational exchange between older and younger colleagues. The project will research, develop and deploy a programmable platform enabling the integration and customization of supportive ICT technologies, such as ergonomic surfaces, tools for cognitive support, intelligent time and task management as well as trainings on the job. Smart user identification will allow the automatic reconfiguration of workplaces according to specific user needs and preferences.

ProMe – Professional Intergenerational Cooperation Mentoring

Start: April 1, 2014
Duration: 36 Months
http://www.aal-europe.eu/projects/pro-me/
http://pro-me.eu

The project aims at offering an ICT solution that will be designed to facilitate intergenerational dialogue, lifelong learning and to create value among generations. ProMe seeks to provide meaningful opportunities for occupation in the life of older adults, in the transition from work to retirement and beyond. It allows:

- The exchange of professional formal and tacit knowledge.
- Intergenerational cooperation and mentoring via an online service, bringing together older adults with younger generations.
- Meaningful occupation on a voluntary basis.

WELLBEING - Optimizing the Workplace of ELderly Laborers: BE IN Good health!
Start: June 1, 2014 Duration: 36 Months http://www.aal-europe.eu/projects/wellbeing/ http://www.wellbeing-project.eu
Wellbeing offers a holistic web-based platform, combining physical training, workplace ergonomics, nutritional balance and stress management in order to ensure a healthy life style at the workplace, especially focusing on the needs of older adults. Since older adults are working in very diverse fields, the project focuses on the main thing they all have in common in order to reach a broad target group: performing their job in a sitting position for a longer period of time. Hence the project supports e.g. secretaries, office clerks, technicians, lawyers at the same level and can be extended to new target groups easily.

4. Market Analysis

Nowadays we have several companies that sell E-learning platforms with or without training and social/collaborative tools. In this section some companies will be described that can have products similar with the main idea of the Active@Work project. The next sub-sections are organized taking into account the project modules previously introduced in section 2.1.1 (please refer to it for details). Prices are provided if available, since they give an idea of how much money people are willing to pay for a somehow similar product.

It is relatively easy to find wearable devices for fitness that measure heart rate, respiratory rate and other blood flow parameters. There are some devices that measure stress by sweat. If the idea will be to adapt an existing device to our platform, the market already offers a variety of products.

4.1. Collaborative Module

4.1.1. InnoCentive@Work

URL: http://www.innocentive.com/

Location: Headquartered in Waltham Mass. USA with an office in London UK

InnoCentive is the open innovation and crowdsourcing pioneer that enables organizations to solve their key problems by connecting them to diverse sources of innovation including employees, customers, partners, and the world's largest problem solving marketplace.

Corporative Solutions:

- **Premium Challenges** – Online platform for crowdsourcing innovation problems to talented minds from all over the world that compete to provide novel ideas and solutions to important Challenges.
- **InnoCentive@Work** – Cloud-based enterprise innovation management platform for building collaborative internal innovation communities to harness the collective intelligence of your employees and partners.
- **Custom Challenge Programs** – High-profile Challenge programs and innovation competitions, uniquely tailored to your needs, for solving big problems and encouraging breakthrough innovations.

How can InnoCentive@Work Benefit You?

- Allows you to harness your internal brainpower before looking outside to quickly generate novel ideas and solve key problems (and, avoid re-inventing the wheel).
- Augments and accelerates your existing innovation management processes such as PLM, Stage-Gate, and Six Sigma to preserve existing capital and skillset investments.
- Improves your collaboration with internal and invite-only audiences as well as existing knowledge resource systems by harnessing the power and diversity of crowds.
- Enables complete control of Challenge distribution channels and target problem solver audiences to optimally align ideas or problems to the audience(s) most likely to solve them.

- Enables you to keep highly sensitive Challenges “inside” the company, but also provides you an escalation option to post – publically or anonymously – your unsolved Challenges to InnoCentive’s open global community of 300,000 problem solvers.
- Delivers innovation reporting, analytic, and measurement capabilities along with auditing for continuous tracking and improvement.

Dwayne Spradlin, CEO of InnoCentive, Inc. “As businesses have become more global, R&D networks have been established around the world. InnoCentive@Work addresses geographical challenges and encourages increased collaboration that harnesses creative intelligence throughout a worldwide organization. It allows a company to apply their best internal resources to a company Challenge, ensuring that they are solved faster, better and cheaper.”

4.1.2. TallyFox Social Technologies AG

URL: http://www.tallyfox.com/

Location: Zurich, Switzeland

TallyFox Social Technologies AG is headquartered in Zurich Switzeland with a software development team in Serbia and provides cloud based collaboration solutions that integrate knowledge, content and project management. The utilities provided in the TallyFox knowledge network platform have the specific purpose of identifying people with specific know-how, the content that is associated with them, and where both are located. The objective is creating new insights that contribute to continuous growth of a community’s knowledge capital.

You can categorize contents according to each member’s needs. Main features include a Knowledge Bank that allows members to learn in the form of questions, answers and poll results; the SmartMatchPro where you receive custom alerts matched to your personal needs make it easy to find relevant information; with Online Meeting Solution you have chat, voice and web conference meeting spaces to enable more efficient meetings; with Content Sharing and Wikis it allows you share documents with your group or general public and it makes easy for teams to collaborate on documents and export as branded PDF’s.

Case study: The Water Network

In 2011 TallyFox launched the first Knowledge Network for water professionals. Today TheWaterNetwork.org is leading online network for global water professionals with 5200 companies represented from over 170 countries. We are proud to provide our platform to help the world’s water professionals address the complex issues that result in over 1 billion people not having access to clean drinking water and sanitation. Individual professionals can join for free. Professional workspaces for non-profits and educational institutions are provided at no change. The Health, Energy, and Food networks are in planning. We are dedicated to provide Knowledge Networks for the world's most critical sectors. If you would like one in your own we would love to hear from you.

Products:

- Cluster – Smart Cloud Collaboration: An online Platform for Content, Project & Knowledge Management. Clusters can be customized for a variety of use cases including:
    - Content Management
    - Project Management
    - Knowledge Management
    - Ideation
- Network – Powerful Knowledge Network
    - The Network allows individuals to share best practices, collaboratively build sector intelligence and work more efficiently. Within the platform, members can set up private groups or work collectively with industry peers.
- EventFox – Clever Event Management

Prices (per month):

Accounts	Basic	Plus
5	free	€40,00
10	€30,00	€60,00
50	€180,00	€250,00
200	€620,00	€810,00
500	€1400,00	€1620,00

Table 1 – Cluster prices

4.1.3. Jive

URL: https://www.jivesoftware.com/

https://www.linkedin.com/company/jive-software

Location: Palo Alto, California, USA

Jive Software, Inc. is headquartered in Palo Alto, California, USA with offices in United Kingdom, France, Germany, Netherlands and Sweden. It is focused to provide modern communication and collaboration solution for business.

Jive product is the digital workplace that unites people, conversation and content across your business, helping your employees work much better together. With Jive, everybody can connect, communicate and collaborate in one place to stay informed, aligned and productive. Jive integrates with your essential apps and systems, and runs on desktops, smartphones and tablets, enabling people to work however and wherever they work best.

Jive Daily is a go-anywhere app that is easy to use and that lets you bring targeted, relevant communications to every level of your organization. And to make sure your messages are getting through, detailed metrics are in place to measure your overall impact, every time.

Case Studies:

a) https://www.jivesoftware.com/wp-content/uploads/2014/09/jivesoftware_liveperson_case_study.pdf

Senior management is able to share company developments with employees via blog posts and videos, using Jive's blogging and video sharing capabilities.

b) https://www.jivesoftware.com/wp-content/uploads/2014/09/jivesoftware_alcatel_lucent_case_study.pdf

"Now employees feel they have a real dialogue with the senior leadership. It's made us more of an open culture, and its increased broad participation and effective decision-making." Jem Janik, Enterprise Community Manager, Alcatel-Lucent.

Prices:

2 USD per user and per month.

4.2. Skill Development Module (and also Collaborative Module)

4.2.1. Docebo

URL: https://www.docebo.com/

Location: Napoli, Italy

Docebo is headquartered in Napoli, Italy and is a Cloud E-Learning solutions provider that is revolutionizing the online training market with its Software as a Service (SaaS) Learning Management System (LMS). An LMS or E-Learning platform is a learning software designed to deliver, track and certify online courses and training.

DoceboLMS it is a product that was designed to be delivered in SaaS as an ecosystem of features and modules that can be enabled or disabled per customer requirements. The LMS is very easy to use; manages, delivers and tracks instructor led and web-based training activities; organizations can better train their workforce, channels and clients; Enterprise Cloud Solution option allows the LMS to run on a dedicated Cloud instance; Robust and extendable in order to meet large sized project requirements.

Social apps and widget – Engage your students with Social Learning using Forum, Comments and Blog.

Also with Mobile app, Docebo delivers learning at the point of need and on-demand via all devices including mobile and tablet.

Prices:

50 users – 170€/month

250 users – 390€/month

500 users – 490€/month

1000 users – 590€/month

4.2.2. Epignosis

URL: http://www.talentlms.com/

http://www.efrontlearning.net/

Location: San Francisco, California, USA

Epignosis is headquartered in San Francisco, California, USA, with offices in United Kingdom and Greece. It is a learning technologies vendor that publishes TalentLMS a leading SaaS LMS platform which became available at the end of 2012 and currently supports more than 25,000 e-learning portals, making an average month-on-month growth rate higher than 10%.

TalentLMS is an online learning management system that can be used by organizations to train employees, partners, customers or students. It enables trainers to offer online training to a lot of people in a reproducible way. The course marketplace allows course sellers a channel to promote their courses and buyers to obtain direct access to quality content.

TalentLMS is suitable for organizations or departments within organizations that specialize in training provision and are amenable to an online learning model. It can be used by businesses of varying sizes, from the micro business with five users to the large organization of 1,000+ monthly registered users.

TalentLMS main features include course creation from content around the web, learning assessment through tests and surveys, an easy reporting system, course sharing with non-registered users, and a marketplace for buying and selling courses.

http://www.getapp.com/hr-employee-management-software/a/talentlms/#product_analysis

Prices (Premium):

25 users – 109 USD/month

100 users – 239 USD/month

250 users – 369 USD/month

500 users – 499 USD/month

4.2.3. .LRN – Learn, Research, Network

URL: http://dotlrn.org/

Location: Boston, USA

.LRN support services: Cognovis, Germany; Knowledge Markets, Austria

.LRN is a complete open source LMS with a sophisticated portal system that integrates tools for course and content administration and collaborative tools.

Viaro Learning Suite is an exclusive distribution of .LRN. It is certified, tested, and fully supported by Viaro Networks. As a result, you get the open source innovation with enterprise class support.

Viaro Learning Suite includes: Installation and configuration; Basic customization including its own template design; A stable license that allows you to view and modify your files as you and trouble support; Administrative training; End user manuals; Enhancements and corrections when you need them; Fully guaranteed and supported by Viaro Networks; Oracle or Postgres database (Oracle must be licensed separately); All the open source freedom and tested version of the .LRN open source base project; Periodic upgrades on new releases as they become available (two-four per year), fully tested and administered; Keep the open source.

Case Study: UNED Spanish National University for Distance Education

Why UNED chose .LRN?

UNED uses dotLRN in two different scopes i) Exploitation (Innova Group) and ii) Research (aDeNu Group) due to the integration capabilities, adaptivity, reusability and accessibility support. In particular, **Innova** chose dotLRN due to 1) Virtual community approximation, 2) User centred approach, 3) Collaborative spaces, 4) E-mail centred work and 5) Technical efficiency. **aDeNu** group focuses on research, and uses dotLRN for its support for 1) Adaptivity, 2) Reusability, 3) Accessibility, 4) Internationalization, 5) Support for educational standards, 6) Friendly interface (more usable and accessible), 7) User tracking, 8) Blogs, 9) RSS, 10) Feeds, 11) Wiki need; No licenses of any type (number of users, processors, etc.); Continuous monitoring pages and 12) Web services to facilitate the integration of external components.

What the UNED is doing with .LRN

Innova group has developed and maintains aLF, the UNED customization of dotLRN. Statistics show that since 2000, aLF platform usage has increased according to UNED needs in terms of users and sessions but also of functionalities provided by the tool. aLF is currently hosting more than 350 courses and communities, providing services to 55,000 students, professors and tutors. The number of users is increasing year after year on 22% average. On the other side, the number of sessions is increasing more significantly, 33%, with an average of 4 million transactions per day.

At **aDeNu** group, the management of aLFanet project in dotLRN was a great success, with more than 500 files uploaded, near 30 forums created, 70 members and 10 subgroups. For the following research projects, dotLRN was migrated to version 2.2, to benefit from the new functionalities and improved interface. Currently, there are 8 active communities in aDeNu platform to manage the different projects aDeNu member are involved. 165 users are taken part in them, contributing to more than 150 forums and 100 top level folders.

4.3. Cognitive Module

4.3.1. Valencell

URL: http://www.valencell.com/

Location: Raleigh, North Carolina, USA

The most validated biometrics in the marketplace, Valencell's PerformTek sensor technology enables high-performance biometric monitoring during virtually any activity.

Comprising the world's most experienced team in wearable biometric sensor technology, Valencell is the partner of choice for leading brands in fitness, gaming and military/first-responder markets.

Valencell's biometric sensor technology provides clinical-grade accuracy for anyone, doing anything, anytime.

Our ultimate goal is to help make healthy lifestyles easier, more effective, and more affordable through seamless mobile technology. PerformTek® sensor technology has been clinically validated, and the company is pursuing FDA approval for applications within the health sector, under the Healthset® brand. Highly accurate vital statistics measurements provide the backbone of monitoring solutions for those managing hypertension, diabetes, and other medical conditions.

4.3.2. InfraVitals

URL: http://infravitals.com/

Location: Clearwater, Florida, USA

Infra-V was founded as a group of technology enthusiasts and professionals with a singular goal. The goal of designing new and innovative sensors and data acquisition systems that allow creation of ground breaking devices that blend seamlessly into daily life while changing it for the better. We have gathered from the previously diverse technology fields of software design, electronic design and manufacture and healthcare. We represent seasoned professionals with many years of experience and industry contacts who have been dreaming of an opportunity to expand the tool-sets that will improve the daily lives of millions and have taken the initiative to see innovation turn into revolution. Also, we count among us, up and coming talent with knowledge of the latest trends and developments and fresh theoretical knowledge.

After many months on the drawing board, inspired by the success of wearable technologies like the pebble, Fit bit and others, we began work on prototype designs. What we found was the wealth of reference designs and an area of technology ready to explode. It is ripe with raw opportunity in sensor design and refinement and integration into platforms made possible by the new generation of integrated circuits and development boards.

InfraV Technologies Incorporated was then registered on June 5, 2014 to seek funding to bring our prototypes to market and join this new frontier and contribute to the new and exciting community that is beginning to emerge.

4.3.3. Vancive Medical Technologies

URL: http://vancive.averydennison.com/

https://www.metriaih1.com/

Location: Headquartered California, USA

Metria™ Informed Health is a portfolio of digital health products being developed by Vancive Medical Technologies™, an Avery Dennison business, to monitor and transmit physiological information for various health, wellness and clinical applications.

In general, Metria products have three main components to them:

- Sensing: This is the actual product or device that adheres to the skin to enable sensing of the user or patient. It typically incorporates multiple sensors to collect various physiological signals. Along with the sensors, there are additional components such as on board processing and memory. It also incorporates some means of communication (for example, USB or Bluetooth) to relay the collected signals out. Vancive Medical Technologies has leveraged its expertise in skin and materials science to develop a sensing product that is comfortable to wear, and one that enhances the user's quality of life.
- Interpreting: Depending on the configuration of the Metria product, there are several algorithms to help interpret the collected sensor signals to derive specific metrics. In some cases, the algorithms may require signals from only one sensor, but in other cases it may blend signals from multiple sensor data streams. Some of the popular algorithms include activity, activity levels, calorie expenditure, sleep duration and quality, heart rate, and respiration rate.
- Visualizing: This refers to the part where the collected metrics are visualized. Again, depending on the configuration of the product, data may be visualized on a website or an app, retrospective or real time. Through this interface, a user will be able to view their activity or sleep or whatever metrics they are interested in. If real time data transmission is enabled (for example via Bluetooth), the user will also be able to get near real time access to their values. Vancive recently announced the launch of their first Metria Informed Health product – the Metria IH1 Lifestyle Assessment System. It is an unique, disposable product that can be worn continuously for up to one week, and is intended for lifestyle assessment applications.

Metria TM Partnership

Vancive Medical TechnologiesTM is eager to work with potential partners to utilize MetriaTM Informed Health technology in your applications. We offer co-branding services and API access to ensure you successfully integrate MetriaTM technology into your existing systems. Please contact us to discuss more about partnership opportunities.

5. Relevant Standards

This section identifies and describes standards and quasi-standards available on the market considered as probably being relevant to the Active@Work project from the interoperability point of view.

The next sub-sections try to present the relevant standards by major types/groups with the more specifics being presented at the beginning and the more general at the end, although it's not always easy to do this since some might be seen as belonging to more than one type/group.

5.1. Clinical Interoperability Standards

5.1.1. HL7

Health Level Seven International (HL7) (http://www.hl7.org/) is a not-for-profit, ANSI-accredited standards developing organization dedicated to providing a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services.

HL7 and its members provide a framework (and related standards) for the exchange, integration, sharing and retrieval of electronic health information. These standards define how information is packaged and communicated from one party to another, setting the language, structure and data types required for seamless integration between systems. HL7 standards support clinical practice and the management, delivery, and evaluation of health services.

HL7 standards are grouped into seven reference categories that are described at www.hl7.org/implement/standards/index.cfm?ref=nav.

5.1.1.1. Version 2.x

HL7 Version 2.x (V2) messaging standard is the workhorse of electronic data exchange in the clinical domain and arguably the most widely implemented standard for healthcare in the world. This messaging standard allows the exchange of clinical data between systems. It is designed to support a central patient care system as well as a more distributed environment where data resides in departmental systems.

HL7 Version 2.x messages use a human-readable, non-XML encoding syntax and are backward compatible, meaning a message based on version 2.3 will be understood by an application that supports version 2.7). Due to its widespread use, Version 2 will continue to play an integral part in healthcare messaging even with the HL7 Version 3 Normative Edition. HL7 is committed to support and extend Version 2 in parallel with Version 3, providing continuity for current installations.

Version 2.8.1 was published by the HL7 (http://www.hl7.org/) in 2014.

HAPI, an open-source object-oriented HL7 Version 2.x parser and library for Java, can be found at http://hl7api.sourceforge.net/.

5.1.1.2. Version 3

HL7 Version 3 (V3) Normative Edition - a suite of specifications based on HL7s Reference Information Model (RIM) - provides a single source that allows implementers of V3 specifications to work with the full set of messages, data types and terminologies needed to build a complete implementation. The 2014 Normative Edition represents the complete suite of V3 specifications. It includes standards for communications that document and manage the care and treatment of patients in a wide variety of healthcare settings. As such, it is a foundational part of the technologies needed to meet the global challenge of integrating healthcare information, in areas such as patient care and public health.

Version 3 represents an approach to clinical information exchange based on a model driven methodology that produces messages and electronic documents expressed in XML syntax. The V3 specification is built around subject domains that provide storyboard descriptions, trigger events, interaction designs, domain object models derived from the RIM, hierarchical message descriptors (HMDs) and a prose description of each element. Implementation of these domains further depends upon a non-normative V3 Guide and normative specifications for: data types; the XML technical specifications or message wire format; message and control “wrappers” and transport protocols.

The latest HL7 Version 3 Normative Edition was published by the HL7 (http://www.hl7.org/) in 2014.

5.1.1.2.1. CDA

The HL7 Version 3 Clinical Document Architecture (CDA) is a document markup standard that specifies the structure and semantics of "clinical documents" for the purpose of exchange between healthcare providers and patients. It defines a clinical document as having the following six characteristics:

- Persistence.
- Stewardship.
- Potential for authentication.
- Context.
- Wholeness.
- Human readability.

A CDA can contain any type of clinical content -- typical CDA documents would be a Discharge Summary, Imaging Report, Admission & Physical, Pathology Report just to mention a few. The most popular use is for inter-enterprise information exchange.

Release 2 was published by the HL7 (http://www.hl7.org/) in 2005.

Note: It’s an alternative to the ASTM CCR.

5.1.1.2.2. RIM

RIM is the cornerstone of the HL7 Version 3 development process. An object model created as part of the Version 3 methodology. As seen in *Figure 2* the latest RIM version (2.41) is a large, pictorial representation of the HL7 clinical data (domains) and identifies the life cycle that a message or groups of related messages will carry. It is a shared model between all domains and, as such, is the model from which all domains create their messages.

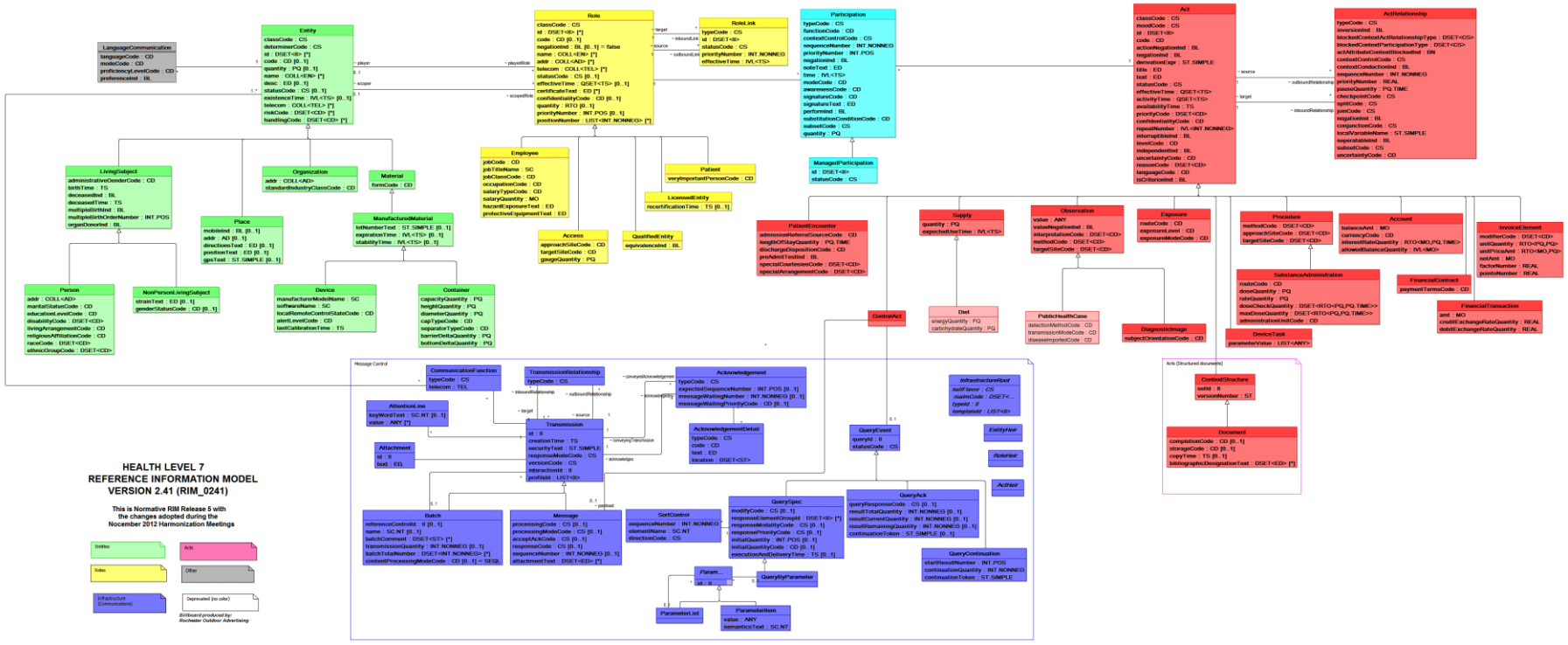


Figure 2 – RIM version 2.41

RIM versions can be downloaded at http://www.hl7.org/implement/standards/rim.cfm.

5.1.1.3. FHIR

FHIR (Fast Healthcare Interoperability Resources) combines the best features of HL7s Version 2, Version 3 and CDA product lines while leveraging the latest web standards and applying a tight focus on implementability.

FHIR solutions are built from a set of modular components called “Resources”. These resources can easily be assembled into working systems that solve real world clinical and administrative problems at a fraction of the price of existing alternatives. FHIR is suitable for use in a wide variety of contexts: mobile phone apps, cloud communications, EHR-based data sharing, server communication in large institutional healthcare providers, etc.

Release 1 is currently published as a Draft Standard for Trial Use (DSTU). Further information can be obtained at http://hl7.org/fhir.

HAPI-FHIR, an open-source implementation of the FHIR specification in Java, can be found at http://jamesagnew.github.io/hapi-fhir/.

5.1.2. CEN/ISO 13606

CEN/ISO EN13606 is a European norm from the European Committee for Standardization (CEN) (https://www.cen.eu/) also approved as an international ISO standard. It is designed to achieve semantic interoperability in the electronic health record communication.

Its overall goal is to define a rigorous and stable information architecture for communicating part or all of the electronic health record (EHR) of a single subject of care (patient) between EHR systems, or between EHR systems and a centralized EHR data repository. It may also be used for EHR communication between an EHR system or repository and clinical applications or middleware components (such as decision support components) that need to access or provide EHR data, or as the representation of EHR data within a distributed (federated) record system.

CEN/ISO 13606 follows a dual model architecture that defines a clear separation between information and knowledge. The former is structured through a Reference Model that contains the basic entities for representing any information of the EHR. The latter is based on archetypes, which are formal definitions of clinical concepts, such as discharge report, glucose measurement or family history, in the form of structured and constrained combinations of the entities of a Reference Model. It provides a semantic meaning to a Reference Model structure.

The interaction of the Reference Model (to store data) and the Archetype Model (to semantically describe those data structures) provides an unseen capability of evolution to the information systems. Knowledge (archetypes) will change in the future, but data will remain untouched.

The standard published by the ISO (http://www.iso.org/) is broken down into five parts:

- ISO 13606-1 - Part 1: Reference model.
- ISO 13606-2 - Part 2: Archetype interchange specification.
- ISO 13606-3 - Part 3: Reference archetypes and term lists.

- ISO/TS 13606-4 - Part 4: Security.
- ISO 13606-5 - Part 5: Interface specification.

The EN 13606 Association (http://www.en13606.org/) recently created an online archetype repository, called Clinical Information Model Manager (CIMM), that can be found at http://cimm.en13606.org/ (requires registration).

5.1.3. OpenEHR

openEHR (http://www.openehr.org/) is a virtual community working on interoperability and computability in e-health whose main focus is EHRs and systems.

The openEHR foundation has published a set of specifications defining a health information reference model, a language for building 'clinical models' or archetypes (see ADL), which are separate from the software, and a query language (see AQL). The architecture is designed to make use of external health terminologies, such as SNOMED CT, LOINC and ICDx. Components and systems conforming to openEHR are 'open' in terms of data (they obey the published openEHR XML schemas), models (they are driven by archetypes, written in the published ADL formalism) and APIs. They share the key openEHR innovation of adaptability, due to the archetypes being external to the software, and significant parts of the software being machine-derived from the archetypes.

Access to the latest deliverables of the openEHR specification project can be done at http://www.openehr.org/programs/specification/releases/currentbaseline.

The openEHR online archetype repository, called Clinical Knowledge Manager (CKM), can be found at http://www.openehr.org/ckm/.

5.1.3.1. ADL

Archetype Definition Language (ADL) is a formal language for expressing archetypes, which are constraint-based models of domain entities, or what some people might call ‘structured business rules’. The ADL syntax is one possible serialisation of an archetype.

ADL uses three other syntaxes: cADL (constraint form of ADL), dADL (data definition form of ADL), and a version of first-order predicate logic (FOPL) to describe constraints on data which are instances of some information model (e.g. expressed in UML).

Version 1.4 was published by the openEHR (http://www.openehr.org/) on December 12, 2008.

5.1.3.2. AQL

Archetype Query Language (AQL) is a declarative query language developed specifically for expressing queries used for searching and retrieving the clinical data found in archetype-based EHRs. Its syntax is independent of applications, programming languages, system environment and storage models. The minimum requirement for data to be queried with AQL (including with archetype structures and terminology) is for the data to be marked at a fine granularity with the appropriate archetype codes and terminology codes. Unlike other query languages, such as SQL or

XQuery, AQL expresses the queries at the archetype level (semantic level), other than at the data instance level.

Version 0.6 was published by Ocean Informatics (http://oceaninformatics.com/) in 2009.

5.1.4. ASTM CCR

The ASTM Continuity of Care Record (CCR) is a core data set of the most relevant administrative, demographic and clinical information facts about a patient's healthcare, covering one or more healthcare encounters. It's XML-based and provides a means for one healthcare practitioner, system or setting to aggregate all of the pertinent data about a patient and forward it to another practitioner, system or setting to support the continuity of care. The primary use case for the CCR is to provide a snapshot in time containing the pertinent clinical, demographic and administrative data for a specific patient.

The latest version of E2369 was published by the ASTM (http://www.astm.org/) in 2012.

Note: It's an alternative to the HL7 CDA.

5.2. Medical Device Communications Standards

5.2.1. IEEE 11073 PHD

IEEE 11073 Personal Health Data (PHD) standards are a group of standards from IEEE (https://www.ieee.org/) addressing the interoperability of personal health devices such as pulse oximeters, blood pressure monitors, glucose meters, etc. The standards draw upon earlier IEEE 11073 standards work, but differ from this earlier work due to an emphasis on devices for personal use (rather than hospital use) and use a simpler communications model.

As shown in *Figure 3*, the IEEE 11073 standard is comprised of three major areas. The first area refers to the devices used and which are represented by the IEEE 11073-104xx standards (see *Table 2* for details), the second area corresponds to the data transfer protocol represented by the IEEE 11073-20601 standard and the third area to the communication protocols (Bluetooth, USB, etc.).

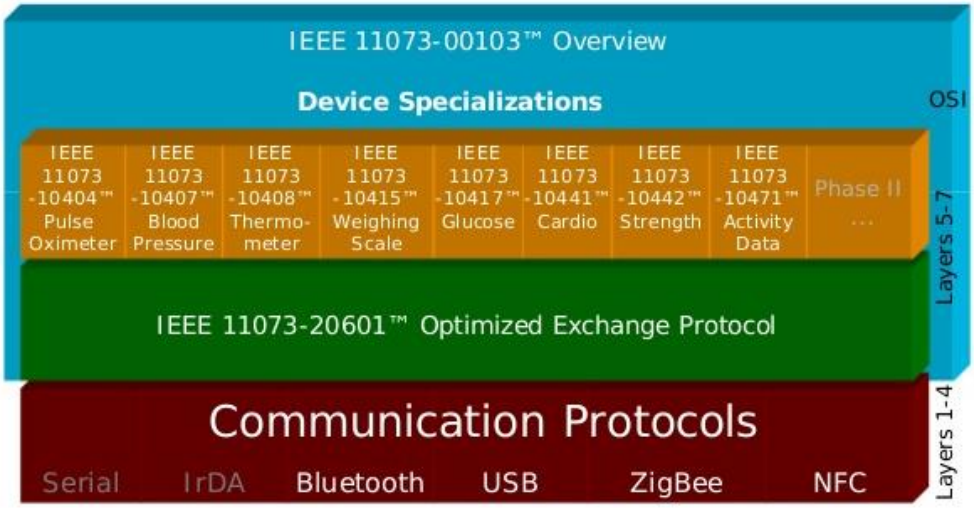


Figure 3 – IEEE 11073 Personal Health Device standards

Table 2 presents the currently active IEEE 11073 standard parts that describe device specific specializations (http://standards.ieee.org/findstds/standard/healthcare_it_all.html - please note that standard parts still in development are not part of this list).

Standard	Device
11073-10404	Pulse oximeter
11073-10406	Basic electrocardiograph (ECG) (1- to 3-lead ECG)
11073-10407	Blood pressure monitor
11073-10408	Thermometer
11073-10415	Weighing scale
11073-10417	Glucose meter
11073-10418	International Normalized Ratio (INR) monitor
11073-10419	Insulin pump
11073-10420	Body composition analyser
11073-10421	Peak expiratory flow monitor (peak flow)
11073-10424	Sleep Apnoea Breathing Therapy Equipment (SABTE)
11073-10425	Continuous Glucose Monitor (CGM)
11073-10441	Cardiovascular fitness and activity monitor
11073-10442	Strength fitness equipment
11073-10471	Independent living activity hub
11073-10472	Medication monitor

Table 2 – IEEE 11073 device specializations

5.2.2. Bluetooth HDP

The Bluetooth Health Device Profile (HDP) is an application profile from Bluetooth SIG (http://www.bluetooth.com/) that defines the requirements for qualified Bluetooth Healthcare and Fitness (referred to as 'health') device implementations. This profile is used for connecting application data *Source* devices such as blood pressure monitors, weight scales, glucose meters, thermometers, and pulse oximeters to application data *Sink* devices such as mobile phones, tablets, laptops, desktop computers and health appliances without the need for cables.

This profile is specialized for health applications and thus has the following advantages over other more generic Bluetooth profiles:

- Defines the interoperability requirements for the applications within the HDP application.
- Provides strong application level interoperability by operating with the ISO/IEEE 11073-20601 Personal Health Data Exchange Protocol, which defines a transport-agnostic Data Exchange Protocol and representation of device application data based on international standards.
- Provides strong application level interoperability by operating with Device Data Specializations which are compatible with the Data Exchange Protocol. The Device Data Specializations define the format of device application data based on international standards and can be added through updates to the Bluetooth Assigned Numbers without the need to update the HDP specification.
- Provisions for a standardized method by which the device-type and supported application data-types of a device can be determined wirelessly, using the Bluetooth Service Discovery Protocol (SDP).
- Connection-oriented to ensure more reliable behaviour when a *Source* moves out of range or disconnects (either inadvertently or intentionally), allowing the device to recognize the condition and take appropriate actions.
- Permits multiple simultaneous Data Channels.
- Allows per-channel Logical Link Control and Adaptation Protocol (L2CAP) configuration using Enhanced Retransmission Mode and Streaming Mode which allows Data Channels to be configured separately from each other and from the Control Channel. This allows for flexibility to configure channel reliability as required.
- Relatively inexpensive to implement since it is based on Multi-Channel Adaptation Protocol (MCAP) which has a small list of relatively simple control commands and low code-space requirements.

The HDP is dependent upon MCAP and Generic Access Profile and has conditional dependence on the Device ID Profile.

Version 1.1 was published by the Bluetooth SIG (http://www.bluetooth.com/) on July 24, 2012.

5.3. General Communications Standards

5.3.1. JSON

JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for humans to read and write and easy for machines to parse and generate. It is based on a subset of the JavaScript Programming Language (standard ECMA-262 3rd Edition - December 1999). JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and many others. These properties make JSON an ideal data-interchange language.

JSON is described by two competing standards: RFC 7159 and ECMA-404. The ECMA (www.ecma-international.org/) standard is minimal, describing only the allowed grammar syntax while the RFC also provides some semantic and security considerations.

5.3.2. XML

Extensible Markup Language (XML) is a simple, very flexible text format derived from SGML (ISO 8879). Originally designed to meet the challenges of large-scale electronic publishing, XML is also playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere.

Version 1.1 (Second Edition) was published by the W3C (http://www.w3.org/) on August 16, 2006.

5.3.2.1. WSDL

Web Services Description Language (WSDL) is an XML-based interface definition language used for describing the functionality offered by a web service. The acronym is also used for any specific WSDL description of a web service (also referred to as a WSDL file), which provides a machine-readable description of how the service can be called, what parameters it expects and what data structures it returns.

Version 2.0 (in three parts) was published by the W3C (http://www.w3.org/) on June 26, 2007.

5.3.2.2. XSD

XSD (XML Schema Definition) is a language for expressing constraints about XML documents. Checking a document against a schema is known as validating against that schema.

Since XSD supports associating data types with element and attribute content, it is also used for data binding, i.e., for software components that read and write XML representations of computer programming-language objects.

Version 1.1 (in two parts) was published by the W3C (http://www.w3.org/) on April 5, 2012.

5.3.2.1. XQuery

XML is a versatile markup language, capable of labelling the information content of diverse data sources including structured and semi-structured documents, relational databases and object repositories. XQuery is a query language designed to be broadly applicable across many types of XML data sources.

Version 3.0 was published by the W3C (http://www.w3.org/) on April 8, 2014.

5.3.3. REST

Representational State Transfer (REST) is an architectural style (not a standard) that specifies constraints, such as the uniform interface, that if applied to a web service induce desirable properties, such as performance, scalability and modifiability that enable services to work best on the Web. In the REST architectural style, data and functionality are considered resources and are accessed using Uniform Resource Identifiers (URIs), typically links on the Web. The resources are acted upon by using a set of simple, well-defined operations. The REST architectural style constrains an architecture to a client/server architecture and is designed to use a stateless communication protocol, typically HTTP. In the REST architecture style, clients and servers exchange representations of resources by using a standardized interface and protocol.

RESTful web services are built to work best on the Web. The following principles encourage RESTful applications to be simple, lightweight and fast:

- Resource identification through URI: A RESTful web service exposes a set of resources that identify the targets of the interaction with its clients. Resources are identified by URIs, which provide a global addressing space for resource and service discovery.
- Uniform interface: Resources are manipulated using a fixed set of four operations - **PUT**, **GET**, **POST** and **DELETE**. **PUT** creates a new resource, which can then be deleted by using **DELETE**. **GET** retrieves the current state of a resource in some representation while **POST** transfers a new state onto a resource.
- Self-descriptive messages: Resources are decoupled from their representation so that their content can be accessed in a variety of formats, such as HTML, XML, plain text, etc. Metadata about the resource is available and used, for example, to control caching, detect transmission errors, negotiate the appropriate representation format and perform authentication or access control.
- Stateful interactions through hyperlinks: Every interaction with a resource is stateless; i.e., request messages are self-contained. Stateful interactions are based on the concept of explicit state transfer. Several techniques exist to exchange state, such as URI rewriting, cookies and hidden form fields. State can be embedded in response messages to point to valid future states of the interaction.

5.3.4. SOAP

SOAP (Simple Object Access Protocol) is a lightweight protocol intended for exchanging structured information in a decentralized, distributed environment. It uses XML technologies to define an extensible messaging framework providing a message construct that can be exchanged over a variety of underlying protocols. The framework has been designed to be independent of any particular programming model and other implementation specific semantics.

Version 1.2 was published by the W3C (http://www.w3.org/) on April 27, 2007.

6. Regulatory Requirements

This section covers the various regulatory requirements related to health monitoring solutions (privacy, ethical concerns, etc.) and indoor environmental quality.

6.1. Privacy, Ethical and Legal issues

In this project, ethical considerations apply to the data privacy access restrictions and access to some of the system outcomes, namely alerts related to health issues or wellness of the monitored users. Both dimensions will be handled in ways that are ethically valid and acceptable to the end-users and to society in general. This means that ethical issues will be addressed from the concept phase to test installations, related to user involvement during the project and when the solution is tested and launched in the market. To guarantee that all ethic and legal issues are achieved (at national and international level), the Consortium will create an Ethical Advisory Board composed of ethical experts, that will be responsible for tracking any ethics related issues and ensuring that the project follows European ethics rules/policies.

Before and during the project execution, ethical experts will cooperate closely with technicians in order to identify the ethical issues that must be addressed. The ethical expert's inputs will define ethical requirements and constrains for the project, during the project execution ethical experts will be invited to plenary meetings of the consortium to discuss ethical matters in detail. The development team will have to comply with the ethical requirements identified, and ethical experts will provide an assessment on whether or not their recommendations have been duly considered. All ethical issues will be extensively presented in risks and specification report, as project requirements, as well as in the overall dissemination report. The Informed consent form will contain adequate information to meet the necessary requirements. All form drafts will be available when applying for local ethics committee opinion and approval from national competent authorities, prior to the start of the proposed research.

Active@Work will result in two pilots that will be deployed in live environments, involving workers from the companies/institutions holding the pilots. But, before getting access to any personal data information, each user, willing to collaborate in a volunteer regime, will be informed of the process and the data that will be collected during the pilot. All data related to the user, will be used only under his/her consent either during the preliminary development tests or at the end during the last phase of the project pilot. Additional precautionary measures will be taken to assure compliance with EU legacy and privacy rules as well as with the national legal framework – this may imply for example that certain area do not have to be covered (for privacy reason) or as well that certain data do not have to be archived.

Data protection and privacy problems exist whenever private data is collected and stored in digital form. Improper disclosure and/or control can raise privacy issues. However, the Active@Work project Consortium guarantees that standard/commercially available data access security measure will be implemented to control user’s access to the data.

6.1.1. Data Protection, including Security of Health Data

The rapid development of the mHealth (mobile Health) sector raises concerns about the appropriate processing of the data collected through these applications or solutions, application developers, health professionals, public authorities, etc. [1].

mHealth solutions and devices (e.g. mobile phones, tablets, patient monitoring devices) can collect large quantities of information (e.g. data stored by the user on the device as well as data from different sensors, including the user location) and process them. This information will usually be personal data since it is information related to a person who is directly or indirectly identified or identifiable which makes it particularly sensitive and therefore requiring special protection.

There are also legitimate concerns about the security of individuals' health data when using mobile health technologies as their personal data could be accidentally exposed or leaked to unauthorised parties. This could be the case when healthcare professionals access health information from a mobile device or when patients store personal data on a PHR application. The theft or loss of devices storing sensitive information can also raise serious security issues.

Given the sensitive nature of health data, mHealth solutions should contain specific and suitable security safeguards such as the encryption of patient data and appropriate patient authentication mechanisms to mitigate security risks.

The EU Personal Data Protection Directive [2] from 1995 is being revised in order to better respond to challenges posed by the rapid development of new technologies and globalisation while ensuring that individuals retain effective control over their personal data. The Commission's proposal for a General Data Protection Regulation [3] will provide further harmonisation of data protection rules in the EU, ensuring legal certainty for businesses and increasing trust on eHealth services with a consistent and high level of protection of individuals. The EU is pushing for a complete agreement between Council and European Parliament on the data protection reform before the end of 2015.

Further information about the protection of personal data can be obtained at the EU page http://ec.europa.eu/justice/data-protection/index_en.htm or at the mini website about the new data protection rules for the digital age at http://ec.europa.eu/justice/data-protection/minisite/.

6.1.2. Big Data

It's known that mHealth can facilitate the mining of large amounts of health data. Such data (measurements, medical images, symptom descriptions, etc.) can be stored in large databases with the potential to boost healthcare research and innovation [1].

Big Data is the capacity to analyse a variety of (unstructured) data sets from a wide range of sources. This requires the capability to link data and extract potentially valuable information from unstructured data in an automated cost-effective way.

These data can be a vital element of epidemiological research as they can enable researchers and scientists to improve patient treatment by looking for patterns on a larger scale or draw new

conclusions, for instance on the relation between the development of a medical condition and environmental factors. Big data can also contribute to a reduction of trial periods for medication or to the development of more advanced mechanisms for early detection and prevention of diseases.

Data mining of health data must however be done in compliance with legal requirements, including for the protection of personal data and may give rise to ethical issues, in particular regarding the respect of the principle of informed and explicit consent, where that is relevant, e.g. if the patient did not expressly permit his personal data to be used for research purposes at the time he was asked for his consent.

The fundamental right to personal data protection fully applies in a Big Data context. As a consequence, the processing of personal data has to be done in compliance with data protection rules, in particular given the obviously sensitive nature of health data.

6.1.3. Article 29 Data Protection Working Party

The Article 29 Data Protection Working Party (Art. 29 WP) (http://ec.europa.eu/justice/data-protection/article-29/index_en.htm) set under the Directive 95/46/EC of the European Parliament, in their 'Opinion 02/2013 on apps on smart devices' [4], adopted on 27 February 2013 concludes and recommends that:

App developers must:

- Be aware of, and comply with, their obligations as data controllers when they process personal data from and about users.
- Be aware of, and comply with, their obligations as data controllers when they contract with data processors such as if they outsource the collection and processing of personal data to developers, programmers and for example cloud storage providers.
- Ask for consent before the app starts to retrieve or place information on the device, i.e., before installation of the app. Such consent has to be freely given, specific and informed.
- Ask for granular consent for each type of data the app will access; at least for the categories Location, Contacts, Unique Device Identifier, Identity of the data subject, Identity of the phone, Credit card and payment data, Telephony and SMS, Browsing history, Email, Social networks credentials and Biometrics.
- Be aware that consent does not legitimize excessive or disproportionate data processing.
- Provide well-defined and comprehensible purposes of the data processing in advance to installation of the app, and not change these purposes without renewed consent; provide comprehensive information if the data will be used for third party purposes, such as advertising or analytics.
- Allow users to revoke their consent and uninstall the app, and delete data where appropriate.
- Respect the principle of data minimization and only collect those data that are strictly necessary to perform the desired functionality.
- Take the necessary organizational and technical measures to ensure the protection of the personal data they process, at all stages of the design and implementation of the app (privacy by design).

- Provide a single point of contact for the users of the app.
- Provide a readable, understandable and easily accessible privacy policy, which at a minimum informs users about:
    - Who the app developers are (identity and contact details).
    - What precise categories of personal data the app wants to collect and process.
    - Why the data processing is necessary (for what precise purposes).
    - Whether data will be disclosed to third parties (not just a generic but a specific description to whom the data will be disclosed).
    - What rights users have in terms of withdrawal of consent and deletion of data.
- Enable app users to exercise their rights of access, rectification, erasure and their right to object to data processing and inform them about the existence of these mechanisms.
- Define a reasonable retention period for data collected with the app and predefine a period of inactivity after which the account will be treated as expired.
- With regard to apps aimed at children: pay attention to the age limit defining children or minors in national legislation, choose the most restrictive data processing approach in full respect of the principles of data minimization and purpose limitation, refrain from processing children's data for behavioural advertising purposes, either directly or indirectly and refrain from collecting data through the children about their relatives and/or friends.

<u>It also recommends that app developers:</u>

- Study the relevant guidelines with regard to specific security risks and measures.
- Proactively inform users about personal data breaches along the lines of the requirements of the ePrivacy Directive.
- Inform users about their proportionality considerations for the types of data collected or accessed on the device, the retention periods of the data and the applied security measures.
- Develop tools to enable users to customize retention periods for their personal data based on their specific preferences and contexts, rather than offering pre-defined retention terms.
- Include information in their privacy policy dedicated to European users.
- Develop and implement simple but secure online access tools for users, without collecting additional excessive personal data.
- Together with the OS and device manufacturers and app stores use their creative talent to develop innovative solutions to adequately inform users on mobile devices, for example through a system of layered information notices combined with meaningful icons.

6.1.4. Informed Consent Procedures

As already mentioned on section 2.1.1, the Active@work solution will be tested in two distinct pilots, the first pilot will be deployed in a multinational consulting company and the second pilot will be in a leisure site - both pilots in a volunteer regime and with the "informed consent" of all participants. A fully informed consent will be obtained from the participant in accordance with National and European laws and regulations.

Task 5.01 of the Active@Work project will be in charge of preparing the informed consent form provided to the pilot participants and will address the following issues:

- Explanation of the research purpose.
- Duration.
- Description of the study.
- Foreseen risks.
- Benefits.
- Alternatives.
- Confidentiality.
- Information collected.
- Contact for rights/claims.
- Voluntary participation.
- Possibility to withdraw consent.
- No penalty or loss on stopping.

Additionally, all the participants will be informed that the project is co-funded by the AAL and National authorities and as such aims to benefit the public.

6.2. Indoor Environmental Quality

Indoor Environmental Quality (IEQ) is most simply described as the conditions inside a building. In a broader sense, it can be seen as the sum of a series of factors each one contributing to the overall sense of environmental quality inside a building and more specifically to a working place. The name and number of factors referred as being part of IEQ varies a bit, but in general it can be seen as being:

IEQ = IAQ + ITQ + ILQ + ISQ

where: I = Indoor, Q = Quality

and: A = Air, T = Thermal, L = Lighting, S = Sound

Each of these factors will be briefly described in the next sub-sections.
Some of the existing international standards dealing with indoor environmental parameters include:

- EN 15251: Indoor environmental input parameters for design and assessment of energy performance of buildings - addressing indoor air quality, thermal environment, lighting and acoustics;
- EN 13779: Ventilation for non-residential buildings - Performance requirements for ventilation and room-conditioning systems;
- ASHRAE 62.1 and 62.2: Ventilation and indoor air quality;
- ASHRAE 55: Thermal environmental conditions for human occupancy;
- ISO EN 7730: Ergonomics of the thermal environment - Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria;
- EN 12464-1: Light and lighting - Lighting of work places - Part 1: Indoor work places.

6.2.1. Indoor Air Quality

Indoor Air Quality (IAQ) refers to the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants. IAQ can be affected by gases (including carbon monoxide and dioxide, radon, VOCs), particulates, microbial contaminants (mold, bacteria, viruses as well as dust mites and other organisms), odours or any mass or energy stressor that can induce adverse health conditions.

Strategies used to create good IAQ include bringing in a high percentage of outside air, maintaining appropriate exhaust systems, using high efficiency MERV filters in the HVAC systems, installing walk-off mats at entryways, prohibiting smoking near operable windows and air intakes, providing indoor plants and using only low-emitting / non-toxic materials and green housekeeping products.

Determination of IAQ usually involves the collection of air samples, monitoring human exposure to pollutants, collection of samples on building surfaces and computer modelling of air flow inside the building.

Some of the most common complaints resulting from poor air quality in offices include eye, nose and throat irritation, unpleasant odours, headaches, fatigue and irritability, asthma and asthma-like symptoms, skin dryness and irritation.

6.2.2. Indoor Thermal Quality

Indoor Thermal Quality (ITQ), also called thermal comfort, is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation. The main factors that influence thermal comfort are those that determine heat gain and loss: metabolic rate, clothing insulation, air temperature, mean radiant temperature, air speed and relative humidity.

The Predicted Mean Vote (PMV) model stands among the most recognized thermal comfort models. It was developed using principles of heat balance and experimental data collected in a controlled climate chamber under steady state conditions. The adaptive model, on the other hand, was developed based on hundreds of field studies with the idea that occupants dynamically interact with their environment.

Thermal comfort calculations according to the ASHRAE Standard 55 can be freely performed online using the CBE Thermal Comfort Tool.

The most common complaints related to thermal conditions in offices include discomfort caused by the temperatures being too high (hot feeling) or too low (cold feeling).

6.2.3. Indoor Lighting Quality

Indoor Lighting Quality (ILQ) refers to the integration of daylight and electrical light sources to provide adequate lighting for workers to perform their daily tasks while minimizing/avoiding possible glare effects or major variations in light levels, which can impact comfort and productivity.

The materials used on walls and furniture play a key role in the lighting effect - dark paint tends to absorb light, making a room appear smaller and dimmer than it really is, while light paint does the opposite. In addition to paint, reflective surfaces also have an effect on lighting - surfaces or floors that are too reflective create unwanted glare.

The amount of daylight received in an internal space can be analysed by undertaking a daylight factor calculation. This factor describes the ratio of outside illuminance over inside illuminance, expressed in per cent. The higher the factor, the more natural light is available in the room.

Some of the most common complaints resulting from improper lighting in offices include eyestrain, eye irritation, blurred or double vision, dry burning eyes and headaches.

6.2.4. Indoor Sound Quality

Indoor Sound Quality (ISQ), also called acoustic comfort, refers to office acoustics and noise pollution (presence of unwanted or unpleasant noise). Office workers are subject to many different noise sources and noise can produce tension and stress as well as damage to hearing capability due to a one-time exposure to a loud sound as well as by repeated exposure to sounds at various loudness levels over an extended period of time. The annoying effect of noise can decrease performance or contribute to increase errors in tasks.

A space with good acoustics allows for confidential conversations among collaborating workers without affecting the ones engaged in individual/focused work. It is not too loud, does not echo too much and controls excess noise pollution from both indoor and outdoor sources at the same time.

Some of the most common complaints related to noise in offices include interference with speech communication, annoyance and distraction from mental activities.

7. Risk Analysis and Mitigation Strategies

This section contains the risk analysis done and describes the mitigation strategies chosen to reduce the identified risks. This information is presented in *Table 3* below.

Identified Risks	Mitigation Strategies
Failing to address all the ethical requirements related with the project	The pilot implementation in WP5, will be carried out in a controlled environment and will check the actions against ethical aspects related to safeguarding of the end-users' rights, privacy, security and trust. In case that any issue is detected, the conclusions will be included in the evaluation process that will be performed in task 5.03.
	Both pilots will be held in a volunteer regime and with the "informed consent" of all participants. A fully informed consent will be obtained from the patient in accordance with National and European laws and regulations.
Usability and other problems that the target groups may encounter or lack of perceived benefits	The requirements will be identified in close collaboration with the end-users in WP2. Additionally, close monitoring of the pilots will be conducted where users will be heavily involved in providing feedback on the use and the functionality of the solution.
	User's feedback should be used to improve the system.
	The system should be user friendly, i.e., easy to use.
	The sensors used must be very discreet in order to preserve the user's dignity, especially in case of senior consultants.
	The sensors used should not interfere (much) with the normal users work. Wireless versions if available should be used.
	All the equipment's used on the pilots (PC, tablets, smartphones, sensors, etc.) shall be already available on the market and approved to be used on the European space.
	All project participants will be informed that the project is co-funded by the AAL and National authorities and as such aims to benefit them.
	Vulnerability and exit strategies for the final users groups should be defined to prevent distress when the project finishes.
Interoperability issues	Project development should adopt/use existing standards and regulations.
	Commercial sensors that provide SDK's should be selected if available.
Data protection issues	Project development should adopt/use existing standards and regulations.

	Data protection measures and procedures will not expire until the data are destroyed (at the end of the project).
	After disposal, data will not be recoverable and the risk of data disclosure will be minimized.
	The party who collects and stores the data, and the organization in which this party is situated, will be held accountable for the safe storage of the data.
	A document containing all important metadata and security requirements will be created and everyone accountable for the data must adhere to it.
	Personal data will have an appropriate degree of security to safeguard subject privacy and confidentiality whilst allowing appropriate ease of access.
	If collected health data is provided for research purposes it must be pseudonymised or anonymised so it cannot be linked back to identifiable individuals.
	Users should have the right to request access to the data collected during the project. They might also request its erasure and/or correction.
	If apps are to be developed, the Article 29 Data Protection Working Party recommendations (seen in section 6.1.3) should be followed.

Table 3 – Risk Analysis and Mitigation Strategies

8. Conclusions

This document presented the major market-driven requirements. It was arranged into five main tasks/sections:

- Related Work.
- Market Analysis.
- Relevant Standards.
- Regulatory Requirements.
- Risk Analysis and Mitigation Strategies.

This report started by presenting a Related Work section with a brief summary of other AAL Joint Programme approved projects in the same field as the Active@Work project in order to have a better understanding about the state-of-the-art in the field of ICT-based solutions for supporting occupation in life of older adults – the subject of Call 6, the same of the Active@Work project. Knowing what other similar projects are trying to accomplice might help us to improve our project.

Then it presented the results obtained during the Market Analysis performed in order to find solutions already on the market similar to the Active@Work project idea in order to explore the business potential of the project. If a commercial product is on the market then it's because there's market for it, meaning people are interested in it to the point of paying for that type of products.

After that, it presented and described the Relevant Standards (and quasi-standards) available on the market that might be used by the project with the main focus being put on the interoperability point of view. Following standards during the project development is half way to success since everything that the developers usually need is already available, with the great advantage of already being tested, validated and accepted.

Before the last part, a list of Regulatory Requirements related to health monitoring solutions (privacy, ethical concerns) and indoor environmental quality that could/should be taken into account during the project development were presented. Knowing and following relevant regulations during project development helps to reduce the risks of having problems later on.

Finally, the Risk Analysis and Mitigation Strategies chosen to reduce the identified risks were presented. If followed these mitigation strategies will greatly reduce/minimize the identified risks.

9. References

[1] European Commission, Green Paper on mobile Health ("mHealth") {SWD(2014) 135 final}, 2014

[2] Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, OJ L 281/31, 23.11.1995

[3] Commission proposal for a regulation on the protection of individuals with regard to the processing of personal data and on the free movement of such data, COM(2012) 11

[4] Article 29 Working Party, Opinion 02/2013 on apps on smart devices - WP 202, http://ec.europa.eu/justice/data-protection/article-29/documentation/opinion-recommendation/files/2013/wp202_en.pdf