



ACTIVAGE PROJECT

ACTivating InnoVative IoT smart living environments for AGEing well

Guidelines for the adoption of ACTIVAGE solutions in other Pilots

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Abstract

The following document addresses the need at this moment of the deployment of the ACTIVAGE pilots of collecting and documenting a series of experiences that can be translated into a guide of recommendations for the replication of the same in another series of projects.

In turn, the document addresses the need expressed by the reviewers of the project and previously detected in the scope of work of WP2 of including the aspects related to the User Experience (UX). These aspects are addressed both from the previous work carried out by the different DS (Deployment Sites) before starting to participate in the project, as well as during the deployment of the ACTIVAGE pilots.

This document therefore serves as an input to numerous information from different sources, this information will be used to elaborate a guide of recommendations that will be published in the latest version of this deliverable D2.6.

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1 About This Document

This document includes an update of the document 2.1 including the work progress of WP2 until M30 of the project.

1.1 Deliverable context

Project item	Relationship
Objectives	The main objective of this document is to provide a set of recommendations and references that contribute to the consolidation of a guide of recommendations for the replicability of Large Scale Pilots in the area of Active and Healthy Ageing. The guidelines will be published in the future document D2.6
Exploitable results	Collection of guidelines and references in UX Collection of best practices in Large Scale Pilots
Work plan	This deliverable is an output of task T2.5 "Detailed specification of ACTIVAGE IOT actions for replicability in future pilots" within WP2. This task will be active until the delivering of D2.6.
Milestones	D2.3 contributes indirectly to MS3 EXPAND and MS5 SUSTAIN
Deliverables	D2.3 is an input for D2.6
Risks	

Table 1 "Deliverable context"

2 Introduction

The deliverable D2.3 is a previous version of what will constitute a reference guide for the application of the lessons learned in ACTIVAGE for other Large Scale Pilots and projects. This reference guide will be published in a final version of D2.3, document D2.6.

Since the beginning of the WP2 activity, the participants agreed on the necessity of specializing and focusing in the issues that affect users and the deployment of pilots. In this way, the issues related to interoperability and other technical concepts would be formulated with their corresponding weight in WP3, WP4 and WP5. It is in the scope of these work packages mentioned in which the most technical guidelines or recommendations for the expansion of the pilots are being detailed.

In this document it is intended to undertake in a central way the concern already shown by the reviewers of the project in terms of UX that although it was not reflected with the weight it deserves in the formulation of the ACTIVAGE proposal it is considered very important for the development and future replication of this project.

In addition, the experience accumulated by some of the partners in this field means that part of their previous work has been applied to the improvement of concepts such as User Experience, Usability or Accessibility in ACTIVAGE. This previous work on UX has been addressed by the project in two approaches:

- On the one hand, a consistent guide of recommendations in the field of European innovation work on active and healthy aging is extensively referenced. The document includes some success stories in the application of these recommendations within the different ACTIVAGE products and services.
- On the other hand, the document includes a reference to all the documents, norms and recommendations that were used by the different DS in the previous development of their products even before the formulation of the ACTIVAGE proposal.

In turn, the document includes an initial version of different aspects outside the UX that have emerged from the evaluation of the different pilot sites and have been contrasted in debate spaces and workshops. As noted above, these aspects will be expanded in the future version D2.6 to form a guide of recommendations for the replication of pilots in the field of active and healthy aging.

3 Glossary

Reference Use Case (RUC)	<p>The redefinition of the use cases of ACTIVAGE (AUC) to attend the real use cases targeted in the DS, and serve as a reference for the DS activities.</p> <ul style="list-style-type: none"> • RUC 01. Daily activity monitoring • RUC 02. Integrated care • RUC 03. Health parameter monitoring • RUC 04. Emergency trigger • RUC 05. Exercise promotion • RUC 06. Cognitive stimulation • RUC 07. Prevention of social isolation • RUC 08. Safety, comfort and safety at home • RUC 09. Mobility monitoring and advice for active mobility • RUC 10. Notification of abnormal situation • RUC 11. Support for caregivers
Service	<p>A package of sub-services that give an added value to the user. It is a set of actions that aims to provide a full and complete feature.</p> <p><i>E.g: A home care platform integrated with health information systems that facilitates the patient's telematic access to various healthcare services and allows for the control of patients' care at home.</i></p>
Sub-service	<p>Part of a service that provides non-divisible features and or functionality.</p> <p><i>E.g: Module of the home care platform that gives access to read information of one healthcare service of the patient.</i></p>
Scenarios	<p>A sequence of steps describing an interaction between a user and a system.</p> <p><i>Eg: A user has fallen and presses the alarm button. After pressing the button, activates the communication with the Emergency center of Red Cross, the worker of the center responds by calming the user and informing the user relatives about the problem, and the emergency team go to the user address with an ambulance.</i></p>
Use cases	<p>A set of possible sequences of interactions (scenarios) between systems and users in a particular environment and related to a particular goal.</p> <p><i>Eg: Sending an alarm to the ARC (UNE-EN 50134-3:2012) and emergency management: immediate attention to emergency</i></p>

	<i>situations. (There are different scenarios that can lead to the activation of the emergency button)</i>
User needs	<p>The needs of the users related to a product or service, and that the product or service must satisfy to get the right outcome for them.</p> <p><i>Eg: I need to have a device that allows me to warn my daughter if I fall.</i></p>
Requirements	<p>A requirement is a statement that specifies what an intended product or service should do, or how it should perform.</p> <p><i>Eg: The solution will allow the use of an emergency pushbutton (social alarm frequency 869.2MHz). This will automatically generate a telephone call to the alarm center</i></p>
ACTIVAGE Use cases (AUC):	<p>The use cases described in the ecosystem of active and healthy aging that were specified in the proposal of the ACTIVAGE project in order to standardize the work procedures between the partners based on a User Centered Design methodology.</p> <ul style="list-style-type: none"> • UC1. Daily activity monitoring at home for informal carers support and for formal carers follow up • UC2. Integrated care for older adults under chronic conditions • UC3. Monitoring assisted persons outside home and controlling risky situations • UC4. Emergency trigger • UC5. Exercise promotion for fall prevention and physical activeness • UC6. Cognitive stimulation for mental decline prevention • UC7. Prevention of social isolation by means of communication tools at home • UC8. Safety, comfort and safety at home • UC9. Support for transportation and mobility
Local Use Cases Description	<p>The Use Cases specification at Deployment Site level. ACTIVAGE use cases are described in a detailed level taking in account the specific environment to be implemented locally.</p>
Deployment Sites (DS):	<p>A cluster of stakeholders in the Active and Healthy Living value network, working together within a geographical space.</p>
ACTIVAGE Targeted Users	<p>Older adults living independently and autonomously in their preferred environments.</p>

	<p>ACTIVAGE will concentrate on IoT solutions for older people classified under Frailty Scale categories 1 to 6.</p>
<p>AIOTES</p>	<p>ACTIVAGE IoT Ecosystem Suite (AIOTES), a set of Techniques, Tools and Methodologies for interoperability at different layers between heterogeneous IoT Platforms and an Open Framework for providing Semantic Interoperability of IoT Platforms for AHA, addressing trustworthiness, privacy, data protection and security.</p>
<p>ACTIVAGE Innovation Phases</p>	<p>Phases of the path to innovation:</p> <ul style="list-style-type: none"> BUILD DEMONSTRATE EXPAND GROW SUSTAIN

Table 2 “Glossary”

4 Piloting solutions from the User Experience perspective

User Experience (UX) is the set of factors related to the interaction of the user, with a specific environment or device, whose result is the generation of a positive or negative perception of this service, product or device. It does not only depend on factors related to design and functionality, but also on emotions, feelings, reliability, etc.

In the ISO standard (9421-210) the User Experience is defined as the perceptions and responses of a person as a result of the use of a product, system or service.

A project such as ACTIVAGE, in which a large-scale pilot with thousands of users with specific characteristics is deployed, as in the case of the elderly, must take into account User Experience and Usability in all its phases, from the beginning to the evaluation.

Since the beginning of the work within WP2, the different requirements formulated by users and other Stakeholders have been included through the application among other tools of the User Centered Design Methodology detailed in document D2.1.

In this section and in the following one, those sources of information that have served to enhance the inclusion of UX within the project are mentioned.

4.1 User Experience Guidelines used in ACTIVAGE

Some of the WP2 partners of the ACTIVAGE project such as CRE, TECSOS and UPM actively participate in the European Commission initiative “European Innovation Partnership on Active and Healthy Aging” (EIP on AHA). Thanks to this participation, in the Action Group C2 on interoperable independent living solutions, a document was published in February 2018 called Personal User Experience (PUX) Recommendations and Lessons Learned.

Although the concept of PUX and other related issues such as usability and accessibility are not broadly contemplated in the project proposal, they are concepts that have been suggested by the reviewers to be progressively included in the project and that are relevant for all the participants involved in the Active and Healthy Ageing Ecosystem.

Thanks to the aforementioned previous experience that some of the partners have in this area, it was considered that the publication "Personal User Experience (PUX) Recommendations and Lessons Learned" should be taken into account transversally in different areas of the project. With this objective, permission was requested to the coordinator of the C2 working group, who indicated its total agreement to reference it and take it into account in the development of the project under the CC-BY 4.0 license.

In the stage of development and deployment of the ACTIVAGE solutions, several examples of the application of these recommendations can be detailed.

In addition to these recommendations, another series of regulations and recommendations have been previously taken into account for the development of the solutions by the different deployment sites. This series of additional recommendations are included in section 5 of this document.

In the context of the mentioned publication it is important to highlight that a Personal User Experience (PUX) was defined in the context of EIP on AHA C2 Action Group as a positive user experience for an individual user, taking into account the following:

- A positive PUX is when the solution matches the user's goals, needs and preferences.
- Different users may have different wishes, needs, and preferences.
- An individual user's wishes, needs, and preferences may be specific to the context of use (including their goals, their equipment and the environment), and are subject to change.
 - An individual user's needs and preferences may include preferences regarding the collection and sharing of personal data (privacy).
- Accessibility for persons with disabilities and older persons is a prerequisite for PUX.

PUX-enabled solution:

- A PUX-enabled solution accommodates an individual user's specific wishes, needs, and preferences in a specific context of use, as much as possible, even when those wishes, needs and preferences change dynamically.
- In consequence, a PUX-enabled solution development requires dedicated user involvement (user-driven design).
- A PUX-enabled solution will significantly contribute to the individual user's empowerment, by supporting and training the individual user to better understand and express their own current and future wishes, needs and preferences.

PUX-enabled solutions provide the following benefits:

- Users find it easier to use the solution because it meets their expectations. They have a better user experience, more joy of use and make less errors.
- Users with disabilities and older users (who often experience a slow degradation in sensory and cognitive abilities) can fully use the solution, optionally with the support of assistive technologies.
- Service providers (including caregivers) find it easier to use the solution, are more productive and make less errors.
- Manufacturers need to spend less time and costs on the training of the users and service provider personnel.
- Manufacturers can more easily comply with accessibility regulation.

4.2 Personal User Experience recommendation list

R1. General recommendations

R1.1 Make adaptable solutions: Allow users to adapt your solution

The user should be able to adjust the look & feel of your solution. And the user should be able to adjust the functionality of your solution (including parameters such as thresholds for monitor alarms). Example: The user includes a doctor or clinician who is responsible for monitoring a client.

R1.2 Make adaptive solutions: If the system actively adapts to a user, allow the user to overwrite the system's choices

There are two ways of letting the user overwrite the system's choices: (1) ask the user to confirm or reject a proposed adaptation; (2) allow the user to undo the adaptation. Make your solution learn from the user's overwrites: do not propose a rejected adaptation again under the same circumstances.

R1.3 When the user changes user interface settings, update the user interface immediately and continuously

The user gets immediate feedback whenever he/she changes the user interface settings (for example, change the font size as the user moves the "font size" slider). If the new user interface does not fit the user's expectations, he/she can abandon the last changes, or revert to the default settings (reset).

R1.4 Remember the user's settings and adaptations

Users prefer to store their settings and do not want to configure them every time when using the solution. User preferences should be remembered even across different devices and hardware or software platforms. For example, if a user chooses a large font on their tablet, fonts should also be enlarged on their TV.

R1.5 Store the user's preferences rather than their (dis)abilities

Respect the privacy of the user's data. It is not necessary for a solution to know the user's disabilities, if any. It is sufficient to know about the user's interaction preferences. For example, a person who is hard of hearing may want system messages to be spoken in a low frequency, or displayed as text, or both.

R1.6 Do not stigmatize your users

Make sure that your solution looks attractive and is meaningful to everyone. Do not exclude any sub-group of users.

R1.7 Design simple and easy-to-use solutions

Your solution should be easy-to-use. Hide the system's complexity from the user, and provide a smooth and comfortable user experience. This includes the whole lifecycle of the solution ("customer's journey"): information, buying, installing & mounting, using, maintaining, updating, uninstalling, disposing & recycling (hardware).

R1.8 Design human-friendly technology

People should feel comfortable with the technologies they are using. They want to communicate with them in a way that they consider most natural and intuitive. For example, provide interaction modes for touch and voice. When using avatars, have them show facial expressions.

R1.9 Provide information in different formats and by redundant navigational means

Different formats include text, images and videos (with captions* and audio** description). You may also provide a printed "getting started" or "user manual" booklet. Typical navigational means include navigation menus, toolbars, step-by-step dialogs, a search textbox, and speech input.

R1.10 Design in a way that the user can recognize rather than remember

Use icons that are easy to recognize. Use a consistent look-and-feel for your user interface components. Make components that require user input (e.g. buttons) easy to recognize as such.

R1.11 Single sign-on for all apps

The user should be able to access all functionality of your solution by logging in once rather than multiple times.

R2. Development process

R2.1 Start defining user profiles, real needs and true expectations

Use personas and analyse the context of use (expectations of the user, characteristics of the task, the equipment, and the environment). Think about the social character of your solution - rather than its technological features.

R2.2 Consider your users' characteristics

Make sure that you take into account the following: (1) demographics (e.g., age, location of residence, educational level, cultural background), (2) technology usage (ownership of devices, technology skills, attitudes towards technologies), and (3) health status (diseases, attitude towards care professionals, medical skills and knowledge).

R2.3 Focus and meet the needs and expectations of your user groups

Consider both individual users and homogeneous sub-populations (e.g. represented by personas).

R2.4 Consider different personalisation strategies for different groups of users.

Personalisation strategies can include: automatic adaptation, letting the user choose from a set of pre-defined profiles, and manual configuration by the user.

R2.5 Use an iterative development process, following a user-centered design

Involve as many users as possible and use clear and persistent explanations supported by tangible resources

R2.6 Perform a triple validation

Validate your solution and its design in three ways: (1) Technical validation, (2) inspection by relevant stakeholders and (3) validation by a wide variety of identified real users in the lab and in the field. Note that relevant stakeholders include the service providers (acting as “social mediators”).

R2.7 When evaluating your solution with users, respect their rights on information and privacy

When involving users in trials and tests, explain well the conditions of participation and make sure that their data are treated in a confidential and secure way.

R2.8 Make your solution responsive

A responsive solution adapts itself to the user's selected preferences, their behavior, and their devices (e.g. size of user interface components, color schema).

R2.9 Build modular solutions like LEGO® bricks

Separate frontend from backend, so that the user may have a choice between multiple user interfaces. Allow the user to extend your solution by adding additional modules, if needed. Use a standard protocol (e.g. REST) for communication between the modules.

R3. Applying Standards

R3.1 Avoid proprietary solutions

Use software libraries based on standards. Apply hardware standards such as USB. If no appropriate standard exists, publish an external interface for your component so that other vendors can connect to it

R3.2 Identify relevant general and sectorial regulations and guidelines for your solution and follow them

For example, apply ETSI EG 202 4877 “Human Factors (HF); User experience guidelines; Telecare services (eHealth)” if your solution belongs to the telecare services sector.

R3.3 Build personalisation on top of Design for All (DfA) standards

As a baseline (i.e. default user experience), follow the principles of Design for All, to be generally accessible to all users of your solution: (1) ISO/IEC 29138-18 to address the basic user needs of various user groups; (2) Web Content Accessibility Guidelines 2.09 for a minimum level of accessibility; and (3) ETSI EN 301 549 10 to apply accessibility requirements suitable for public procurement of ICT products and services in Europe. On top of Design for All, build personalization features to further improve the user experience for the individual user.

R3.4 Use a standardized format and vocabulary for user profiles

ISO/IEC 24752-811 “User Interface Resource Framework” defines JSON and XML formats for user profiles. ISO/IEC 24751-112 “AccessForAll framework for individualized accessibility” defines a registry for a user profile vocabulary (terms for the description of user preferences and needs).

R3.5 If your solution employs the concept of exchanging user interface resources at runtime: Use a standardized format and vocabulary for describing resources and components of user interfaces so that they are easily discoverable

User interface resources and components include icons, videos, audio clips, help texts, and other parts of user interfaces that can be adapted and exchanged. ISO/IEC 24752-813 “User Interface Resource Framework” defines JSON and XML formats for user interface resource descriptions. The DCMI Metadata Terms¹⁴ define a vocabulary for describing user interface resources and components.

R4. Privacy & Security

R4.1 Make your solution private and secure

Protect your user's privacy (make your solution “private”), and protect your user from harm (make it “secure”). Encrypt if you can, anonymize if you cannot. Make sure your users' data are handled, transmitted and stored securely. See also: European General Data Protection Regulation¹⁵.

R4.2 Explain what data are collected by your solution, and how they are going to be used and how this benefits the users

Users have the right to know what data are collected (e.g. a user's movements in their home, their heart rate over time, etc.). Specify whether the data stay in the user's home or are uploaded and stored in the cloud. Explain why this is necessary for providing functions that the user wants.

R4.3 Allow the user to control their (data) privacy settings in a usable manner

Provide an explanation and examples for each privacy setting. Consider providing a step-by-step dialog to identify a user's preferred privacy settings. Consider allowing

the user to choose from a set of pre-defined profiles which are described in easy language. Include the privacy settings dialog in your usability tests.

R4.4 Users provide their consent to their data being collected and used by your solution

Follow the European General Data Protection Regulation¹⁶.

R5. Business model

R5.1 Consider developing multiple (personalized) business models for each user group

Identify the specific values of your solution for every user group, and consider developing multiple (personalized) business models for each of them, or one business model that is flexible enough to accommodate different user groups.

R5.2 Design your business model in a structured and systematic manner

When accommodating multiple user groups, consider using a tool like business-model-canvas.

R5.3 Consider all stakeholders in the purchase and usage processes of your solution, including buyer, payer, user, prescriber and service provider

For each stakeholder group, look at their expectations along the complete value chain.

R5.4 Make your solution affordable for each of the user groups

Some users may not be able to pay for the solution from their own budget. Consider supporting your users in applying for medical and health insurance funds, or using leasing models, for example.

R5.5 Use mainstream technologies as much as possible for economic sustainability and easy replacement and updates

For example, use off-the-shelf hardware (e.g. smartphones, tablets, mini servers) rather than building your own hardware.

4.3 Examples of the application of the PUX recommendations in ACTIVAGE

The different DS have made use of some of the PUX recommendations when developing or improving their products and services. In this section some of the practical examples of application of these recommendations are detailed.

Recommendation R1.11 Single sign-on for all apps

The user should be able to access all functionality of the solution by logging in once rather than multiple times.

Application in DS_MAD:

This recommendation has been followed in the development of the launcher of MAHA application, thus allowing any application within MAHA to be started by a single sign-on the

launcher. This makes it easier for older users to log in different applications, since they have to enter the user and their password only once, whatever the application they are going to use. In this way the usability of the application is improved, as the user doesn't need to remember several login credentials, while maintaining its security.

Recommendation R4.4 Users provide their consent to their data being collected and used by your solution

Follow the European General Data Protection Regulation¹⁶.

Application in DS_MAD:

This recommendation has been followed in the development of the MAHA application, adding in the application configuration screen some simple explanations of the data that can be collected, always in an anonymous manner with the sole interest of the research within the framework of the project, with some tick boxes that must necessarily be selected by the users, if they wish to allow the collection of data. For each type of data there is an explanation and a confirmation box for granting permission to collect such data. In addition, before to providing data collection confirmation, and to be able to desist from it at any time by un-selecting the corresponding boxes, users are explained, and given in paper, all the data that can be collected from their participation and need to give their permission to participate in the pilot by signing an informed consent. These mechanisms ensure compliance with the GDPR, and thus allow the users to be confident and have peace of mind with respect to the use of their data.

Recommendation R2.6 Perform a triple validation

Validate your solution and its design in three ways: (1) Technical validation, (2) inspection by relevant stakeholders and (3) validation by a wide variety of identified real users in the lab and in the field. Note that relevant stakeholders include the service providers (acting as “social mediators”).

Application in DS_GAL:

The different technological solutions that are being piloting in the DS of Galicia have passed a triple validation process. Firstly, after its development, a team of engineers specialised in technologies applied to vulnerable groups carried out a technical validation. Subsequently, a team of different professionals from the social sector who knew the particularities required by a product or service addressed to the group of elderly people contributed with their opinions to improve the system. Finally a large number of users have the opportunity to participate in the validation through the Large Scale Pilot of the project.

Recommendation R2.5 Use an iterative development process, following a user-centered design

Involve as many users as possible and use clear and persistent explanations supported by tangible resources

Application in DS_GAL:

The User-centered Design Methodology proposed in the project has been applied at certain points by the DS of Galicia even before its participation in the project.

This type of methodology allows users to test the different technological solutions, the extraction of feedback on usability and other types of features and the application of this feedback to implement different improvements by the technical team.

Recommendation R1.1 Make adaptable solutions: Allow users to adapt your solution

The user should be able to adjust the look & feel of your solution. And the user should be able to adjust the functionality of your solution (including parameters such as thresholds for monitor alarms). Example: The user includes a doctor or clinician who is responsible for monitoring a client.

Application in DS_RER:

The Graphical User Interface for professionals has been designed with the possibility for the Care and case manager to select the set of info to visualize.

Recommendation R1.10 Design in a way that the user can recognize rather than remember

Use icons that are easy to recognize. Use a consistent look-and-feel for your user interface components. Make components that require user input (e.g. buttons) easy to recognize as such.

Application in DS_RER:

For example, Icons are provided with explaining text and help tooltips are available in three different configurable levels.

Recommendation R4.1 Make your solution private and secure

Protect your user's privacy (make your solution “private”), and protect your user from harm (make it “secure”). Encrypt if you can, anonymize if you cannot. Make sure your users' data are handled, transmitted and stored securely. See also: European General Data Protection Regulation¹⁵.

Application in DS_RER:

Data are pseudoanonymized. Only FSE (Fascicolo Sanitario Elettronico, the regional eHR), can re associate data with corresponding user.

5 Other User Experience and Design for All Recommendations used in the different DS

5.1 Introduction

Each DS has been invited to share its experience in relation with User Interface (UI) and User Experience (UX). DSs approached the topic in different ways depending on the state of art of their activity and their background. This information integrates the specific guidelines coming from PUX.

Some DSs did not have a precise and formalized approach to UX and UI. As an example, in DS RER, services are not affected sensibly by GUIs for ageing adult, as the main interactions with the system is carried out by professional careers, while Informal care givers and cared ones only interact with the legacy systems. ACTIVAGE solutions needed to respect interaction philosophies of the legacy systems.

5.2 Detailed Greece DS case

The following document from DS_GRC is authored by:

Nikolaos Kaklanis, Stefanos Stavrotheodoros, Konstantinos Votis, Dimitrios Tzovaras, Evangelos Mitsakis, Sofia Segkouli from CERTH/HIT, and Eleni Georga, Theodora Varvarigou from ICCS.

5 piece of literature were the base of their design and implementation:

- [1] A. Sajedi, M. Mahdavi, A. Pourshirmohammadi and M.M.Nejad, “Fundamental Usability Guidelines for User Interface Design”, In: Proc. Intern. Conf. on Computational Sciences and Its Applications, Washington, DC, USA, pp. 106–113 (2008)
- [2] Web Content Accessibility Guidelines 2.0, W3C World Wide Web Consortium Recommendation 11 December 2008 (<https://www.w3.org/TR/2008/REC-WCAG20-20081211/>, Latest version at <https://www.w3.org/TR/WCAG20/>)
- [3] ETSI EG 202 487 V1.1.2 (2008-02) Human Factors (HF); User experience guidelines; Telecare services (eHealth), https://www.etsi.org/deliver/etsi_eg/202400_202499/202487/01.01.02_60/eg_202487_v010102p.pdf (last visited on Feb 16th 2019)
- [4] Making Your Website Senior Friendly Tips from the National Institute on Aging and the National Library of Medicine, Available online at: <http://www.lgma.ca/assets/Programs~and~Events/Clerks~Forum/2013~Clerks~Forum/COMMUNICATIONS-Making-Your-Website-Senior-Friendly--Tip-Sheet.pdf> (last visited on Feb 26th 2019).
- [5] Silva P.A., Holden K., Nii A. (2014) “Smartphones, Smart Seniors, But Not-So-Smart Apps: A Heuristic Evaluation of Fitness Apps”. In: Schmorrow D.D., Fidopiastis C.M.

(eds) Foundations of Augmented Cognition. Advancing Human Performance and Decision-Making through Adaptive Systems. AC 2014. Lecture Notes in Computer Science, vol 8534. Springer, Cham.

5.2.1 Smart home solution

The ACTIVAGE Smart Home Solution used in DS_GRC has been designed to cover the Behaviour & Daily Activity Monitoring and the Integrated Care Scenario.

For the implementation of the Monitoring Platform, a web portal that provides access to the users' behaviour (data/information) for evaluation and follow up when required, several generic guidelines were followed for creating a user-friendly environment. The work of Ali Sajedi et al.[1] was used, where some fundamentals usability guidelines for User Interface design are presented. Also the Web Content Accessibility Guidelines (WCAG) 2.0 [2] were taken into consideration. WCAG 2.0 is a series of web accessibility guidelines published by the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C), the main international standards organization for the Internet. They are a set of guidelines that specify how to make content accessible, primarily for people with disabilities.

Besides these fundamental guidelines for UI/UX design, several others described in the ETSI EG 202 4877 "Human Factors (HF); User experience guidelines; Telecare services (eHealth)" [3] were followed. These guidelines are applicable to the research, design, development and deployment of telecare services, thus make it much more suitable for the Monitoring Platform.

Specifically, here are some of the methodologies adopted:

- Consistency: In UI design, it is concerned with making sure that elements in a user interface are uniform and look and behave the same way. This helps constantly prove a user's assumptions about the user interface right, creating a sense of control, familiarity, and reliability. For the implementation of the Monitoring Platform there were 4 different types of consistency that were taken into account:
 - Visual consistency: Fonts, sizes, buttons, labelling and similar are consistent across the application.
 - Functional consistency: The behavior of interface controls, such as buttons and menu items are consistent across the application
 - Internal consistency: it is the consistency of an interface in regard to itself, such as using the same terminology across the application or system, using a similar color theming throughout, or displaying system messages to the user in identical fashion in different cases.
 - External consistency: it is the consistency of an interface in the context of external influences, such as other applications or systems, current trends and standards, and user's expectations and familiarity with other software. For example, all notifications in the Monitoring platform are displayed in the upper right corner using a familiar icon for such cases.
- Latency: The application was developed so that the UI response times are as fast as possible. Any action that take place between 0.5 to 2 seconds is animated so that the users know that the system has not died.
- Metaphors: In user interface design, an interface metaphor is a set of user interface visuals, actions and procedures that exploit specific knowledge that users already have of other domains. In the case of the Monitoring Platform, there was the adoption of icon metaphors for representing the retrieved measurements. For example, a thermometer icon is used for displaying the temperature and a sun icon is used for the representation of luminance.

- The application is adaptable and enables easy personalization to meet user's needs and preferences. In particular, a default dashboard containing several widgets is provided to the end-users for monitoring the elderly user, but it is adjustable according to the end-user needs. That means that the user can create new widgets, remove any of the existing or edit them by changing size and colour, thus creating a dashboard that is closer to his/her preferences. Moreover, a default set of rules is used for creating notifications. These rules are editable, and the end-user can create different rules for each elderly or define his/her own thresholds.
- The application is responsive to different devices and sizes of user interfaces.
- The messages of application are clear, simple and understandable to users, and complex sentences, unusual words, and technical jargon are generally avoided.
- The application is easy-to-use, and the amount of information presented to user is minimized by presenting only what is necessary.
- The application informs the user with clear and simple messages when they make errors. In addition, constructive advices and suggestions are made in order to help the user. For example, if a required field is not completed, a notification that helps the user to identify the empty or incorrectly filled out field is given
- The visual information provided by the application is perceivable by the users. For example, the size of visual object is not too small and there is a satisfying contrast of visual signals.
- The user requirements were defined after a close collaboration with health professionals and carers participating in the project. During the implementation of the Monitoring Platform, the application was tested by the aforementioned users and they provided feedback for the improvement of the UI and UX.
- The information is presented in the Monitoring Platform in pseudo-anonymized way, which is reversible only by the authorised health professional.

5.2.2 Mobility solution

a) ACTIVAGE Safe Mobility Platform

The mobility solution in DS_GRC has been developed to include Monitoring of behavioural and mobility patterns, personalised trip alerts and Advanced cooperative mobility services.

A number of references [4], [5] (except the aforementioned) have been used in order for the design of the ACTIVAGE Safe Mobility Platform to be as friendly as possible for older citizens. During the design and development process of the ACTIVAGE Safe Mobility Platform, the following parameters have been taken into account:

- **Consistency:** Consistency is one of the main elements when designing a platform. The consistency of the platform ensures its usefulness. Fonts, sizes, buttons, labelling etc. are consistent across the ACTIVAGE Safe Mobility Platform, in order for the visual consistency to be ensured. A consistent navigation is used throughout the application
- **Responsiveness:** ACTIVAGE Safe Mobility Platform is responsive to different devices and sizes of UIs.
- **Messages:** The messages appearing in the ACTIVAGE Safe Mobility Platform are written in simple language, avoiding any jargon and technical terms.
- **Visual information:** The visual information provided in the ACTIVAGE Safe Mobility Platform is easily perceived by the users. The size of the visual objects and the high-contrast color combination between them ensures the easy comprehension of the information provided. In addition, the font that was selected is not condensed in order for the provided information to be easily understandable by the users.

- **Easy-to-use:** ACTIVAGE Safe Mobility Platform is easy-to-use. By structuring navigation, it is ensured that the fewest possible clicks are needed to achieve a given task (specifically, the three-click rule is applied).

During the design and the development of the ACTIVAGE Safe Mobility Platform, the application was tested and the provided feedback for the improvement of the UI and UX has been taken into account.

b) Device Management

The device management user interface was created in addition to the main Mobility scenario UI. It is intended for use internally by the device infrastructure administrators of the DS GR Mobility Pilot and has hence, been solely based on their requirements and feedback analysis in a number of iterations. On this basis, the device management UI has been designed and implemented in a generic and adaptable manner, so that it could be used as well in other cases and deployment sites.

The UI fulfils its objectives as follows:

- Single sign-on user authentication based on FIWARE GEs
- The UI has been designed and implemented to support a loose specification for device models (as also supported by the relevant FIWARE infrastructure), allowing for maximum flexibility, but also adhering to the basic FIWARE standards.
- Displaying device status in the devices list is customizable for each device type.

5.2.3 Further references (includes DS GRE references)

Title	Type	Source	Partner	DS	UX or UI	Link
Personal User Experience (PUX) Recommendations and Lessons Learned	Guideline	European Innovation Partnership on Active and Healthy Ageing (EIPonAHA)	TECSOS	DS-GAL	UX	On EIP-AHA EU website
Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts (ISO/DIS Standard No. 9241).	Standard	International Organization for Standardization - ISO	UPM	MAD	UI & UX	Oniso.org(for sale)
10 Usability Heuristics for User Interface Design	Guidelines	Nielsen Norman Group	UPM	MAD	UI & UX	nngroup.com
A. Sajedi, M. Mahdavi, A. Pourshirmohammadi and M.M.Nejad, “Fundamental Usability Guidelines for User Interface Design”	Paper	Proc. Intern. Conf. on Computational Sciences and Its Applications, Washington, DC, USA, pp. 106–113 (2008)	CERTH-ITI	DS GR	UI & UX	researchgate.net (free restricted access)
Making Your Website Senior Friendly Tips from the National Institute on Aging and the National Library of Medicine	Tips/ Guidelines	National Institute on Aging and the National Library of Medicine	CERTH-HIT	DS GR	UI & UX	Local Government Management Association of British Columbia website

Title	Type	Source	Partner	DS	UX or UI	Link
Silva P.A., Holden K., Nii A. "Smartphones, Smart Seniors, But Not-So-Smart Apps: A Heuristic Evaluation of Fitness Apps".	Paper	Schmorrow D.D., Fidopiastis C.M. (eds) Foundations of Augmented Cognition. Advancing Human Performance and Decision-Making through Adaptive Systems. AC 2014. Lecture Notes in Computer Science, vol 8534	CERTH-ITI	DS GR	UI & UX	springer.com (on sale)
ETSI EG 202 487 V1.1.2 (2008-02) Human Factors (HF); User experience guidelines; Telecare services (eHealth)	Guidelines	ETSI	CERTH-ITI	DS GR	UI & UX	etsi.org
Many studies made with CNRS laboratory (Pr Philippe MALLIN) and many works with neurologists, psychologists, sociologists,...	Studies	Technosens	LaR	DS ISE	UI	Non available
Studies and diagnoses, conducted by CARSAT retirement and occupational health funds and within the framework of IsèreADOM, TASDA, French home automation federation	Studies	TASDA, CD38	LaR	DS ISE	UI	Not available. Refer to www.isereadom.fr
Document presenting the digital solutions through use.	Document	TASDA, CD38	LaR	DS ISE	UX	
Document presenting the digital solutions through use.	Document	TASDA, CD38	LaR	DS ISE	UX	

Title	Type	Source	Partner	DS	UX or UI	Link
White paper on Interactive tablet for seniors	White Paper	TASDA	LaR	DS ISE	UI	
Diagnoses and synthesis	Studies	MADoPA		DS ISE	UX	
Korian interviews report	Studies	MADoPA		DS ISE		
Document presenting ideation workshops at Korian	Document	Korian		I DS ISE	UI & UX	
User manual of the solution for panel 3	Document	Korian		DS ISE	UI & UX	
Users Manuals and case reports Panel 1	Document	TASDA		DS ISE	UI & UX	
User's guide, user's manual, etc.	Tips/ Guidelines		SERGAS, TVES	DS-GAL	UI & UX	
Jakob Nielsen "Usability Engineering"	Book		TVES	DS-GAL	UI & UX	In Google book (on sale)
ISO 9241-210:2010 - Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems	ISO		TVES	DS-GAL	UI & UX	iso.org (on sale)

Table 3 "UX References of DS"

5.3 UX and UI Lesson learnt

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
According to ISO 9241-11, there are three indicators typically agreed upon in usability testing: efficiency, effectiveness and satisfaction. Answering the following questions, we could give a value to these indicators, a non-trivial task: What are the user's goals? What steps must be taken to meet those goals? How is the effort being measured?	DS MAD	UI & UX	Website, application, devices interface	Based on the document "Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts (ISO/DIS Standard No. 9241)."
Basic tips for creating usable and intuitive UI for elderly: Font style Sans Serif (Open Sans has been used in MAHA), font size big enough, high contrast between backgrounds and the other elements of the screen, buttons big enough and with clear functionality including text message or image, simple and intuitive icons.	DS MAD	UI	Android app	Self-experience
The need to have a user engagement strategy for Madrid DS is very important given that an active involvement of the users is necessary to ensure a successful UX	DS MAD	UX	Website, application, devices interface	Self-experience
Devices screen size should be adequate to view the content of the apps	DS MAD	UX	Devices	Self-experience
Visibility of system status. The system should always keep users informed about what is going on, through appropriate feedback within reasonable time	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"
Match between system and the real world. The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
User control and freedom. Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"
Consistency and standards. Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"
Error prevention. A careful design which prevents a problem from occurring in the first place is even better than good error messages. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"
Recognition rather than recall. Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"
Flexibility and efficiency of use. Accelerators—unseen by the novice user—may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"
Aesthetic and minimalist design. Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"
Help users recognize, diagnose, and recover from errors. Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
Help and documentation. Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large	DS MAD	UI & UX	Website, application, devices interface	Based on the document "10 Usability Heuristics for User Interface Design"
The UI should employ modern visualization techniques that can aid users understand the data, timely identify problems and undertake required actions	DS GR	UI & UX	Web based UI, server-client implementation, devices interface	Self-experience
The UI should always display current information along with the date-time that the displayed information was created, in order to avoid confusion. E.g. changes in the device status should be immediately reflected to the status displayed by the UI and accompanied by the time of status change	DS GR	UI & UX	Web based UI, server-client implementation, devices interface	Self-experience
The UI should be customisable so as to be easily adaptable to changes in the deployment of backend services or security procedures followed. E.g. being able to accommodate connection either directly to the services or indirectly via a proxy	DS GR	UI & UX	Web based UI, server-client implementation, devices interface	Self-experience
A web-based UI should be compatible with all widely used web browsers to avoid user confusion. This is also reflected by the tools/libraries utilized for UI development. Well established libraries with strong support should be selected for this reason	DS GR	UI & UX	Web based UI, server-client implementation, devices interface	Self-experience
The UI should automate some procedures to ease the efficient and effective performing of tasks and minimise their complexity for the end user, e.g. propagation of device information across backend services/modules	DS GR	UI & UX	Web based UI, server-client implementation, devices interface	Self-experience

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
When creating a UI that enables the specification of device data models, it should be able to support schemes as loose as supported by the underlying services, in order not to limit the offered functionality and possibilities of usage by other parties and being able to accommodate future device types requirements	DS GR	UI & UX	Web based UI, server-client implementation, devices interface	Self-experience
Single sign on user authentication should be used along with centralized authorization control in order to ease both users and their management, as well as enhance security (user activity monitoring)	DS GR	UI & UX	Web based UI, server-client implementation, devices interface	Self-experience
Different vision problems older citizens may have need to be taken into consideration when designing the platform (e.g. use of proper fonts, size and contrast of visual objects)	DS GR	UI & UX	Web based UI	Self-experience
Fewer-clicks-as-possible techniques need to be taken into consideration in the design of the platform	DS GR	UI & UX	Web based UI	Self-experience
Push latency in the background. Avoid long visual or aural acknowledging against button clicks and son on	DS GR	UI & UX	Web based UI	Based on the paper of A. Sajedi, M. Mahdavi, A. Pourshirmohammadi and M.M.Nejad, "Fundamental Usability Guidelines for User Interface Design"
The designer should prevent users from going into an error prone state by an exhaustive control. When an error occurs, the users should never lose their work. Commit / rollback commands can be used to prevent loss of changes	DS GR	UI & UX	Web based UI	Based on the paper of A. Sajedi, M. Mahdavi, A. Pourshirmohammadi and M.M.Nejad, "Fundamental Usability Guidelines for User Interface Design"

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
Consistency in UI enables users to build an accurate mental model of the way it works, and this mental model will lead to lower training and support costs. The system should use clear words and commands as a standard based on the platform in whole system, especially if the system consists of several subsystems	DS GR	UI & UX	Web based UI	Based on the paper of A. Sajedi, M. Mahdavi, A. Pourshirmohammadi and M.M.Nejad, "Fundamental Usability Guidelines for User Interface Design"
Information and user interface components must be presentable to users in ways they can perceive. This means that users must be able to perceive the information being presented	DS GR	UI & UX	Web based UI, devices interface	Based on the Web Content Accessibility Guidelines 2.0
Information and the operation of user interface must be understandable. This means that users must be able to understand the information as well as the operation of the user interface	DS GR	UI & UX	Web based UI, devices interface	Based on the Web Content Accessibility Guidelines 2.0
Use a typeface that is not condensed. Arial is the most commonly used sans serif font today, but Tahoma and Verdana are also widely available and were developed specifically for the screen	DS GR	UI	Web based UI, devices interface	Based on "Making Your Website Senior Friendly Tips from the National Institute on Aging and the National Library of Medicine"
Structure navigation to ensure that the fewest possible clicks are needed to achieve a given task	DS GR	UI & UX	Web based UI, devices interface	Based on "Making Your Website Senior Friendly Tips from the National Institute on Aging and the National Library of Medicine"
Use high-contrast color combinations of font and/or graphics and background to ensure readability and perceptibility; avoid using blue, green and yellow in close proximity	DS GR	UI	Web based UI, devices interface	Based on "Smartphones, Smart Seniors, But Not-So-Smart Apps: A Heuristic Evaluation of Fitness Apps"

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
Make sure text uses types, styles and sizes appropriate to older adults, for instance, but not exclusively: sans serif, non-condensed typefaces, non-italic, left justified and 12-14-point font	DS GR	UI & UX	Web based UI, devices interface	Based on "Smartphones, Smart Seniors, But Not-So-Smart Apps: A Heuristic Evaluation of Fitness Apps"
Evaluations and testing of telecare services should be conducted with domain experts and representative user samples during all stages (including customization), with the evaluation results fed back into the product and service development process	DS GR	UI & UX	Web based UI, devices interface	Based on "ETSI EG 202 487 V1.1.2 (2008-02) Human Factors (HF); User experience guidelines; Telecare services (eHealth)"
The amount of information presented to user should be minimized by presenting only what is necessary	DS GR	UI & UX	Web based UI, devices interface	Based on "ETSI EG 202 487 V1.1.2 (2008-02) Human Factors (HF); User experience guidelines; Telecare services (eHealth)"
The messages of the telecare service should be clear, inoffensive and understandable to users. Technical terms, jargon and abbreviations should be avoided	DS GR	UI & UX	Web based UI, devices interface	Based on "ETSI EG 202 487 V1.1.2 (2008-02) Human Factors (HF); User experience guidelines; Telecare services (eHealth)"
The application must be adaptable and enable easy personalization to meet user's needs and preferences	DS GR	UI & UX	Web based UI, devices interface	Self-experience
Involving professionals, accompanying change and enhancing data sharing are essential to encourage the appropriation and the use of the digital solutions	DS ISE	UX	Android	Self-experience
The homecare professionals have a key role: their support encourage the beneficiary's appropriation and use of digital solutions	DS ISE	UX	All	Self-experience

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
Give users the opportunity to express themselves on the technical problems through a case reports or through workshops during the test	DS ISE	UX	All	Self-experience
The final solution, co-design with experts in the field of ageing (retired doctors, specialist designer, was adjusted through focus group conducted with elderly people and professionals caregivers. It will be challenged by the end- users during all the testing phase	DS ISE	UX	All	Self-experience
Co-design a pedagogic support with experts in the field of ageing, professional caregivers and end-users promote a better understanding. The document presents the digital solutions through use	DS ISE	UX	All	Self-experience
The evolutivity of the solution that creates bridges between the different moments in an elderly person's life, curtails loss of autonomy and combines human and technical assistance (one of the characteristics of the French DS) will be challenged during the testing phase	DS ISE	UX		Self-experience
The acquisition of a detailed knowledge of the territory and the practices of the active seniors in this territory with a territorial diagnosis allowed us 1 st to better know the target 2 nd to better identify needs and stakes about technologies to be included in the ACTIVAGE device for panel 1	DS ISE	UX		Self-experience
Reflection on the technologies to be implemented in the ACTIVAGE device for panel 1 following feedback from territorial diagnosis and according to technical constraints or uses allowed us to co-construct our ACTIVAGE solution	DS ISE	UI & UX		Self-experience
Find an original way to recruit beneficiaries for panel 1 and more broadly to introduce ageing through: conferences with a dance show on the ageing theme and through a Lego model which allowed us to present the device and reflect with active seniors on the ACTIVAGE solution for panel 1	DS ISE	UX		Self-experience

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
Interviews with professionals working at Korian allowed us to understand professional practices, constraints and expectations and to make recommendations about ACTIVAGE device to implement in the solution for panel 3	DS ISE	UX		Self-experience
Reflection on the technologies to be implemented in the ACTIVAGE device for panel 3 following feedback from interviews Korian professionals and according to technical constraints or uses allowed us to co-construct our ACTIVAGE solution	DS ISE	UI & UX		Self-experience
Realization of ideation workshops with Korian caregivers allowed us to work on and validate all the scenarios of experiments imagined around the ACTIVAGE device for panel 3	DS ISE	UI & UX		Self-experience
Realization of a simplified user manual in paper version for the residents (panel 3)	DS ISE	UX		Self-experience
Training professionals to use the ACTIVAGE device for Panel 3	DS ISE	UX		Self-experience
Need to have an app (Android and Apple) that facilitates the monitoring of the family from a smartphone	DS GAL	UI & UX	App	Self-experience
A drop-down menu would make it easier to navigate the web (and the app if any)	DS GAL	UI & UX	Website, application, devices interface	Self-experience
The caregiver is sometimes confused with the mobility graphic or does not provide relevant/understandable information.	DS GAL	UX	Website, application, devices interface	Self-experience
The language used in sentences to set alarms is sometimes confusing to the caregiver. In addition, according to social professionals, it may be inappropriate (e.g., determining possible dementia by not leaving the home within x hours).	DS GAL	UX	Website, application, devices interface	Self-experience

Lesson learnt	DS	UX or UI	Technology (Android, Win, Devices, environment, ...)	References
Older adults and caregivers have a hard time using PCs to fill out questionnaires.	DS GAL	UX	Website, application	Self-experience
Device should not have emitting lights. This lesson learnt has been contested by some ageing adult that declare that they feel assured by the presence of a lighten led on the device	DS RER	UX	Device interface	Requirements

Table 4 “Lessons learnt in UX from DS perspective”

6 Lessons learnt about the piloting of ACTIVAGE solutions

This section includes information collected in different areas of the project around the activity carried out within the pilots.

On the one hand, section 6.1 includes the experiences treated within the specific work package of the WP9 pilots and already specified in different documents such as D9.8.

Section 6.2 summarizes the list of contributions made by the different participants in a workshop held during the month of May in the plenary meeting of the ACTIVAGE project in Thessaloniki.

The following table shows the list of topics chosen to classify and identify the proposed recommendations.

Topic	Sub-topic
User engagement	Definition of inclusion and exclusion criteria
	Recruitment enrolment (include legal and ethical)
	Co creation (user requirements)
	Key success factor for citizen campaign
	installations
Experiment set up running	Legal and ethical
	Training to recruiter, to user, to trainers
	Purchasing (Procurement policies and procedures)
	Installations
	Follow up and motivation (user engagement)
	Data management
	Support
Evaluation	Questionnaires
	Monitoring

Table 5 “Topic classification”

6.1 Lessons extracted in WP9

This section shows the experiences gathered within the specific Work package for the definition, execution and coordination of the Large Scale Pilots (WP9) and already specified in different documents such as D9.8.

ID	Lesson	DS	Topic	SubTopic
GAL001	Older adults have a low level of education and a poor technological level.	DS1 GAL	Experiment set-up and running	Follow up and motivation
GAL002	Caregivers are the users who most value the solution.	DS1 GAL	Experiment set-up and running	Follow up and motivation
GAL003	Older adults feel safer and more cared for at home. Almost 75% of our pilot's older adults live alone, therefore our use cases are very useful for them.	DS1 GAL	User engagement	Key success factor for citizen campaign
VLC001	Successful communication of citizenship campaign for recruitment from Local Authority.	DS2 VLC	User engagement	Key success factor for citizen campaign
VLC002	Design of internal mechanisms to periodically exchange information among partners on technical incidences and their causes. Protocol for running facilities after installation: collects periodic information for improvements.	DS2 VLC	Experiment set-up and running	Installations
VLC003	Well documented installation and technical support process minimise risk of unsatisfactory user experience.	DS2 VLC	Experiment set-up and running	Support
VLC004	Protocol for ethics and GDPR issues from a proactive and anticipatory strategy, before entering in force to minimize changes during the experiment.	DS2 VLC	Experiment set-up and running	Legal and ethical
MAD001	The need to have a user engagement strategy for Madrid DS is very important given that the users are not passive users with sensors but have to be very active in order to use devices. In this concern the best proven tool has been	DS3 MAD	User engagement	Key success factor for citizen campaign

ID	Lesson	DS	Topic	SubTopic
	the organization of events, not only because possible issues with the devices that users have confronted can be solved but also because there is involvement of other stakeholders like the municipalities and public authorities.			
MAD002	The events create community, AHA community of elderly formal carers, institutions and NGO awareness of the importance of IoT solutions within AHA domain.	DS3 MAD	User engagement	Key success factor for citizen campaign
MAD003	Technology is very useful to relieve caregivers' burden.	DS3 MAD	Experiment set-up and running	Follow up and motivation
MAD004	Elderly with very low level of education & scarce knowledge of technology.	DS3 MAD	Experiment set-up and running	Follow up and motivation
MAD005	Certain patterns of self-perception of the quality of life of end-users must be verified by technology.	DS3 MAD	Evaluation	Questionnaires
MAD006	The ethical approval always takes more time than expected.	DS3 MAD	Experiment set-up and running	Legal and ethical
MAD007	Not all issues can be trained with the caregivers and end-users, real time support is needed from the technical partners.	DS3 MAD	Experiment set-up and running	Training to recruiter to user to trainers; Support
RER001	In DS RER experimentation, embedded in the regional healthcare services, recruitment needs to rely on GPs. This ensures the best possible integration into care practices, as well as due consideration of privacy issues. GPs need to be involved through Institutional, informal and personal meetings to increase their awareness and interest in the services.	DS4 RER	User engagement	Recruitment enrolment

ID	Lesson	DS	Topic	SubTopic
RER002	Home environment features greatly differs and citizen could be concerned in hosting installed technology. Careful consideration of user requests and flexible installation strategies is often needed. Skilled installer is needed, that knows how to deal with placing new device in apartment, apartment materials, and good attitude in relating to older persons. Two person may be needed for each installation.	DS4 RER	Experiment set-up and running	Installations
RER003	Online tool for gathering questionnaire results is required	DS4 RER	Evaluation	Questionnaires
RER004	Getting ethical clearance is burdensome, also because of the innovative approach involving behavioural assessment. So, plan in advance submission to Ethical Committee. Any change in protocol need to be revised by Ethical committee	DS4 RER	Experiment set-up and running	Legal and ethical
RER005	Cloud-based data-management involves several actors. Clear role definition is needed, with a main data processor in charge, and effective anonymization strategies allowing distributed services to be managed in a compliant way by multiple partners providing data analytics services.	DS4 RER	Experiment set-up and running	Data management
GRC001	Although the installation of the devices were relatively easy and not much time consuming, in many cases the recruited user's home was located in a place that internet connection was very poor making this case unfit to be included. Thus, before sending the crew for instalment it is important that internet connectivity of the area is evaluated.	DS5 GRC	Experiment set-up and running	Installations

ID	Lesson	DS	Topic	SubTopic
GRC002	Due to fact that some elderly have the feeling that they are monitoring by the installed motion sensors it is important to explain with details and with simple words the function of the technological service so as to feel comfortable with that operation. Also the elderly must have the feeling that their privacy and their personal data will be protected in any case.	DS5 GRC	Experiment set-up and running	Data management
GRC003	The identification of end-users and targeted audience for a continuous dissemination actions is vital. In order for the elder people to engage with the programme, since they are afraid of the new technology, it is crucial to share with them the feeling of security the new establishments will offer.	DS5 GRC	User engagement	Key success factor for citizen campaign;
GRC004	In order for older citizens to participate in the mobility scenario/ to register themselves in the ACTIVAGE Safe Mobility Platform, it is crucial to explain them well the importance of the scenario, in terms of safety. This is an actual need, due to the fact that older citizens have a lack of familiarity with such technologies.	DS5 GRC	User engagement	Key success factor for citizen campaign
ISE001	Long process for the ethical committee approval.	DS6 ISE	Experiment set-up and running	Legal and ethical
ISE002	Many exceptional cases appears. Almost each home being a specific case. Major difficulty: electrical installation of the beneficiary not always certified	DS6 ISE	Experiment set-up and running	Installations
WOQ001	Technical requirements for cables failed, old standards are problematic, many devices broke due to higher Voltage.	DS7 WOQ	Experiment set-up and running	Installations

ID	Lesson	DS	Topic	SubTopic
WOQ002	We found difficulties when people live yet in apartments and add afterwards the solution that translated in lower acceptance rate	DS7 WOQ	Experiment set-up and running	Installations; Follow up and motivation
LEE001	Some users turn off the home gateway at night.	DS8 LEE	User engagement	Training to recruiter, to user, to trainers
LEE002	Some main trial users (elderly) were dismissive of having a career and feel that they are more than capable of looking after themselves.	DS8 LEE	Experiment set-up and running	Follow up and motivation
LEE003	Technologically we had issues with immature systems.	DS8 LEE	Experiment set-up and running	Installations
LEE004	Special attention should be made to wording, for example "Have you had a fall?" was not liked, "Have you taken a fall?" was preferred.	DS8 LEE	Experiment set-up and running	Follow up and motivation
LEE005	When recruiting trial users more emphasis should be made to include family/friends as opposed to carers.	DS8 LEE	User engagement	Definition of inclusion and exclusion criteria; Recruitment enrolment
FIN001	We slightly overestimated the digital skills of the elderly, and they were and are not as keen or interested to use digital solutions.	DS9 FIN	Experiment set-up and running	Follow up and motivation
FIN002	The formal caregivers on the other hand are more than motivated and truly try their best to attract the real elderly users to the pilots.	DS9 FIN	Experiment set-up and running	Follow up and motivation

Table 6 “Lessons collected from ACTIVAGE WP9”

6.2 Lessons extracted in Thessaloniki Workshop

In the scope of the plenary meeting of the ACTIVAGE project that took place in the city of Thessaloniki, on May 28th and 29th, a workshop was held to obtain valuable information on the status of the Project.

The workshop proposed by the leader of WP2 together with the authors of this document D2.3 served to gather the positive aspects that should be converted into recommendations of a

future guide of replication of the project, as well as aspects to avoid or ideas that can be useful so that this type of projects are developed in better conditions.

During the workshop the members of the different Deployment Sites were distributed into 3 large groups. 3 facilitators were in charge of managing the different opinions for each important group of issues:

- User engagement
- Experiment set-up running
- Evaluation

Opinions were categorized as follows:

- Recommendations (green post-it)
- Things to avoid (red post-it)
- Opportunities for improvement (yellow post-it)

After the realization of this workshop, all the information was digitalized in Table 7.

Figure 1 and Figure 2 show different moments of the workshop in Best practices about the city of Thessaloniki.



Figure 1 “ Co-creation Workshop on Guidelines”



Figure 2 “Results of the Co-creation workshop in Thessaloniki”

The following table shows the overview of the different ideas proposed by the partners during the workshop:

ID	Lesson	DS	Topic	SubTopic
UE001	Inclusion & exclusion criteria well done because were defined between all partners	DS_VLC	User engagement	Definition of inclusion and exclusion criteria
UE002	Citizen campaign well performed because the city council had an important role on it	DS_VLC	User engagement	Key success factor for citizen campaign
UE003	Citizen campaign, a key thing was to adapt the language and the message of the campaign to the target public (elderly and relatives) and the choice of the different communication channels	DS_VLC	User engagement	Key success factor for citizen campaign
UE004	Involvement and recruitment according to the population demographic reality (gender,age, skills)	DS_MAD	User engagement	Recruitment enrolment (include legal and ethical)
UE005	Performance of events and set of conferences related to aging to increase user engagement	DS_MAD	User engagement	Key success factor for citizen campaign

ID	Lesson	DS	Topic	SubTopic
UE006	For recruitment, going where elderly people are: church, elderly people associations...	DS_GAL	User engagement	Training to recruiter to user to trainers
UE007	Guidelines for recruitment team to recruit and make attractive the project for the users	DS_VLC	User engagement	Training to recruiter to user to trainers
UE008	Building trust with participants by using words that they understand (Not too technical)	DS_LEE	User engagement	Recruitment enrolment (include legal and ethical)
UE009	Before deployment we spent several months defining the pilot e.g.: pilot requirements, procedures, communications channels	DS_GAL	User engagement	
UE010	Coordinate recruitment with “technology” to avoid frustrations and drop-outs	DS_MAD	User engagement	Recruitment enrolment (include legal and ethical)
UE011	To carry out different phases of recruitment to reduce drop-out and do the process easier to external collaborators	DS_GAL	User engagement	Installations
UE012	Try to recruit, evaluate and give technology in a short period to avoid drop-out	DS_MAD	User engagement	Installations
UE013	Cities had organized social meetings for elderly in health thematics to attract beneficiary and promote the Active and Healthy Ageing solutions	DS_ISE	User engagement	Key success factor for citizen campaign
UE014	Good planning of goals and steps to be delivered	DS_VLC	User engagement	
UE015	Privacy issues with recruitment of particular type of users like stroke patients	DS_RER	User engagement	Recruitment enrolment (include legal and ethical)
UE016	Recruitment should be aligned with the available dates to install to avoid drop-outs	DS_GAL	User engagement	Installations
UE017	Flexibility of the participation Criteria	DS_GAL	User engagement	Definition of inclusion and exclusion criteria
UE018	The need of validation of the project by ethical committee	DS_RER	User engagement	Legal and ethical
UE019	Ensure enough low technological background profiles during the co-creation process	DS_MAD	User engagement	Co-creation (user requirements)
UE020	Exclusion & inclusion criteria to be improved by segmentation according to the different services	DS_MAD	User engagement	Definition of inclusion and exclusion criteria

ID	Lesson	DS	Topic	SubTopic
UE021	Need to motivate users to participate in the innovation process	DS_WOQ	User engagement	Key success factor for citizen campaign
UE022	Exclusion & inclusion criteria should start at 55 years old because it is a preventive approach	DS_GAL	User engagement	Definition of inclusion and exclusion criteria
UE023	More time and effort should be spent on co-creation processes	DS_FIN	User engagement	Co-creation (user requirements)
UE024	Waiting list of participants waiting for installations and for too long, this led into annoyed participants and withdrawals	DS_VLC	User engagement	Installations
UE025	Difficult engagement for promotion by citizen campaign	DS_RER	User engagement	Key success factor for citizen campaign
UE026	Informed consents and questionnaires too long. Delayed the process of installation so we decided to split installations from consent form signature and baseline questionnaires	DS_VLC	User engagement	Installations
UE027	General inclusion criteria make that solutions that “fit” with “older” elderly are not good for “younger” elderly. Need sub-criteria	DS_MAD	User engagement	Definition of inclusion and exclusion criteria
UE028	Improve the focus of relatives and use them as prescriptors	DS_GAL	User engagement	Key success factor for citizen campaign
UE029	Too long informed consent that people do not really read	DS_GAL	User engagement	Recruitment enrolment (include legal and ethical)
UE030	Low window criteria for recruitment	DS_RER	User engagement	Recruitment enrolment (include legal and ethical)
UE031	Too selective inclusion criteria	DS_RER	User engagement	Definition of inclusion and exclusion criteria
UE032	Too many forms and documents to explain and to be signed by older users (informed consents, privacy documents)	DS_RER	User engagement	Recruitment enrolment (include legal and ethical)

ID	Lesson	DS	Topic	SubTopic
UE033	Co-creation with final users to make really easy to use products	DS_VLC	User engagement	Co-creation (user requirements)
UE034	Not to have defined strategic campaign of recruitment through digital media	DS_GAL	User engagement	Key success factor for citizen campaign
UE035	Recruitment failed in produce materials for the elders. Some alternative media such as video, tablets to avoid paper stuff	DS_VLC	User engagement	Recruitment enrolment (include legal and ethical)
UE036	Workshops, specially co-creation methods in challenging topics make project meetings and progress more active and participative	DS_FIN	User engagement	Co-creation (user requirements)
UE037	Co-creation sessions were useful to identify functionalities but just a reduced list of them it will be finally implemented in the project	DS_VLC	User engagement	Co-creation (user requirements)
UE038	Co-creation between social and technical people to define the solution takes a long time	DS_ISE	User engagement	Co-creation (user requirements)
UE039	To expand recruitment to chronic disease	DS_RER	User engagement	Recruitment enrolment (include legal and ethical)
UE040	Improve the description of the product to make easy the user engagement from the beginning	DS_VLC	User engagement	Key success factor for citizen campaign
UE041	Exclusive criteria too selective (internet connection, person living alone...)	DS_ISE	User engagement	Definition of inclusion and exclusion criteria
UE042	“educational” awareness of the usefulness of this type of solutions	DS_MAD	User engagement	Key success factor for citizen campaign
UE043	Involve more human resources in the recruitment and to engage all the partners	DS_GAL	User engagement	Recruitment enrolment (include legal and ethical)
UE044	Having a more restrictive inclusion & exclusion criteria make the evaluation process more accurate	DS_MAD	User engagement	Definition of inclusion and exclusion criteria
UE045	Demo of IoT installations and project description to disseminate the project	DS_RER	User engagement	Key success factor for citizen campaign

ID	Lesson	DS	Topic	SubTopic
UE046	Motivating ideas to keep elderly committed in technology use.	DS_VLC	User engagement	Key success factor for citizen campaign
UE047	Difficult engagement for digital illiterate must be solved	DS_RER	User engagement	Key success factor for citizen campaign
UE048	Activities to involve relatives in the solution follow-up	DS_GAL	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU049	Dissemination and great ecosystem generation	DS_MAD	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU050	Follow up and motivation visits and phone calls plus a short informal questionnaire to participants every 4 months	DS_VLC	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU051	The installation process was good because procedures and protocols were clear and defined	DS_VLC	Experiment set-up and running	Installations
ExpSU052	Installations must be validated with a checklist before leaving the homes	DS_GAL	Experiment set-up and running	Installations
ExpSU053	Training to installators so they can be trustable to the final users	DS_GAL	Experiment set-up and running	Installations
ExpSU054	Coupling installer and social workers together when deploying IoT solution at user homes	DS_ISE	Experiment set-up and running	Installations
ExpSU055	Set-up a hotline for issue tracking	DS_ISE	Experiment set-up and running	Support
ExpSU056	Protocol to manage incidences and technical support	DS_VLC	Experiment set-up and running	Support
ExpSU057	Proactive approach to anticipate GDPR entering and data protection issues	DS_VLC	Experiment set-up and running	Legal and ethical
ExpSU058	Designation of Ethical manager at pilot level	DS_VLC	Experiment set-up and running	Legal and ethical
ExpSU059	Recruitment process very satisfactory due to the confidence between partners and city council final user providers	DS_VLC	Experiment set-up and running	Recruitment enrolment (include legal and ethical)
ExpSU060	Proactivity of smaller town governments comparing to bigger towns	DS_MAD	Experiment set-up and running	Follow up and motivation

ID	Lesson	DS	Topic	SubTopic
				(user engagement)
ExpSU0 61	Bottom up approach to adapt to each DS	DS_MAD	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU0 62	Maintain contacts and motivation to participate in the project by explaining users and caregivers the benefits of using some IoT solutions	DS_RER	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU0 63	Utilising student groups in installations processes has been successful (together with carers)	DS_FIN	Experiment set-up and running	Installations
ExpSU0 64	It is important to train caregivers on the use of the solution	DS_MAD	Experiment set-up and running	Training to recruiter to user to trainers
ExpSU0 65	Time taken to agree legal documents between participating parties	DS_LEE	Experiment set-up and running	Legal and ethical
ExpSU0 66	Synchronize recruitment, deployment & device acquisition	DS_MAD	Experiment set-up and running	Purchasing (Procurement policies and procedures)
ExpSU0 67	Lack of usefulness perception of the solution by the end users	DS_MAD	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU0 68	Ethical guidance and requirements have been really unclear	DS_FIN	Experiment set-up and running	Legal and ethical
ExpSU0 69	Beneficiaries dropping-out the experiment due to IoT solution instability	DS_ISE	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU0 70	Tech support for end-users and staff	DS_LEE	Experiment set-up and running	Support
ExpSU0 71	Rely on an electrician to install IT solutions but not professional that sometimes is not expert on dealing with frailty people	DS_ISE	Experiment set-up and running	Installations
ExpSU0 72	Lack of information of the final users about the goal of the project and their contribution	DS_GAL	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU0 73	Would be good to have more tools and support for user motivation	DS_FIN	Experiment set-up and running	Follow up and motivation (user engagement)

ID	Lesson	DS	Topic	SubTopic
ExpSU074	We need a unified glossary for different skills (social vs technical)	DS_RER	User engagement	Co-creation (user requirements)
ExpSU075	Avoid the obsolescence of the devices by improving the provisioning and contract with the provisioning company	DS_ISE	Experiment set-up and running	Purchasing (Procurement policies and procedures)
ExpSU076	Using real installation to train more people from installation team is very invasive for the older adults	DS_GAL	Experiment set-up and running	Installations
ExpSU077	Too many technical incidences to solve delay deployment	DS_VLC	Experiment set-up and running	Installations
ExpSU078	Legal documentation for the user must be clear	DS_GAL	Experiment set-up and running	Legal and ethical
ExpSU079	Training about legal issues needed	DS_MAD	Experiment set-up and running	Legal and ethical
ExpSU080	Anonymization slow down tech support	DS_RER	Experiment set-up and running	Legal and ethical
ExpSU081	Installation time was increased because users “need” to talk with installators (loneliness)	DS_GAL	Experiment set-up and running	Installations
ExpSU082	Problems are only reported by relatives and not by final users	DS_GAL	Experiment set-up and running	Support
ExpSU083	Installation must be estimated in more PM in the proposal	DS_VLC	Experiment set-up and running	Installations
ExpSU084	User engagement focused in relatives, users want to participate because relatives recommend it	DS_VLC	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU085	Technical people need contact access to end users to collect needs and adapt the solutions	DS_MAD	Experiment set-up and running	Co-creation (user requirements)
ExpSU086	Technical problems must be solved before the installations	DS_GAL	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU087	Installation follow-up must be done so defects can be detected	DS_GAL	Experiment set-up and running	Follow up and motivation (user engagement)
ExpSU088	End users better support to avoid the lack of confidence of some users about technology	DS_LEE	Experiment set-up and running	Support

ID	Lesson	DS	Topic	SubTopic
ExpSU090	Better Communication between all parties to understand objectives	DS_LEE	Experiment set-up and running	Co-creation (user requirements)
EVAL091	A global dashboard of collected evaluation	DS_VLC	Evaluation	Monitoring
EVAL092	Focus Groups are a good method to extract Qualitative data	DS_RER	Evaluation	Monitoring
EVAL093	Translate questionnaires into local languages	DS_VLC	Evaluation	Questionnaires
EVAL094	Focus groups to find out more in some preliminary results of local evaluation	DS_VLC	Evaluation	Monitoring
EVAL095	Divide users and solution in different use cases	DS_VLC	Evaluation	Key success factor for citizen campaign
EVAL096	Definition of monthly reports at pilot level	DS_VLC	Evaluation	Monitoring
EVAL098	Evaluation staff makes the process of collecting data less “heavy” for the elderly users using engagement activities	DS_MAD	Evaluation	Monitoring
EVAL099	360° evaluation with the involvement of every of stakeholders including technical staff	DS_MAD	Evaluation	Monitoring
EVAL100	Graphical approach to visualize evaluation results in a common way	DS_VLC	Evaluation	Monitoring
EVAL101	Definition of correlation among variables by all partners taking into account all interests	DS_VLC	Evaluation	Monitoring
EVAL102	Identification of new possible use cases based on the data collected (E.g: energy poverty)	DS_VLC	Evaluation	Monitoring
EVAL103	Evaluation used to personalize solutions	DS_VLC	Evaluation	Personalization
EVAL104	Focus groups for caregivers help them to share problems	DS_RER	Evaluation	Support
EVAL105	A responsible for KPI must be defined at all DS	DS_LEE	Evaluation	Monitoring
EVAL106	Some questions are repetitive and boring for the elder users	DS_RER	Evaluation	Questionnaires
EVAL107	Lack of common standard tool to ensure data collection process	Anonymo us	Evaluation	Monitoring
EVAL108	Different questionnaires not adapted to people	DS_VLC	Evaluation	Questionnaires
EVAL109	Elderly users prefer papers but administrating them is extra work for caregivers	DS_VLC	Evaluation	Follow up and motivation (user engagement)
EVAL110	Long questionnaires rely on long phone calls for a big number of users	DS_GAL	Evaluation	Questionnaires

ID	Lesson	DS	Topic	SubTopic
EVAL111	Questionnaires with large text and answering options	DS_VLC	Evaluation	Questionnaires
EVAL112	Too many questionnaires annoy elderly users	DS_VLC	Evaluation	Questionnaires
EVAL113	Language of the questionnaires is not friendly for elderly users	DS_VLC	Evaluation	Questionnaires
EVAL114	Definition of target of the KPIs before knowing the real situation	DS_VLC	Evaluation	Monitoring
EVAL115	Common tools to collect data arrived late in the project	DS_VLC	Evaluation	Monitoring
EVAL116	Weak control about the real use of solutions	DS_VLC	Evaluation	Monitoring
EVAL117	Use real data from IoT to define “Quality of life”	Anonymo us	Evaluation	Monitoring
EVAL118	Knowing better the users and their “QoL” at the beginning to apply qualitative investigation	DS_VLC	Evaluation	Monitoring
EVAL119	Questionnaires should be self-explainable	DS_VLC	Evaluation	Questionnaires
EVAL120	Definition of the common KPIs before recruitment	DS_MAD	Evaluation	Monitoring
EVAL121	Use the app for the questionnaires to relatives	DS_GAL	Evaluation	Questionnaires

Table 7 “Lessons collected from co-creation workshop in Thessaloniki”

7 Conclusions and Future Work

Throughout this document, the application of the UX and PUX concepts in the development of the different solutions piloted in ACTIVAGE has been highlighted. These aspects were not widely developed in the initial proposal, but they had been taken into account by many of the partners participating in the project for the development of their different technological solutions. In addition, this topic was addressed in the comments of the reviewers during the previous project review. In this way, the document contemplates the different regulations and recommendations that have significantly influenced the products and services deployed in the ACTIVAGE project.

At the same time, the document includes a set of lessons learnt for the development of Large Scale Pilots in the Active and Healthy Aging area that has been agreed by the different partners of the project in a collaborative way.

The different pieces of information collected in this document will serve as the basis for the publication of a guide of Best Practices for the adoption of ACTIVAGE solution in other pilots that will be published in the latest version of this deliverable, with epigraph D2.6, together with the upcoming activity of DSs and WP2 of collecting and synthesize further experiences.