MAPPING OF ACCESSIBILITY AND ADOPTION OF SERVICES AND PRODUCTS

IN-4-AHA Project - *Innovation Networks for Scaling Active and Healthy Ageing*

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More information about the project can be found on the IN-4-AHA webpage and social media pages:
https://innovation4ageing.eu/
https://www.facebook.com/IN4AHA
https://twitter.com/EIP_AHA
https://www.linkedin.com/groups/8912125/

More information about the EIP on AHA community and FUTURIUM platform:
https://futurium.ec.europa.eu/en/active-and-healthy-living-digital-world
https://digital-strategy.ec.europa.eu/en/policies/eip-aha

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History of changes

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Glossary

AHA	Active and Healthy Ageing
IN-4-AHA	Innovation Networks for Active and Healthy Ageing
CSG	Cluster Saúde de Galicia
ITGALL	Innovation Technological Galician Living Labs
PCA	Person-Centred Approach
WHO	World Health Organisation
INE	National Statistics Institute of Spain
GSE	Galician Statistical Institute
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
TRL	Technological Readiness Level
PD	Participatory Design
UCD	User-centred design
UD	Universal Design
DT	Design Thinking

Key terms

Definition	Description
Accessibility	Universal accessibility is the condition that environments, processes, goods, products and services, as well as objects or instruments, tools and devices, must meet in order to be understandable, usable and practicable by all people in safety and comfort and as autonomously and naturally as possible (7).
Scalability	Deliberate efforts to increase the impact of health service innovations successfully tested in pilot or experimental projects, in order to foster lasting policy and programme development (WHO,2009).[1]
Adoption	The adoption process is an individual process consisting of the acceptance of the innovation by the individual, i.e. it is the decision to use or not to use an innovation.
Service providers	By service provider we specifically refer to service/solution developers or product/service developers. .
Person-centred Approach	The person-centred approach to projects and solutions related to care technologies refers to the consideration of the person as someone valuable and deserving of respect, seeking personalisation of the support provided and, therefore, their participation in the design, use and evaluation of the innovative product or technology. In the context of this project, person-centredness is synonymous with human-centredness, personal-centredness, user-centredness and patient-centredness
Facilitator	Are: 1) professionals in health and care institutions (hospitals, social and healthcare centres, assisted living communities, etc.) who provide professional support for the elderly person (65+) in connection with service, which is being evaluated, 2) family members, relatives, or other informal care givers who assist the elderly person to improve their health condition and/or help in general, or 3) any other person (i.e., volunteers) who directly assists the elderly person to improve their health conditions and/or helps in general. (12)
End-users	Are persons aged 65+ that the service aims to improve their health and living condition or help receive care/assistance. (12)

[1] World Health Organisation. Practical guidance for scaling up health service innovations. WHO, Geneva, 2009. http://whqlibdoc.who.int/publications/2009/9789241598521_eng.pdf

Executive summary

This document, "Mapping of accessibility and adoption of services and products", aims to identify the key factors in the accessibility and adoption of technological innovations taking into account a Person-Centred Approach. This approach focuses on the needs of the people for whom the solution is intended and where the person should be involved in making decisions about their own health or care.

As a result of the accessibility and adoption mapping, an image is designed to visualise how the uniqueness of people and the design of solutions affects the accessibility and adoption of technology products or services.

The activities carried out by the Work Package were threefold: 1) focus group to map end-users' accessibility to the most relevant technology products and services in the market, 2) adoption case studies: identification of main barriers and key success factors and, finally, 3) cross-border scalability of accessibility and adoption models.

As a result of the first activity, a *focus group to map the accessibility of end-users to the most relevant technological services and products on the market*, it was identified that education, lifestyle, level of training, economic situation and the environment of the elderly person have a very significant influence on access to technological innovations. Universal design is the key factor for accessibility as it is the condition that technologies must meet in order to be understandable, usable, and practicable by all people in safe conditions and as autonomously and independently as possible.

During the second activity, *adoption of case studies: identification of the main common barriers and key success factors*, testing of the projects selected in the IN-4-AHA call (April 2021) is carried out. The key user experience factors identified are ease of use and comprehension, simplicity, intuitiveness, security, personalisation, and efficiency of the product or service. The digitisation and automation of processes and technological solutions that favour remote customer service are also key. The most important key is for technology developers to take into account person-centred design, as this is related to greater adoption and satisfaction of the people who will use the solution.

The main barriers detected in the user experience are those related to technical problems and interoperability problems between devices. Major difficulties in the process of signing up for a technological solution led to rejection and discarding the use of the technological solution. Another important barrier is the need for a lengthy process to integrate information in order to use the solution along with cultural, social, and educational barriers.

In the third activity, cross-border scalability of accessibility and adoption models, an approach to the main models of adoption and accessibility is made.

One of the main contributions that D4.2 makes to the project is the creation of a tool for measuring person-centred attention present in technological innovations from the user experience. The tool generates information that guides technology developers to focus on the real needs and expectations of the end-user in order to achieve more successful and scalable products and services.

1. Introduction

1.1. Scope and objective of the deliverable

WP4 has facilitated the testing activities in living labs and the validation activities necessary to design scalable solutions, assessing the accessibility and adoption of the projects selected in the IN-4-AHA call. Protocols have been developed to increase the accessibility of technological innovations for end-users and innovation standards have been promoted for their adoption (Annex I).

The objective of D4.2 "Mapping of accessibility and adoption of services and products" is to identify the key factors for mapping the accessibility and adoption of technological innovations from a People-Centred Approach.

1.2. WP4.2 Activities

The Person-Centred Approach is the transversal methodology that accompanies all the work developed in the activities that have been carried out. It is also key to understanding the real needs of end-users and to being able to design technological innovations that are more in line with the expectations of all stakeholders.

In order to achieve this, the following activities have been carried out:

1) Focus group to map the accessibility of end-users to the most relevant technological services and products on the market, where the opinions of all parties involved are gathered (See Table 3. For profile of participants). As a result, information is obtained on what facilitates and hinders accessibility.

2) Adoption case studies: identification of the main common barriers and key success factors. In order to carry out the adoption of the projects selected in the IN-4-AHA open call, a testing and co-creation process has been carried out with different profiles of participants where the key factors to adoption and barriers are analysed.

3) Cross-border scalability of accessibility and adoption models, where a review of the most relevant models is carried out.

In the course of these activities, the need to develop a tool to help assess the Person-Centred Approach of technological innovations and its relation to accessibility and adoption by end-users has been identified.

1.3. Methodology

The transversal theme axis of all activities carried out by D4.2 is the Person-Centred Approach (PCA). This methodology brings benefits not only to end-users (older people), but also to service providers and technology developers by designing more accessible and adaptable technological solutions. Moreover, taking into account this PCA during the implementation of the activities improves the quality of the results obtained by involving the end-users during the development of the activities as active agents in the construction of knowledge.

This is why, during the development of the D4.2 activities, a participatory methodology is central with a work process that conceives the participants of the processes as active agents, in line with the fact that people are at the centre of the activities carried out.

The Design Thinking (DT) methodology is also present in the core of the activities carried out by D4.2. DT is a working methodology divided into different phases and based on a collaborative learning and development process. Furthermore, it focuses on practical skills, such as learning by doing, and on the human approach, including empathy and listening. Consequently, DT is presented as a methodology for developing people-centred innovation, where challenges can be observed, needs can be identified, and solutions can be offered.

Finally, a Participatory Design (PD) approach, defined as a democratic process, has been taken into account in the development of certain tasks (10). The central argument of early versions of PD is that all stakeholders should be involved in the design of the social and technological systems in which they operate (10). As explained in the report Overview of the evaluation toolkits (11).

1.4. Timeline

The schedule of activities is shown in Table 1.

Table 1. *Timeline of D4.2 activities.*

Activity	Task name	2021												2022					
		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1	Focus Group to map end-users' accessibility to validated services and products.																		
2	Adopting case studies: identifying the main common barriers and key success factors																		
3	Cross-border scalability of accessibility and adoption models																		
D4.2 DELIVERABLE: Mapping accessibility and adoption of services and products																			

2. Focus Group to map accessibilities to validated services/products

The aim of the focus groups carried out within activity 1 of WP D4.2 *Focus Group to map accessibilities to validated services/products*, is to map the accessibility of end-users to the most relevant technological products and services on the market and to identify what makes accessibility difficult and what facilitates accessibility.

2.1. Timeline

The timeline for Activity 1 of D4.2 is shown in Table 2.

Table 2. *Timeline for the Focus Groups.*

Focus Group	Task name	Participants	Date
1	Focus group made up of family carers and professionals.	8	04/05/2021

2	Focus group composed of self-employed older people (+65 years).	9	06/05/2021
3	Focus group of service providers: managers of the CSG's Living Lab network.	9	06/05/2021
4	Focus group formed by the CSG expert committee and members of the IN4AHA consortium to participate in the development of a principles of values (face-to-face and online).	16	24/05/2021

2.2. Participants

In order to have a representative sample of the members of the elderly care ecosystem, the profiles shown in Table 3 have been selected.

Table 3. *Profiles of focus group participants*.

Profiles of participants	Description
Self-employed persons over 65 years of age	This group is represented by 90% of women with an average age of 73 years, 33% of whom have a university education, live in a semi-urban or urban environment and use mobile phones on a daily basis.
Informal caregivers	This group is made up of relatives of elderly dependents. In which 100% of the participants were women with an average age of 59 years, 75% of whom have a university education and live in a semi-urban environment and have computer skills and a daily contact with technology.
Socio-health professionals	This group is made up of 75% women and 25% men, with an average age of 35 years, 75% have a university education and 25% have vocational training. All the participating professionals report at least two years of experience working with the elderly (social and health care centres, residences, day centres, associations for the elderly...).
Managers Living Labs	It is made up of living lab managers from the CSG network, ITGALL. The group is made up of 75% women and 25% men.

2.3. Focus Group Design

In the framework of the IN-4-AHA project, the following design for the implementation of the focus group sessions has been proposed.

Table 4. *Structure of the focus group sessions*.

Structure of the sessions	
Steps	**Description**
Step 1.	Presentation of the IN-4-AHA project
Step 2.	Technological context to help focus the collection of information.

Step 3.	Participatory dynamics
Step 4.	Results

The first and second steps serve to put the participants of the focus groups in context so that the facilitator presents the project and the objectives to be achieved by carrying out the focus groups.

During the participatory session, the five moments of truth in the experience of using technological solutions, specifically the mobile phone, are presented. The facilitator encourages participants to comment on their opinion by asking questions related to these key moments and collects their opinions on the panels using post-it notes.

Table 5. *Structure of the dynamics during the focus groups*.

Moments of truth of the user experience	Questions for participants
Discovery/recognition of the need	How did you detect the need to acquire this technological product/service?
Search for information on the technological solution	How did you find out about it? Who gave you information?
	What obstacles have you encountered?
	Can you think of anything that would have helped you?
Acquisition of the technological solution	How did you acquire the technology product/service?
	What obstacles have you encountered?
	Can you think of anything that would have helped you?
Implementation of the technological solution	What has it been like to start using the technology product/service?
	What obstacles have you encountered?
	What did you miss to improve the implementation?
Customer service or technical service	If you need help or have a problem, what do you usually do?
	What obstacles have you encountered?
	Can you think of anything that would have helped you?

2.4. Results

The results of the focus groups according to each participant profile can be summarised as follows:

- Older people in general consider that there are barriers to accessing technological solutions, but they want to feel included in this technological social change. Increasingly, older people want to learn how to use technology, so the existence of resources (computer classes, product sales outlets, older people's associations, etc.) is a key factor.
- Difficulties due to ageing, such as loss of vision, manual dexterity, hearing loss, forgetfulness, etc., interfere with accessibility to technologies. In addition, they have difficulties in understanding and seek information or help from family and friends. They consider the cost of electronic devices to be high and do not know where health technology services are sold. They only access health technology services when the deterioration in the ageing process begins, on medical or family recommendation, and do not consider the preventive nature of these services.
- Families or informal caregivers see technology as providing "control" and security when they observe the advance of ageing. Moreover, they are not clear where and how to look for information on technological solutions adapted to the needs of older people. It is worth mentioning certain overprotective attitudes of families towards older people where ideas such as the difficulty of learning or the impossibility of solving problems by themselves are generalised, which prevents and hinders accessibility.
- Health professionals find it difficult for older people to acquire the necessary skills to access technological solutions. This view generates certain paternalistic behaviours of caregivers. This is a barrier, which is why the promotion of autonomy, participation, and independence in the use of technological solutions is valued.

In conclusion, education, lifestyle, and level of training have a very significant influence on access to technological innovations. At the same age, the higher the level of education, the greater the predisposition to access and use technological innovations. The economic situation can facilitate or hinder access to technology because of the high cost of hardware, software, and internet access. The environment is also key to accessing technologies, such as living in an urban area, having resources, and having a family or social support network nearby. Universal design is the key factor for accessibility as it is the condition that technologies must meet in order to be understandable, usable, and practicable by all people in safe conditions and as autonomously and independently as possible.

3. Adoption of case studies: identification of main common barriers and user experience key factors

In *Adoption of case studies: For identification of main common barriers and user experience key factors* (22) tests of the five pilots selected in the IN-4-AHA open call were carried out.

The open call offered the opportunity to test and mentor five innovative and scalable technology/digital-based solutions focused on Active and Healthy Ageing (AHA). Table 6 shows the characteristics of the five selected projects. User-centred cross-border testing was conducted in physical environments in Finland and Spain through Xamk's Active Life Lab and the Living Labs of the Cluster Saúde de Galicia (CSG), (ITGALL). The following criteria were taken into consideration for the selection of the solutions: scalability, the solution, the team behind the solution, and the business potential.

Each selected project has received a report detailing the entire testing process, the barriers and the most relevant key factors of their solution and a series of proposals for improvement. In addition, an

assessment is made of the PCA present in their solution and its relationship with the degree of adoption from a user experience point of view.

Table 6. *Summary table of the five chosen solutions.*

Avecen
Avecen is a virtual assistant for monitoring neurodegenerative diseases. The consortium behind this solution is led by Plexus Tech, a Spanish IT products and services consultancy. The Technology Readiness Level (TRL) of the solution is 6 and the demonstration of the system or process is carried out in a functional environment. The final/overall goal is to improve the lives of people with dementia, their caregivers, and families by helping to slow down and self-manage neurodegenerative diseases, such as Parkinson's or Alzheimer's, characterised by a progressive deterioration of cognitive functions. They aim to do so by developing a platform that helps patients self-manage their neurodegenerative disease and gives additional tools to care professionals for their decision-making process. To this end, it is proposed to create a dynamic virtual assistant that continuously monitors and evaluates the execution of certain clinical and lifestyle routines. In addition, the assistant makes recommendations adapted to the patient's condition and evaluates their frequent or habitual behaviour at any given moment, allowing the patient's evolution over time to be monitored.
Coquus
Coquus is a software for managing the food supply in the hospital environment that integrates the different menus with the needs of the patients to achieve a healthy diet. It is developed by *Novos Sistemas de Información S.L.*, a Spanish company, the TRL of the solution is 9 and the platform has been tested in a real system and in a functional environment. Coquus aims to adapt its software to the care home sector and to integrate at two levels. On a first level, it helps nutrition teams to configure the different diets and menus with their data sheets, allergens, costs, and nutritional assessments digitally. On a second level, it collects all the medical (allergies, intolerances, diet requirements, etc.) and personal (such as tastes, preferences, religion requirements, etc.) characteristics of the users' diets and connects this information with the first level. It then automatically decides which menu each person should have and provides a set of digital tools to facilitate the preparation and control of the meal. *Novos Sistemas de Información S.L* want to test the adoption of Coquus in a nursing and home context of the eldery population and scale-up their solution globally. Their final goal is to accompany the person on their nutritional control whether in a hospital, care home or at their private home.
Enna
Enna is an operating hardware for tablets that facilitates independent digital communication for the elderly. It is developed by Enna, a German startup, the TRL of the solution is 7 and the demonstration of the prototype is in an operational environment. Enna's goal is to enable digital beginners to communicate independently and digitally with their family members, access and use digital content such as entertainment. For this purpose, a commercially available tablet is extended with a haptic operating concept using NFC cards, which enables an active and error-free use of the system. Enna's

challenge is related to marketing and sales as it expands into other markets.

Myontec
Myontec is a Finnish wearable company that takes muscle activation technology, electromyography (EMG), out of the laboratory to bring a new dimension to the understanding of muscle behaviour. The technological solution is at technology readiness level (TRL) 5. Myontec's goal is to monitor blood flow and metabolism sufficiently to prevent blood clots. The challenges faced by Myontec are regulatory issues, and on the other hand, low awareness of smart clothing technology and its benefits. Therefore, they want to assess the performance of the calf muscles in the daily activities of elderly in order to determine blood flow and metabolism.
TempID
TempID is an Estonian based technology company that has developed a TempID smart patch with a smart sensor that measures and records body temperature via mobile app. The patches are reusable for home users and disposable for hospitals. The sensors are waterproof, non-charging and reusable for up to one year. The TRL level is 7 and the prototype system has been demonstrated in an operational environment. The aim of the TempID Smart Patch is to support remote care and increase the efficiency of the medical system. The biggest challenge TempID faces is the acquisition of CE certification.

3.1. Timeline

Table 7. *Relationship between the Living Lab timeline and the projects.*

Living Labs	Selected projects				
	Avecen	Coquus	Enna	Myontec	TempID
Afaga	S[2] 18/08/2021 E[3] 04/02/2022	-	-	-	-
Atendo	S: 18/08/2021 E: 04/02/2022	-	-	-	S: 18/08/2021 E: 14/01/2022
Ategal	-	-	S: 12/07/2021 E: 21/01/2022	S: 26/07/2021 E: 31/01/2022	-
Red Cross	S: 18/08/2021 E: 04/02/2022	-	-	-	-
DomusVi	-	S: 12/07/2021 E: 04/02/2022	-	-	-
Saraiva	S: 18/08/2021 E: 04/02/2022	-	S: 12/07/2021 E: 14/01/2022	S: 26/07/2021 E: 31/01/2022	S: 18/08/2021 E: 14/01/2022

[2] Start date
[3] End date

3.2. Creation of the ITGALL Living Labs network

In order to carry out the testing of the innovations of the IN-4-AHA project, a network of living labs has been created, made up of six centres that have in common the provision of services to the elderly. They are social-health centres, residences, day care centres, home-help services, associations of elderly people and relatives of elderly people or volunteers.

Each living lab offers services to the elderly, which allows them to have a real knowledge of the needs of the elderly and their relatives, as well as of the professional team. This knowledge provides a broad vision of the accessibility and adoption of innovations or technological solutions that are in the prototyping phase. For this reason, the living lab service was created to help improve innovations or technological solutions through co-creation, testing and piloting processes.

The aim of the living lab tests is to obtain information that will help technology developers to gather data to improve the design of solutions, increase the accessibility and adaptation of the product to end-users and its scalability in the markets.

To ensure the proper functioning of the ecosystem, the positition of the CSG living labs network coordinator has been created. Its responsibility is to ensure that the co-creation, testing, and piloting processes are carried out with a common working method in the network of ITGALL centres, as well as to take care of coordination between technology developers and the network's living labs. To this end, a common testing protocol with a Person-Centred Approach has been developed.

Table 8. *List of participants per project according to Living Lab.*

Living Labs	Selected projects				
	Avecen	Coquus	Enna	Myontec	TempID
Afaga	7	-	-	-	-
Atendo	19	-	-	-	16
Ategal	-	-	14	17	-
Red Cross	11	-	-	-	-
DomusVi	-		-	-	-
Saraiva	12	-	16	17	29
Total	**48**	**7**	**30**	**34**	**45**
	165				

3.3. Testing process of the selected technological solutions

The testing protocol designed for co-creation in an everyday environment with end-users has been carried out. Thus, the testing of technological innovations by users of the CSG Living Labs network was conducted as follows:

- Selection phase**:** During the selection phase, several meetings were held with the team of technology developers, as well as with those responsible for the living labs in order to determine the necessary requirements for testing. The result of this phase is the selection of the Living Lab best suited to the testing needs and the selection of the sample criteria necessary to carry out the testing process. At the same time, during this phase, an *ad hoc* testing guide has been designed for each technological solution, which is used as support in each Living Lab.

- Reception phase: The aim of this phase is to get a friendly reception of the technological solutions by the living labs network, ITGALL. During this phase, a training session is held to present the project, explain the testing process, hand over the devices and the relevant documentation. This training session is conducte out by the ITGALL coordination.

- Development phase: The objective of this phase is to understand the reactions and attitudes of end-users to the proposed solutions and to capture their behaviour, which is made possible by testing in real-life contexts.

  In addition, the coordination of the living lab network, ITGALL, has been monitoring the tests on a weekly basis. The monitoring is carried out by the means of communication agreed with the living lab. This can be in person, via email or telephone. The objective is to collect all the incidents recorded, modify the plan, or make changes in the testing process. The person coordinating the living lab network is the one who communicates with the technology developers (service providers) of each of the projects, collects the incidents from each of the living labs where their technological solution is being tested and interprets possible anomalies due to the difference in the participating profiles or due to the different services of the network and its professionals.

- Evaluation phase: Once the testing period is over, project-specific questionnaires are used to collect information. Qualitative and mixed approaches have been combined with quantitative evaluation providing measurable results and subsequent qualitative evaluation providing a better understanding of the user experience.

It is worth mentioning that the designed questionnaires were created for three profiles: for end-users, facilitators and service providers. End-users (persons aged 65+) - the service aims to improve their health and living condition or help receive care/assistance. Facilitators are: 1) professionals in health and care institutions (hospitals, social and healthcare centres, assisted living communities, etc.) who provide professional support for the elderly person (65+) in connection with service, which is being evaluated, 2) family members, relatives, or other informal care givers who assist the elderly person to improve their health condition and/or help in general, or 3) any other person (i.e., volunteers) who directly assists the elderly person to improve their health conditions and/or helps in general. Service providers are thought to be representatives of the team or company who have developed the solution (technological device or service) and have designed its delivery process. The service provider is a product owner or part of the product owner's team that has put the service on the market and has defined the target group(s) of users (11).

In addition, as a measurement instrument for the evaluation of the technological solutions, information was also obtained from the PCA impact assessment questionnaire co-created with WP5,

see D5.2. AHA innovation assessment framework (11). Finally, information is collected through semi-structured interviews with living labs' managers who are in charge of supporting older people during testing.

3.4. Results

In testing each of the selected projects, the main barriers and key success factors of the user experience were identified and are summarised in Table 9 and 10.

After the testing process, it has been observed that the **key factors** of user experience are those related to ease and understanding of use, simplicity, degree of intuition, security, personalisation and efficiency of the product or service, being factors that also generate well-being in users. On the other hand, the digitalisation and automation of processes and technological solutions that favour remote care are also key.

It is also necessary for technology developers to involve multidisciplinary professionals with experience and knowledge in the field of older people in the co-design of technology solutions for AHA. This makes the process of co-creation and stakeholder involvement more successful.

The most relevant key is for technology developers to take into account person-centred design as it is related to higher adoption and satisfaction among the people who will use the solution.

Table 9. *Case studies' key success factors*

Common key factors in the case studies
• The use of the technological solution should be as easy, simple. In addition, as understandable as possible for a wider adoption of the technological solution. • The technological solution should be as intuitive as possible. • The technological solution must bring about well-being and security for the end-users. • The technological solution should present customisation options for end-users. • Automation and digitisation of technological processes benefit end-users • For optimal participatory design, all stakeholders in the elderly care ecosystem (elderly people, family members, caregivers, health professionals and service providers) must be taken into account. • **Designs with a more person-centred approach have higher adoption and satisfaction among end-users.**

The **main barriers** identified in the user experience are related to technical problems and interoperability issues between devices.

Major difficulties in the process of users signing up for a technology solution lead to rejection and discarding of the use of the technology solution. Other important barriers are the need for a lengthy process to integrate information to be able to use the solution along with cultural, social, and educational barriers.

Table 10. *Case studies' common barriers*

Common barriers in the case studies
• Ongoing technical problems in a technological solution prevent good adoption. • The existence of interoperability issues between Android and iOS devices or between devices such as tablet and mobile. • High complexity when signing up for a technology solution leads to rejection • A lengthy process for integrating data for the use of a technology hinders the process of co-creation and stakeholder involvement. • Cultural, social, and educational barriers to the use of technological solutions.

4. Crossborder scaling up of accessibility and adoption models

4.1. Accessibility and adoption models

A review of the definitions of accessibility and adoption, as well as the most relevant models in use, has been carried out.

The 2003-2010 Accessibility Plan (22) defines **accessibility** as the set of characteristics that an environment, product or service must have in order to be usable in conditions of comfort, safety, and equality for all people.

Furthermore, universal accessibility is the condition that environments, processes, goods, products, and services, as well as objects or instruments, tools, and devices, must meet in order to be understandable, usable and practicable by all people in safety and comfort and as autonomously and naturally as possible (10).

Accessibility favours, in one way or another, the entire population, but it is clear that there are groups of people who are affected by the existence of barriers, either permanently or circumstantially. It is important to know their number of people, their evolution and characteristics in order to better assess the impact of accessibility improvement policies in any field. Three main groups are considered as beneficiaries of barrier removal:

- People with permanent functional diversity (physical, sensory, mental).
- Elderly people and elderly people with physical and/or cognitive impairment.
- Persons affected by transitory circumstances, activities or situations that may result in impairment.

In the case of the elderly, the accessibility of technological products and services does not have a special treatment, which is why it should be emphasised that with the appropriate training and, in some cases, with the necessary adaptations to alleviate their limitations, the elderly will be able to take advantage of the benefits offered by technology to improve their quality of life. For this, it is necessary to overcome the barriers mentioned in activity 1 of WP4 D4.2 *Focus Group to map accessibilities to validated services/products* and to show them the benefits that technology can bring to their daily lives, thus attracting their interest in the use of the different existing technological resources.

- Web Accessibility Initiative (WAI) model

The definitions of accessibility provided by the World Wide Web Consortium (W3C) define accessibility for all to the Web regardless of the type of hardware, software, network infrastructure, language, culture, geographical location, and capabilities of users (W3C, 2008). Thus, with the aim of

operationalising this principle, the Web Accessibility Initiative (WAI) was born, developed by a working group of the W3C itself, and whose approaches are based on the main idea of making the Web more accessible to all users regardless of the circumstances and devices involved when accessing information. In 1999, in order to make Web content accessible, the WAI published the Web Content Accessibility Guidelines 1.0 (WCAG 1.0), a guide on website accessibility that takes into account the needs and technological barriers encountered by people with disabilities. A second version of the guidelines was published in December 2008 as WCAG 2.0. This new formulation aims to rectify errors detected by previous versions and to respond to real situations of non-accessibility reported by users.

However, as the above-mentioned research shows, the reality remains that the accessibility levels of the vast majority of websites and web resources are far from being accessible to all types of users, especially older users.

One could say that the **adoption** process is the decision whether or not to use an innovation (9). In other words, the adoption process is an individual process that consists of the individual's acceptance of the innovation. Thus, when a person is confronted with a new technology, they gather and synthesise information related to that technology and as a result of this process a series of beliefs about the use of the technology are generated that determine whether people accept or reject it; in other words, beliefs are the driving force behind the decision to adopt.

- Technology Acceptance Models (TAM)

The TAM model considers the effect of external factors on beliefs, attitudes, and intentions and that these fundamentally affect the adoption of innovations related to information systems and technologies: perceived usefulness and perceived ease of use.

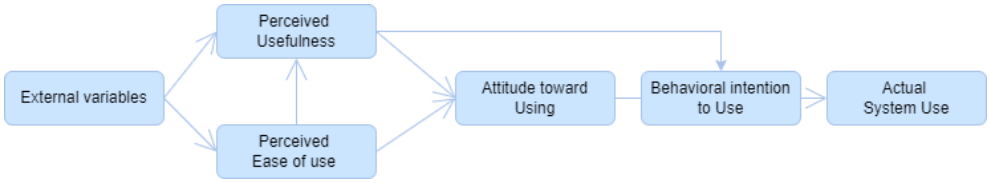

Figure 1. *Technology Acceptance Model (TAM). Source: (23)*

- Perceived usefulness attempts to capture a person's belief about how a particular product/service will improve their performance on a task.
- Perceived ease of use is the extent to which the user of a technology expects its use to be effortless, i.e., easy to use.

- Unified Theory of Acceptance and Use of Technology (UTAUT)

This model aims to integrate into a single model all existing models to date (15), due to the limitations that researchers found in previous models. The model consisted of four constructs moderated by four factors, which are described below:

- **Performance expectancy**, which is defined as a person's level of belief that a technology will help them achieve an increase in job performance. This is the most influential antecedent on intention
- **Effort expectancy,** which is defined as the degree of ease of use associated with a technology. If the user perceives that a particular tool will be easy to use, they are more likely to adopt it. Effort expectancy is conceptually identical to the concept of perceived ease of use in the TAM model.
- **Social influence**, which indicates the extent to which a user perceives how others think a particular technology, should be used. Users tend to adopt a technology if they perceive that

the people who influence them think that they should use the technology. This factor is moderated by gender, experience, age, and voluntariness of use.

- **Enabling conditions**, which indicates the extent to which the user perceives that there is an adequate technical infrastructure and support organisation to meet their needs. To the extent that the user perceives that these facilities exist, the user will adopt the technology earlier (16).

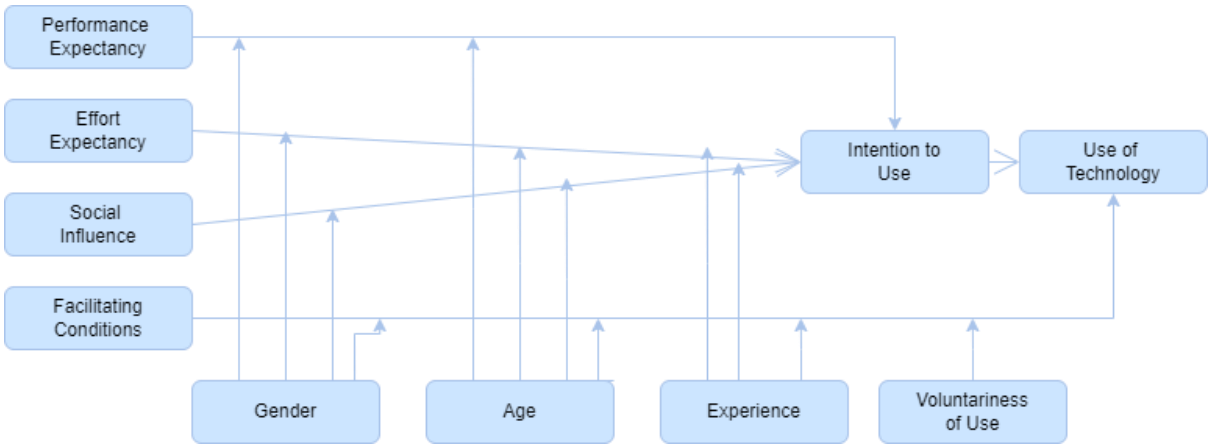

Figure 2. *UTAUT model. Source: (23)*

The Unified Theory of Acceptance and Use of Technology (UTAUT) considers age to be the main barrier to accessing digital technology (17). Recent studies consider factors such as anxiety and social influence to be other important factors in the adoption of technology. However, in contrast to the assumption of age as a barrier to technology adoption, recent research suggests that age as such is not a barrier, but rather **ageism** towards older people and internalised ageism (24), i.e., that older people themselves take stereotypical assumptions about older people as true.

Ageism is commonly identified as stereotyping, prejudice, and discrimination towards people because of their age (18). Ageism can influence the use, adoption, and design of technology products and/or services, as, for example, technology designers take into account these learned biases about older people.

In the focus groups carried out as part of activity 1. *Focus Group to map accessibilities to validated services/products* (4), overprotective attitudes of families towards the elderly were identified, where ideas such as the difficulty of learning or the impossibility of solving problems on their own are generalised. The view of health professionals can also generate certain paternalistic behaviours, which prevents and hinders greater independence of the older person.

It is necessary to raise awareness among policy makers, designers, health professionals, the family environment, and older people themselves, in order to change this negative view of the ageing process and thus achieve accessibility and realistic adoption in line with society's needs.

5. Person-centred design in the accessibility and adoption of technology products and services

The person-centred approach was developed in psychotherapy practice but has spread to many fields such as technology. Person-centredness is an approach to participatory design (PD), which focuses on the active involvement of users in the design process and continuous observations during design (3).

Norman (20) highlights two aspects that changed the world of design: the usability of products and the advantages of incorporating the real needs and interests of users. Norman puts the user at the centre of design for the first time, thus giving way to user-centred design (UCD). UCD is understood to be a continuous design process in which designers focus on consumers and their needs with the support of a variety of research techniques to create highly usable and accessible products. Universal design also aims to develop products and environments that are easily accessible to as many people as possible, without the need for special adaptation or redesign. The concept stems from barrier-free design, accessible design, and assistive technology (13).

5.1. Measurement tool for person-centred approach and its relationship with the degree of accessibility and adoption of technology products and services.

During the development of the WP4 D4.2 activities, a PCA tool (par. 5.1.4. of the report) was designed with the aim of measuring person-centred design of technological solutions and taking into account the user experience. The development of this tool has been carried out through a Design Thinking process, whose methodology consists of collaborative development. Specifically, it uses the Double Diamond Model, developed by the British Design Council (20), which consists of 4 phases: discover, define, develop, and deliver. Together, these stages function as a map that designers can use to organise their thoughts in order to improve the creative process. It is worth mentioning that this model is by no means linear. In fact, it has moved back and forth between these stages in order to fully understand the problem and how to solve and improve it, see figure 3.

1. Discover: data collection, prior research that allows us to discover the insights, the contextual keys that will define the subsequent tool presented to solve the problem.
2. Define: filtering of the data. The search process leads to a selection of the results obtained. The first two phases lead to the creation of new concepts and defining the problem, taking into account the user experience.
3. Develop: design or redesign that consists of responding to the clearly defined problem, turning the specific idea into something achievable, focusing on the visual construction of the solution and co-designing with the different stakeholders.
4. Deliver: test and launch. This is putting the solution into practice at prototype level. It is to see how the design responds on a small scale, carrying out validations with experts, in such a way that we obtain real feedback throughout the process until we achieve the finish desired by the consumer.

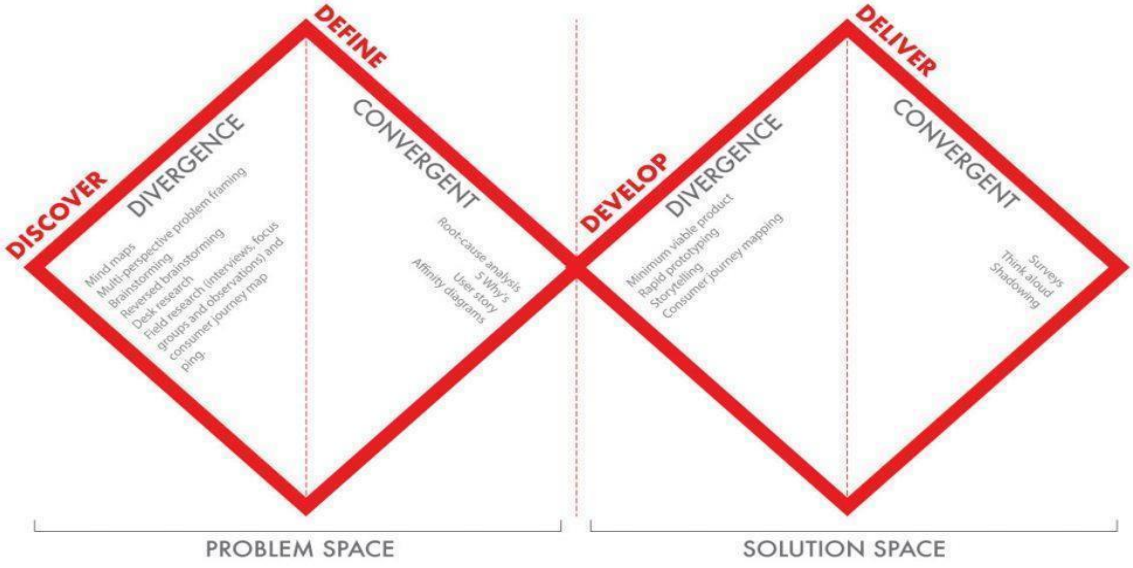

Figure 3. *The Double Diamond design thinking process (Adopted from the Design Council)*. Source: (20)

5.1.1. Discover

The first phase of the Double Diamond model consists of learning more about the different variables that affect the problem and its possible solutions. During this first stage and in order to establish the framework, a thorough research of the relevant literature has been carried out in order to find the tools most used by innovators/service providers to measure the Person-Centred Approach (PCA) of the solutions/services/products they develop.

The most relevant tools for assessing innovation impact in the field of Active and Healthy Ageing (AHA) are MAFEIP, MAST and NASS; see D5.1. Overview of evaluation toolkits (11), which are used to assess health technology innovation impact in different domains. However, it is necessary to take into account the generic domains and where some domains have more weight than others.

Finally, it is concluded that these tools are useful and provide sufficient information to innovation providers. However, as pointed out in the Report D5.1 Overview of evaluation toolkits (11), it is important to note that there are multiple shortcomings, e.g. NASSS does not take into account ethical aspects and only partially considers the patient's perspective, as do the other two toolkits. This means that there is a need for a tool that is even more person-centred and considers the domains related to PCA, which is intended to be achieved in the designing of the PCA tool (par. 5.1.4. of the report).

5.1.2. Define

The first version of the tool was developed during Activity 1 *Focus Group to map accessibilities to validated services/products* (6), as shown on Table 11, where the main principles were developed and define how they should be applied to be fulfilled.

Table 11. *First version of the tool resulting from the focus group, Activity 1.*

Principles	How it is applied
Welfare	Technology must be geared towards generating the well-being of the people for whom it is designed and aligned with the framework of ethics and PCA.
Dignity	Technology contributes to respect and values the rights of the people who use it. It contributes to the dignified treatment of the individual.
Autonomy	Technology should make it easier for the individual to decide on his or her own life project, facilitating access to and control over his or her personal data at all times.
Independence	Technology must be understood from a dual approach, since technology can promote independent living for the people who use it and must be designed in such a way that it can be used independently, without external help.
Personalisation	It is understood from a dual approach, as technological solutions must be customised according to the needs of users and allow for the adaptation of interventions to the needs of the people for whom they have been designed, providing added value to the person's life and respecting their privacy and intimacy.

Empowerment	A technological solution empowers the user when the person is able to use it independently. And for this it is essential that its design is intuitive from the first interaction "without the need to read the user manual".
Co-design and participation	Technological solutions must be co-designed and developed through participatory processes, taking into account the voice of the users themselves. For people and with people.
Social inclusion	The capacity that technology brings to break down social gaps and generate opportunities for participation in the social and cultural life of their environment.
User experience	Design of interactions throughout the acquisition, use and after-sales process. This should be designed in a user-friendly, inclusive, and stimulating way, favouring interoperability and easy integration of solutions.
Affordable	Person-centred technology must favour a balance between added value and price in order to be accessible to older people, families, administrations, and organisations.

The initial hypothesis is how to design a tool to analyse the principles of the Person-Centred Approach (PCA) present in innovations and whether there is a relationship between PCA and adoption and accessibility through the collection of user experience information.

5.1.3. Develop

This phase takes place during Activity 2 of WP4.2, *Adoption of case of studies: identification of main common barriers and user experience key factors* (7). Its purpose is the testing of the five projects selected in the IN-4-AHA open call, in the living labs of the CSG, ITGALL.

Prior to the testing, a user experience questionnaire has been created and impact assessment questionnaires for person-centred innovations were co-designed between WP5 and WP4 taking into account the two possible profiles, end-users and facilitators.

Validation of the tool is also carried out during the testing process. Although the number of participants in the tests was 165, 96 facilitators and 63 users answered the questionnaires; the difference is due to the fact that some participants were unable to answer for medical reasons, hospitalisation, or death. The facilitators' questionnaire is the most used because the participants of the tests were people with different degrees of impairment and needed support to be able to carry out the test.

In this way, the tool is validated to measure PCA present in the technology solutions. As a result, two of the solutions have a high level of Person-Centred Approach, one solution has a medium level of a Person-Centred Approach, and, finally, the last two have a lower level of a Person-Centred Approach.

For the results, the interviews carried out and the weekly incidents recorded were also taken into account.

The results obtained through the tool between the degree of PCA present in the projects and their user experience are related to the degree of adoption by the end-users. It can therefore be concluded that the higher the degree of PCA present in the technological innovations, the higher the level of adoption by the end-user.

Table 12. *Second version of the tool designed during Activity 2*

Principles	How it is applied	Evaluation instruments	Level of compliance (% of affirmative responses from test participants)
Welfare	Technology must be geared towards generating the well-being of the people for whom it is designed and aligned with the framework of the ethics of person-centred care.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Dignity	Technology contributes to respect for and values the rights of the people who use it. It contributes to the dignified treatment of the individual.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Autonomy	Technology should make it easier for the individual to decide on his or her own life project, facilitating access to and control over his or her personal data at all times.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Independence	Technology must be understood from a dual approach, as technology can promote independent living for the people who use it and must be designed in such a way that it can be used independently, without external assistance.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low

Personalisation	It is understood from a dual approach, as technological solutions must be customised according to the needs of users and allow for the adaptation of interventions to the needs of the people for whom they have been designed, providing added value to the person's life and respecting their privacy and intimacy.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Empowerment	A technological solution empowers the user when the person is able to use it independently. And for this it is essential that its design is intuitive from the first interaction "without the need to read the user manual".	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Co-design and participation	Technological solutions must be co-designed and developed through participatory processes, taking into account the voice of the users themselves. For people and with people.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Social inclusion	The capacity that technology brings to break down social gaps and generate opportunities for participation in the social and cultural life of their environment.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
User experience	Design of interactions throughout the acquisition, use and after-sales process. This should be designed in a user-friendly, inclusive, and stimulating way, favouring interoperability and easy integration of solutions.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low

Affordable	Person-centred technology must favour a balance between added value and price in order to be accessible to older people, families, administrations, and organisations.	Test questionnaire PCA impact measurement questionnaire Semi-structured interview.	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low

In order to evaluate the results of the questionnaires, the percentage of affirmative answers of the participants in each of the principles of the tool will be taken into account. Thus, the levels of compliance can be:

- Between 7 - 10 high principles, the technological solution will have a HIGH person-centred design level.
- Between 5 - 6 high principles, the technological solution will have a MEDIUM person-centred design level.
- Less than 4 high principles, the technological solution will have a LOW person-centred design level.
- Between 5 - 10 medium principles, the technological solution will have a MEDIUM person-centred design level.
- Less than 4 average principles, the technological solution shall have a LOW person-centred design level

Table 13. *Testing questionnaire: User experience*

User experience questionnaire during testing in the Living Labs: end-users
1. Does the appearance of the solution look right to you? 2. Have you had support to use the solution? If yes, from whom have you had support? 3. Is it possible to customise the solution and adapt it to your needs? 4. Is there a formal channel of communication in case you need help? 5. Are the guidelines and information you have been given about the solution useful? 6. Do you rate your experience of using the solution as straightforward? 7. Do you rate your experience of using the solution as pleasant? 8. Do you consider the solution an intuitive technology? 9. Would you recommend the solution to others?

10. Would you be willing to pay for the service of the technology solution?
User experience questionnaire during testing in the Living Labs: facilitators
1. Does the appearance of the solution seem appropriate for older people? 2. Have you supported the older person to use the solution? 3. Is it possible to customise the solution and adapt it to the needs of the elderly person? 4. During testing, are there any formal channels of communication in case you need help? 5. Are the guidelines and information you have been given about the solution useful? 6. Do you rate your experience of using the solution as straightforward? 7. Do you rate your experience of using the solution as pleasant? 8. Do you consider the solution to be an intuitive technology? 9. Would you recommend the solution to others?

Table 14. *Semi-structured interview* script *with Living Labs managers*

Semi-structured interview with living lab managers.
1. What did you like most about the technological solution? 2. What are the biggest obstacles that older people encounter when using the solution? 3. Have end-users been able to use the technology solution independently? 4. Did end-users feel frustrated or empowered when using the technology solution? 5. Do you think the solution improves the relationship of older people with their environment/community? 6. Does the use of the technology solution increase user participation in their environment/community?

5.1.4. Deliverable

During the monitoring of the test, the professionals and elderly who have answered the questionnaires have stated that there are questions that they do not understand and there is a need to revise the tool to make it as simple as possible to make it easier for the elderly to understand.

Thus, in March 2022, a new focus group was held with the managers of the ITGALL network to analyse the lessons learned and propose improvements to the tool. This focus group was attended by 10 people. Consequently, the questionnaires have been redesigned to achieve more relevant information for technology designers and in the process of adoption by older people and to make it a viable tool in other European countries, resulting in the final tool, see Table 15 and 16.

This new tool is designed for two profiles, end-users, and facilitators.

The previous version of the tool (Table 12) has been validated to measure the PCA present in the technological solutions and the degree of adoption by the end-user. However, in the framework of the IN-4-AHA project, it will not be possible to validate the latest version of the tool whose validation will be carried out with the ITGALL network in the next planned testing projects. Once the validation of the latest version has been completed, it will become part of the validation tools of the Living labs of the Cluster Saúde Galicia, ITGALL.

Table 15. *Person-Centred Approach Measurement Tool: Indicators and questions for end-users.*

Tool for measuring the Person-Centred Approach and its relationship to accessibility and adoption.				
Principles	**How it is applied**	**Indicators**	**Questions**	**Level Of Compliance** (% of affirmative responses from test participants)
Welfare	Technology must be geared towards generating the well-being of the people for whom it is designed and aligned with the framework of the ethics of person-centred care.	Percentage of people who have a better perception of their quality of life after the use of the technological solution on a social, functional, psychological, or physical level. 2. Percentage of people who have felt good about using the technology solution	1. Has your perception of your quality of life improved while using the technological solution? *Yes/No* If yes, in which aspects has your quality of life improved? physically/psychologically/functionally, cognitively/other? 2. Did you feel good about using the technological solution? Yes/No	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Dignity	Technology contributes to respect for and values the rights of the people who use it. It contributes to the dignified treatment of the individual.	1. Percentage of people who feel safe while using the technology solution 2. Percentage of people who experience respect and dignity when using the technology solution.	1. Did you feel confident using the technology solution? *Yes/No* 2. Did you feel that you were treated with dignity and respect during the use of the technology solution? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Autonomy	Technology should make it easier for the individual to decide on his or her own life project, facilitating access to and control over his or her personal data at all times.	1. Percentage of people who use the technological solution to improve their autonomy. 2. Percentage of people who trust that their data is handled securely	1. Does the technological solution facilitate your day-to-day decision-making? *Yes/No* 2. Do you consider that your personal data has been handled securely? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Independence	Technology must be understood from a dual approach, since technology can promote independent living for the people who use it and must be designed in such a way that it can be used	1. Percentage of people who have needed help to start using the technological solution. 2. Percentage of people who have been able to use the technological solution independently.	1. Did you need help in getting started with the technology solution? *Yes/No* 2. Have you used the technological solution yourself? *Yes/No* 3 Have you needed help to resolve any doubts or incidents that have arisen during the testing of the	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low

	independently, without external help.	3. Percentage of people who have needed help during the use process on an ad hoc basis.	technological solution? *Yes / No*	
Personalisation	It is understood from a dual approach, as technological solutions must be customised according to the needs of users and allow for the adaptation of interventions to the needs of the people for whom they have been designed, providing added value to the person's life and respecting their privacy and intimacy.	1. Percentage of people who can adapt the technological solution to their needs (physical, cognitive, organisational, etc.). 2. Percentage of people who are able to adapt the technological solution to their tastes and preferences 3. Percentage of people who consider that the technological solution adapts to their life routines.	1. Do you consider that the technological solution is adapted to your needs (physical, cognitive, organisational...)? Yes/No 2. Do you consider that the technological solution suits your tastes and preferences? *Yes/No* 3. Do you consider that the technological solution adapts to your daily routines? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Empowerment	A technological solution empowers the user when the person is able to use it independently. And for this it is essential that its design is intuitive from the first interaction "without the need to read the user manual".	1. Percentage of people who feel empowered by using the technology solution	1. Do you feel that your self-esteem has improved since you have started using this technological solution? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Co-design and participation	Technological solutions must be co-designed and developed through participatory processes, taking into account the voice of the users themselves. For people and with people.	1. Percentage of people providing feedback on the development or improvement of the technology solution 2. Percentage of users who have been part of the co-design of the technological solution.	1. Has your feedback been collected to improve the technological solution? *Yes/No* 2. Have you actively participated in the improvement of the technological solution? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Social inclusion	The capacity that technology brings to break down social gaps and generate opportunities for participation in the social and cultural life of their environment.	1. Participation of people in their environment.	1. Has using the technology solution increased your involvement in your community? *has increased/decreased/not changed*	• High has increased High • No changeMedium • It has decreased

				low
User experience	Design of interactions throughout the acquisition, use and after-sales process. This should be designed in a user-friendly, inclusive, and stimulating way, favouring interoperability and easy integration of solutions.	1. Percentage of people who consider the technological solution to be intuitive 2. Percentage of people who find the technology solution easy to use 3. Percentage of people who find the technological solution useful 4. Percentage of people recommending the technology solution to others	1. Do you consider the technological solution to be intuitive? *Yes/No* 2. Do you find the technological solution easy to use? *Yes/No* 3. Do you consider the technological solution to be useful? *Yes/No* 4. Would you recommend the solution to others *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Affordable	Person-centred technology must favour a balance between added value and price in order to be accessible to older people, families, administrations, and organisations.	1. Percentage of people who would be willing to pay for the service of the technology solution 2. Percentage of people who can afford the technology solution	1. Would you be willing to pay for the service of the technology solution? *Yes/No* 2. The technological solution has a price of X, could you afford it? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low

Table 16. *Person-Centred Approach Measurement Tool: Indicators and questions for Facilitators*

Tool for measuring the Person-Centred Approach and its relationship to accessibility and adoption.				
Principles	**How it is applied**	**Indicators**	**Questions**	**Level of compliance** (% of affirmative responses from test participants)
Welfare	Technology must be geared towards generating the well-being of the people for whom it is designed and aligned with the framework of the ethics of person-centred care.	1. Percentage of older people who have a better perception of their quality of life after using the technological solution. 2. Percentage of older people who felt a sense of wellbeing when using the technological solution	1. Has the quality of life of the elderly person improved after using the technological solution? *Yes/No* If yes, in what ways has your quality of life improved? improved physically/improved psychologically/improved cognitively/other l 2. Did the older person feel comfortable using the technological solution? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low

Dignity	Technology contributes to respect for and values the rights of the people who use it. It contributes to the dignified treatment of the individual.	1. Percentage of older people who feel safe while using the technology solution 2. Percentage of older people who experience respect and dignity when using the technology solution	1. Did the older person feel safe using the technological solution? *Yes/No* 2. Did the older person feel that he/she was treated with dignity and respect during the use of the technological solution? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Autonomy	Technology should make it easier for the individual to decide on his or her own life project, facilitating access to and control over his or her personal data at all times.	1. Percentage of elderly people who use the technological solution to improve their autonomy. 2. Percentage of older people who trust that their data is handled securely	1. Does the technological solution facilitate the decision making of the older person? *Yes/No* 2. Do you consider that the personal data of the end-user/elderly person has been handled securely? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Independence	Technology must be understood from a dual approach, as technology can promote independent living for the people who use it and must be designed in such a way that it can be used independently, without external assistance.	1. Percentage of older people who have used the technological solution independently 2. Percentage of older people who have received support to use technological innovation 3. Percentage of people who are able to use the technological solution more independently after receiving support	1. Did the older person need help to start using the technological solution? *Yes/No* Has the elderly person independently used this technological solution? *Yes/No* 3. Did the elderly person need help to resolve any doubts or incidents that arose during the testing of the technological solution? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Personalisation	It is understood from a dual approach, as technological solutions must be customised according to the needs of users and allow for the adaptation of interventions to the needs of the people for whom they have been designed, providing added value to the person's life and respecting their privacy and intimacy.	1. Percentage of older people who can adapt the technological solution to their needs (physical, cognitive, etc.). 2. Percentage of older people who can adapt the technology solution to their tastes and preferences 3. To find out the percentage of people who consider that the technological solution adapts to their life routines.	1. Do you consider that the technological solution is adapted to the needs (physical, cognitive...) of the elderly person? *Yes/No* 2. Do you consider that the technological solution adapts to the tastes and preferences of the elderly person? *Yes/No* 3.Do you consider that the technological solution adapts to the daily routines of the elderly person? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Empowerment	A technological solution empowers the user when the person is able to use it independently. And for this it is	1. Percentage of older people who feel empowered by using the technology solution	1. Do you consider that the self-esteem of the older person has improved since you have started using this technological solution?	• 70 - 100 - High • 50 - 69 -

	essential that its design is intuitive from the first interaction "without the need to read the user manual".		*Yes/No*	Medium • >49 - Low
Co-design and participation	Technological solutions must be co-designed and developed through participatory processes, taking into account the voice of the users themselves. For people and with people.	1. Percentage of older people who provide input into the development or improvement of the technological solution 2. Percentage of users who have been part of the co-design of the technological solution.	1. Has the opinion of the elderly person been collected for the development and improvement of the technological solution? *Yes/No* Has the older person actively participated in the development of the technological solution? *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Social inclusion	The capacity that technology brings to break down social gaps and generate opportunities for participation in the social and cultural life of their environment.	1. Participation of older people in their environment.	1. By using the technology solution, has the older person's participation in their community increased? *has increased/decreased/not changed*	• High has increased High • No changeMedium • Has decreased - Low
User experience	Design of interactions throughout the acquisition, use and after-sales process. This must be designed in a user-friendly, inclusive, and stimulating way, favouring interoperability and easy integration of solutions.	1. Percentage of older people who consider the technological solution intuitive 2. Percentage of older people who find the technology solution easy to use 3. Percentage of older people who find the technological solution useful 4. Percentage of older people recommending the technology solution to others	1. Do you consider that the technological solution is intuitive for the elderly person? *Yes/No* 2. Do you consider that the technological solution is easy to use for the older person? *Yes/No* 3. Do you consider that the technological solution is useful for the older person? *Yes/No* 4. Would you recommend the solution to others *Yes/No*	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low
Affordable	Person-centred technology must favour a balance between added value and price in order to be accessible to older people, families, administrations, and organisations.	1. Percentage of older people who would be willing to pay for the service of the technology solution 2. Percentage of older people who can afford the technological solution	1. Do you consider that the older person would be willing to pay for the service of the technological solution? *Yes/No* 2. The technological solution has a price of X; do you think the elderly person could afford it?	• 70 - 100 - High • 50 - 69 - Medium • >49 - Low

			Yes/No	

In order to be able to evaluate the results of the questionnaires, the percentage of affirmative answers of the participants in each of the principles of the tool will be taken into account. Thus, the levels of compliance can be:

- Between 7 - 10 high principles, the technological solution will have a HIGH person-centred design level.
- Between 5 - 6 high principles, the technological solution will have a MEDIUM person-centred design level.
- Less than 4 high principles, the technological solution will have a LOW person-centred design level.
- Between 5 - 10 medium principles, the technological solution will have a MEDIUM person-centred design level.
- Less than 4 average principles, the technological solution shall have a LOW person-centred design level

In the measurement of the results, it is observed that if the levels of compliance with the principles are high, it means that the technological solution has been designed with a high Person-Centred Approach. This means that the technology developers have taken into account the real needs of the people for whom the solution is intended. In addition, users feel that their performance and effort expectations are met, and together with the facilitating conditions of the technological solution and the support of the testing professionals, a good adoption of the technological solution is achieved.
To test the feasibility of the tool in other countries, the collaboration of IN-4-AHA project partners has been requested. For this purpose, a partner from Northern Europe (Xamk, Finland) and a partner from Southern Europe (UPorto, Portugal) have been sought to test the suitability of the tool questionnaires and to check if there are any impediments in the cultural, social, regulatory, or economic context.

The Xamk team from Finland has conducted a review of the tool and concluded that the indicators and questionnaires fit perfectly in their test environment and that the tool as a whole would be useful in their testing processes. Furthermore, the designed tool is also adapted to their social, regulatory, economic, and cultural context. The UPorto Porto4Ageing team in Portugal reviewed the tool's questionnaires and reported its suitability in their social, cultural, and political context.

6. Mapping accessibility and adoption of services and products

When we think of **accessibility**, we focus on the conditions that technological products or services must meet in order to be understandable, usable, and practicable for all people. In doing this mapping, it has been observed that people's conditions influence accessibility in the same way. In other words, accessibility is influenced by the conditions that technological products and services must meet, and in turn, also by the individual characteristics of people, with the elderly being the most heterogeneous and diverse group.

In this way, the singularity of the people who affect accessibility can be specified in their physical, functional, and cognitive state. The person's environment affects, such as family and social support, the existence of resources or living in a rural or urban area. Lifestyle also affects accessibility, i.e., the level of education, culture, or profession. Economic capacity affects accessibility since technological services and products have a high cost and economic resources or a good support system is needed to be able to afford them.

It can be concluded that, for greater accessibility, the characteristics that a person must have, are a good physical, functional and cognitive state, a good network of family and friends, high economic resources, living in urban areas, an active life together with a high cultural level and higher education. In order for people who do not meet the above conditions to have access to technological products or services, these must be **universally designed.**

Principles of universal design

The Center for Universal Design at North Carolina State University defines universal design as the design of products and environments so that they can be used by all people, to the greatest extent possible, without the need for adaptation or specialised design. The principles of universal design are as follows (14):

1. Equality of use: the design must be user-friendly and suitable for all people regardless of their abilities and skills.
2. Flexibility: the design should be able to accommodate a wide range of individual preferences and abilities.
3. Simple and intuitive: the design should be easy to understand regardless of the user's experience, knowledge, skills, or level of concentration.
4. Easily perceivable information: the design must be able to exchange information with the user, regardless of environmental conditions, or the user's sensory capabilities.
5. Error tolerance: the design should minimise accidental or fortuitous actions that could have fatal or unintended consequences.
6. Low physical effort: the design should be able to be used efficiently and with as little effort as possible.
7. Appropriate dimensions: sizes and spacing must be appropriate for the user's reach, handling and use, regardless of size, position, and mobility.

Adoption refers to an individual process of accepting the innovation, deciding to use or not to use an innovation. This decision making is influenced by ease of use, perceived usefulness, and user experience. Thus, the simpler, more intuitive, more secure, and more understandable the technological product or service is, the higher the adoption by the end-user will be. A product or service that generates an expectation of reduced effort and improved performance in processes such as automation or digitisation will achieve higher adoption. The experience of using the technological

product or service must generate well-being and dignity in the user, as well as greater autonomy, independence, participation, inclusion, and empowerment. The personalisation of the product or service is fundamental for making decisions about its use.

As a conclusion of the adoption of technological products and services, it has been observed that **person-centred design** is key, i.e., the involvement of all stakeholders in the design process in which technology developers focus on consumers and their needs with the support of a variety of research techniques to create highly usable and accessible products. In this way, the International Organisation for Standardisation (ISO) establishes the following principles of person-centred design (19):

1. Understanding users, usage, and their environment
2. User participation throughout the design and development process.
3. The design is developed and optimised through a user-centred evaluation.
4. The process should be iterative
5. The design must take into account the whole user experience.
6. The design team should have a multidisciplinary perspective.

In this mapping (Figure 4), it is also necessary to consider existing prejudices in society about older people and older people themselves. This concept of **ageism** generates a negative view in general that is commonly identified with stereotypes and discrimination towards people on the basis of their age. This can influence the use, adoption, and design of technological products and/or services, as technological developers may unconsciously take these prejudices as barriers to develop solutions for elderly.

In contrast to ageism (Figure 4), there is the Person-Centred Approach where a positive view of older people is generated by emphasising dignity, attention to the ability to decide, the need for self-realisation, the interest in the full development of the potential inherent in each person and the idea of the person both in relation to how they discover themselves and in their interdependence with others.

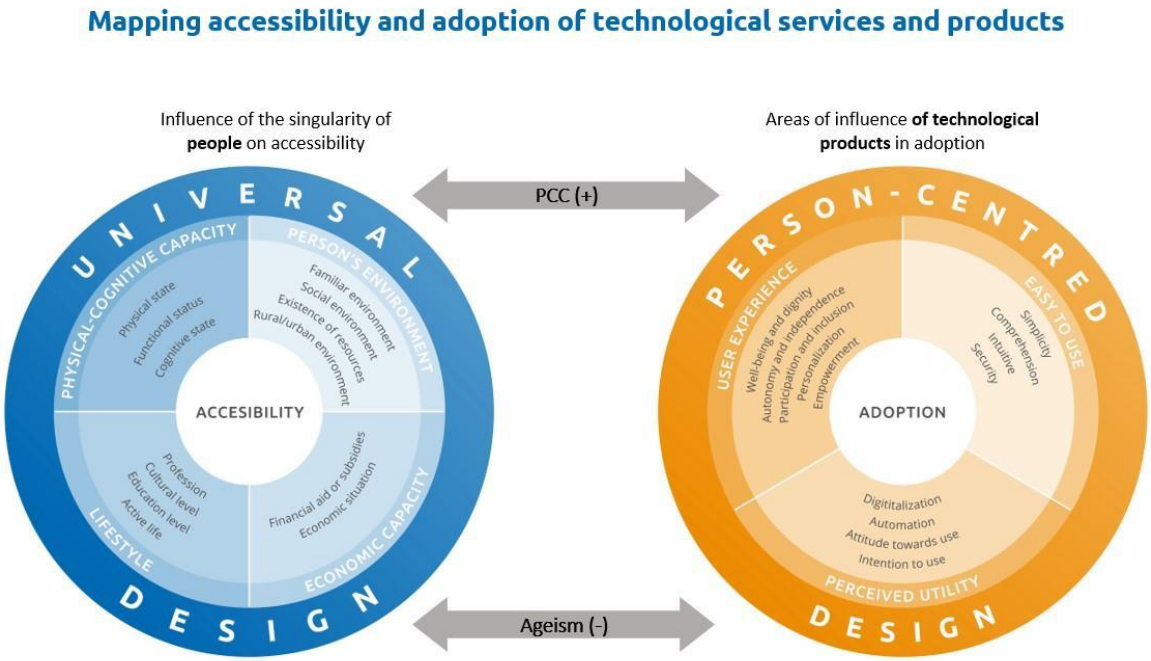

Figure 4. *Mapping accessibility and adoption of services and products*. Source: Own elaboration.

7. Conclusions

The completion of the three activities has provided the information necessary to map the accessibility and adoption of technology products and services. This mapping allows technology developers to identify the optimal type of design and participation to achieve good accessibility and adoption results and subsequent scaling, with a Person-Centred Approach being key to the whole process of designing a product or service.

The focus on the design of technological products or services for their accessibility and adoption is important, but so is the acquisition of skills by older people. Ageism generates a negative view of ageing, but this has less and less weight because it has been proven that older people can learn and want to learn.

The tool designed to measure the Person-Centred Approach present in technological solutions allows us to know the degree of adoption that the solution will have. The greater the Person-Centred Approach of a technological solution, the greater the degree of adoption and this is important for its scalability.

It supports the sustainability of the IN-4-AHA project, as the tool designed will be used by ITGALL for the evaluation of those products and/or services tested in its network of Living Labs.

The next step after this work is the creation of a scalability model that takes into account the information generated in this work package where the Person-Centred Approach is key and relevant.

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Testing protocol for innovative solutions under the Person-Centred Approach

Index

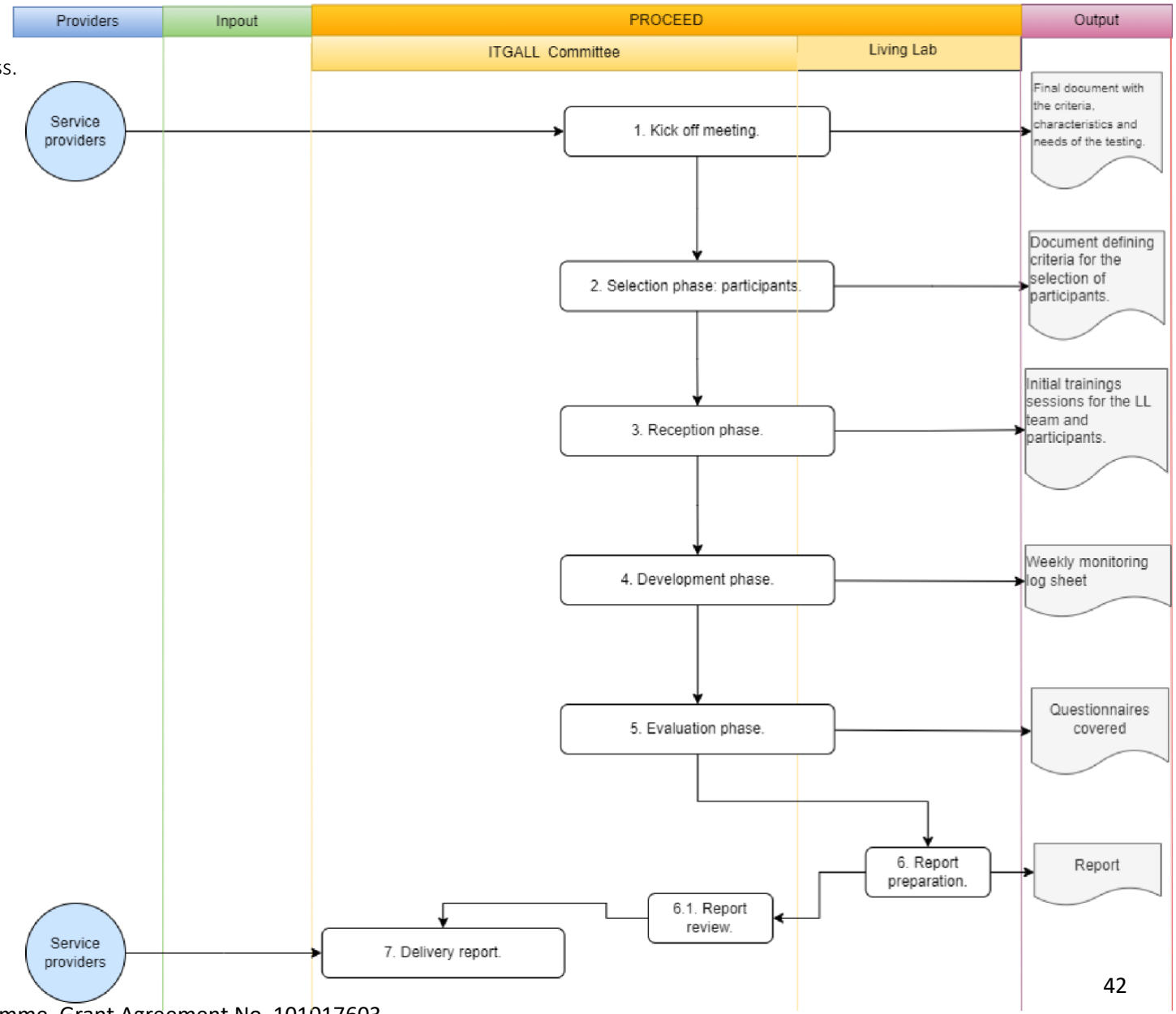
Introduction

The testing process document serves as an internal guideline for the development of an ITGALL network test and to have a common framework.

Testing is understood as the process that is co-created between the living labs of the ITGALL network to test a technological solution in an everyday environment. In addition to testing the solution, the understanding, reactions and attitudes of the users are evaluated and, among other things, the behaviour towards the technological solution is captured.

Flowchart

Figure 1. Flowchart of the testing process.



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Kick off meeting

The ITGALL committee which is integrated by CSG president, management, and coordination. During this kick off meeting, the documentation necessary to carry out the testing is handed over and a meeting is arranged between the service provider (technological development) and the person responsible for the living lab to get to know each other and clarify any doubts.

Selection phase

Based on the criteria, characteristics and needs of the service provider/technological developer and as a result of the meetings held between those responsible for the living labs, the ITGALL committee defines the criteria for the selection of the sample of participants for the test.

To determine the degree of physical and/or cognitive impairment of the elderly participants, the following scales or indices must be taken into account: Mini Cognitive Examination (MEC), Barthel Index, Tinetti Scale, Global Deterioration Scale (GDS).

- Mini-Mental Status Examination (MMSE)[4]: This is a test used for the initial screening of cognitive impairment and consists of a series of questions and the performance of certain actions by the person being assessed. Its results allow an assessment of cognitive status in different areas that can be related to different cognitive symptoms. The scores determine the following:
    - 30-35: determines normality.
    - 25-29: determines that there is a mild cognitive deficit.
    - 20-24: determines that there is a mild cognitive deficit.
    - 15-19: determines that the cognitive impairment is moderate and a clear sign of dementia.
    - 0-14: determines that there is severe cognitive impairment revealing advanced dementia.
    - The cut-off point at which the diagnosis of dementia is established is 23/24 points in people aged 65 and over and 27/28 in people under 65.

- Barthel Index[5]: It is a generic measure that assesses the level of independence of the patient with respect to the performance of some basic activities of daily living, whereby different scores and weights are assigned according to the ability of the subject examined to carry out these activities. The scores determine the following:

    - 0-20: Total dependency
    - 21-60: Severe dependency
    - 61-90: Moderate dependency
    - 91-99: Low dependency
    - 100: Independence
- Tinetti Scale[6]: It is a scale to assess the mobility and balance of older people and consists of two dimensions: balance and gait. Depending on the scores, the following is determined:

[4] Revalidación y normalización del Mini-Examen Cognoscitivo (primera versión en castellano del Mini-Mental Status Examination) en la población general geriátrica: shorturl.at/gpA57

[5] Valoración de la discapacidad física: el índice de Barthel. shorturl.at/prEW8

[6] Estudio de prevalencia y perfil de caídas en mayores institucionalizados. shorturl.at/iyD03

- 19 or less: High risk of falls.
- 19-23: Risk of falls.
- 24-28: Low or slight risk of falls.

- Global Deterioration Scale (GDS)[7]: It is a scale consisting of a clinical description of seven distinct phases from normal to the most severe degrees of dementia of Alzheimer's disease. Its score is:

  - GSD 1: no cognitive impairment.
  - GSD 2: very mild cognitive impairment.
  - GSD 3: mild cognitive impairment.
  - GSD 4: mild dementia.
  - GSD 5: moderate dementia.
  - GSD 6: moderately severe dementia.
  - GSD 7: very severe dementia.

Once the participants have been selected, we continue with the next phase.

Reception phase

The main objective of this phase is to encourage a friendly reception of the testing of the technological solution by the living lab team and elderly involved.

In order to promote a friendly welcome, a training session is held, which is suggested to take into account the structure shown in Table 1 below. This training is given by ITGALL committee in collaboration with the living lab manager in order to schedule the meeting with the living lab team and the participating users.

Table 1. *Training session for a good reception.*

Training session for a good reception	
Type	**Description**
First part (30 min)	Presentation of the project and delivery of documentation.
Second part (30 min)	Explanation of the technological solution and delivery of devices or log-in.
Third part (15 min)	Questions and answers

[7] Validación y precisión de la escala de deterioro global (GDS) para establecer severidad de demencia en una población de Lima. shorturl.at/eCEM0

Development phase

The objective of this phase is to gather information regarding the understanding, reactions and attitudes of the end users with the technological solution.

The team responsible and involved in the development of the testing are: ITGALL committee, living lab managers and living lab professionals.

Timing

Timing is understood as the number of sessions and the duration needed to carry out the testing. For example, 3 sessions per week for each participant with a duration of 30 minutes per session.

Resources

In order to optimally carry out the testing process in living labs, it must be clear what human resources, materials and infrastructure are necessary.

Follow-up

In addition, it is the responsibility of the ITGALL committee to carry out a weekly follow-up by e-mail with those responsible for the LL in order to share the incidents that have occurred during the week, so that any needs or incidents that may have arisen can be resolved. The Incidents Registration (Annex I) is available for this purpose.

Evaluation phase

At the completion of the testing period, the evaluation questionnaires will be completed by the living lab managers or professionals.

The questionnaires used by the ITGALL network are those developed during the European project IN-4-AHA (Innovation Networks for Scaling Active and Healthy Ageing), see tables 15 and 16 of the D4.2 report.

Once the questionnaires have been completed, it is recommended that an interview be conducted with the members of the team in charge of carrying out the tests in order to gather as much information as possible.

In this phase, the information gathered in the incidents will be taken into account and will serve as support for the improvement proposals.

Deliverable

The final deliverable or report will be produced by the living lab manager and should contain a detailed description of each of the phases of the testing process, as well as a structure that is the same for all living labs.

Table 4. *Structure of the deliverable or final report.*

Structure of the report	
Type	**Description**
Project Summary Sheet (Annex I)	Brief summary of the content of the test report.
Timetable of activities	Graphical representation of the activities carried out as a function of time.
Selection phase	• Definition of the selection criteria for the sample of participants. • Definition of the Living Lab: objectives, characteristics, services offered, types of users... • Local context: brief description of the characteristics of the population to which the Living Lab belongs.
Reception phase	Description of the induction phase, annexing those materials used in the training session.
Development phase	• Timing • Resources • Follow-up
Evaluation phase	Development of the ECP tool and interviews with the team involved in the realisation of the testo.
Conclusions	• Key success factors in user experience • User experience barriers • Proposal for improvement
Bibliography	Set of references to publications used in the report.
Annexes	Relevant information and/or documentation on the work that has been carried out

Annexes

Annex I. Project summary sheet

Project summary sheet			
Summary			
Consortium	**Project**	**Contact person**	**Email**
Name of the solution:			**TRL:**
Objectives of the test			
Start date:		**End date:**	
ITGALL Team			
Project coordination:		**Email**:	
Living Lab	**Address**	**Responsible for Living Lab**	**Participant profile:**
CONCLUSIONS			
Key success factors •			
Barriers •			

Conclusions
Other comments

Annex II. Register of incidents

INCIDENTS REGISTRATION			
LIVING LAB	**DATE**	**RESPONSIBLE**	**TYPE OF INCIDENT**