D2.2 Report on user-centered design methodology

Ambient Assisted Living Joint Programme

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List of abbreviations (alphabetically)

Abbreviation	Full name
A24	Assistenz24
AAL	Active Assisted Living
AT	Assistive Technology
BLE	Bluetooth Low Energy
CIA	Confidentiality, Integrity and Availability
DoW	Decription of Work
GDPR	General Data Protection Regulation
GPS	Global Positioning System
HICS	HICS s.r.l. (the coordinator)
ICT	Information and Communications Technologies
iOS	iPhone Operating System
IoT	Internet of Things
ISO	International Organization for Standardization
LED	Light-Emitting Diode
PbD	Privacy by Design
PESTLE	Political, Economic, Social, Technological, Legal, Environmental
PTSD	Post-Traumatic Stress Disorder
QUEST	Quebec User Evaluation of Satisfaction with Assistive Technology
RITE	Rrapid Iterative Test and Evaluation
SD	Secure Digital
SIM	Subscriber Identification Module
SUS	System Usability Scale
UCD	User-Centred Design
UCY	University of Cyprus
UK	United Kingdom
USB	Universal Serial Bus
UX	User Experience
W3C	World Wide Web Consortium
WCAG	Web Content Accessibility Guidelines
WP	Work Package

Executive Summary

The aim of eSticky project is to support people with memorization problems to maintain their autonomy of living. The main target group are people with age-related obliviousness, people with beginning stages of dementia and people with beginning Alzheimer's disease. The project proposes a new approach for ambient integration of memorization and notification aids, which needs little or no acquisition of new skills by the end user. For this purpose the consortium partners plan to design according to user-centered design (UCD) methodology, implement, integrate and optimize a set of networked graphical displays (the digital eSticky notes) that assist the person by presenting important information including scheduled events, medication reminders and nutrition recommendations or notifications of events that need attention. In this concept messages will be able to be easily updated by carers, family members and the users themselves via internet.

The project activity will pick-up from the older adults and their carers/families analysis of demands and needs, and the platform specification, to guarantee that these demands and needs are respected in the hardware configuration of the device and the adaptation of the software platform and services. For the evaluations that will be conducted, a total of 40 older adults (20 from Austria and 20 from Poland) are planned to participate. In the project a full user centred design approach will be applied. To provide this the end-user oriented partners will constantly monitor, discuss, evaluate and provide feedback based on the system development activities, which in turn is to guarantee the proper implementation, integration and optimisation of the platform.

All these intentions are to be fulfilled using various approaches, methods and tools focused on users, as well as by analyzing products similar to the designed one, to guarantee finally the usability, effectiveness of the product and the willingness to buy it by customers.

1 Introduction

This document, D2.2 *Report on user-centered design methodology*, is the only one and final report, in which it is planned to cite more or less known tools, used to involve end users and their carers in the process of joint design and refinement of the eSticky notes, as well as to check and analyze their further interest in the final product. The report summarises the phases of planning and defining how the used-centered design work is performed throughout the project.

The document represents the output of task 2.2 *User Centred Design (UCD) Methodology* of the project. This task focused on choosing and usage of investigative methods for user-centered design, to fulfill the goal of a product engineered for its users, including: ethnographic study, contextual inquiry, prototype testing, usability testing and other methods. Generative methods were also mentioned to be used, including: card sorting, affinity diagramming and participatory design sessions. In addition, user requirements are being inferred by careful analysis of usable products similar to the product being designed. The goal of the user-centered design is to make products which have very high usability. This includes how convenient the product is in terms of its usage, manageability, effectiveness and how well the product is mapped to the user requirements.

This document is divided on several parts:

- Section 2 contains brief information about norms, standards and guidelines, which should be useful and considered by the consortium for designing the user-oriented eSticky system. This information covers ISO norms (ISO 9241-11:2018: *Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts;* ISO 9241-210:2019: *Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems* and ISO/IEC/IEEE 29148-2018: *International Standard - Systems and software engineering — Life cycle processes — Requirements engineering*), Universal Design approach, Privacy by Design issue, Confidentiality, Integrity and Availability, W3C standards, Web Content Accessibility Guidelines, Mobile Web Best Practices and finally Design for All approach.
- Section 3 covers extensive considerations of methods, tools and ways that can be used in a project in practice to design and develop a solution in which users are involved practically throughout the entire project period. First, approach to end users involvement including initial investigations and user-centric activities, co-creation methodology, and planning tests, trials and pilots were described. Then the following UCD methods were mentioned: etnographic study with focus groups, interviews and questionnaires; contextual inquiry; prototype testing, usability testing, and finally generative methods like card sorting, affinity diagramming and participatory design sessions. The final selection of tools to engage users will be confirmed during the project implementation. This report provides guidance that such methods can be used and what their general operating principles are. Moreover, it is worth underlining that the goal of the project is to develop a useful product for which users will be willing to pay and who will also be involved in business activities validating the product in terms of its usability, willingness to purchase, checking price sensitivity, etc. Therefore, in this document such business tools like SWOT analysis, PESTLE analysis, Business Model Canvas, Stakeholder analysis and User stories were described in their main principles.
- Section 4 includes an analysis of usable products similar to the product being designed and other products that may have influence on eSticky, taking into account requirements and

needs of older adults. Last part of this sections contains the first conclusions from the analysis of competitive market products for further designing usable, effective and marketable eSticky product.

- Section 5 was prepared taking into account the requirements for preparing templates and documents in eSticky, which will be used in the research and testing phases with users.
- Section 6 contains final summary and conclusions from this report, which has the planning goal for the next tasks in the project including the involvement of users to design, implement and optimize the eSticky system.
- Last section 7 includes the appendixes with proposed materials for user involvement in testing phases. Moreover, the templates that are planned to be used during the observation of users in prototype testing, measuring eSticky system usability during the tests and also user satisfaction of eSticky system are attached. These sheets will give first answers if the users involved to the project are interesting in paying for such solution and using it.

2   Standards and interoperability

The eSticky system will be designed to be simple and flexible for users. The networked graphical displays (that visualize traditional sticky notes) aimed for use by the end-users will have a very simple and accessible user interface and set up procedure, which shall be based on partners' experience and developed in cooperation with end user groups in two countries (Poland and Austria). Development and evaluation of the eSticky system will be based on the application of standards and guidelines described in below subsections.

2.1   ISO norms

Based on the International Organization for Standardization (ISO) norms the consortium partners plan to create usable, effective and interactive system that will be mapped to the user requirements.

ISO 9241-11:2018: *Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts[1]* will be used in eSticky to guide the implementation of a human-centred design process, thus adhering to universal design standards.

ISO 9241-210:2019: *Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems[2]* focuses on human-centred design. A note in the standard mentions: "The term "human-centred design" is used rather than "user-centred design" in order to emphasize that this document also addresses impacts on a number of stakeholders, not just those typically considered as users. However, in practice, these terms are often used synonymously". Therefore it is worth underlining that the terms are basically used interchangeably and in this meaning will be used in the project. The main aim in eSticky will be to design usable system, which „can provide a number of benefits, including improved productivity, enhanced user well-being, avoidance of stress, increased accessibility and reduced risk of harm."

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[1] https://www.iso.org/obp/ui/#iso:std:iso:9241:-11:ed-2:v1:en

[2] https://www.iso.org/obp/ui/#iso:std:iso:9241:-210:ed-2:v1:en

ISO/IEC/IEEE 29148-2018: *International Standard - Systems and software engineering — Life cycle processes — Requirements engineering[3]* will also be considered in the project from a software engineering perspective that has provisions for the processes and products related to the engineering of requirements for systems and software products, and services throughout their life cycle.

2.2   Universal Design

The requirements for system, software product and its services will be supported in the project by an Universal Design[4] approach. It is dedicated to enabling the design of environments that can be accessed, understood and used regardless of a person's age, size, ability or disability. According to the Center for Universal Design in the North Carolina State University, the 7 Principles of Universal Design "may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the characteristics of more usable products and environments":

- Principle 1: Equitable Use - the design is useful and marketable to people with diverse abilities.
- Principle 2: Flexibility in Use - the design accommodates a wide range of individual preferences and abilities.
- Principle 3: Simple and Intuitive Use - use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
- Principle 4: Perceptible Information - the design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
- Principle 5: Tolerance for Error - the design minimizes hazards and the adverse consequences of accidental or unintended actions.
- Principle 6: Low Physical Effort - the design can be used efficiently and comfortably and with a minimum of fatigue.
- Principle 7: Size and Space for Approach and Use - appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

2.3   Privacy by Design

The architecture of the eSticky system will comply to the notion of Privacy by Design (PbD) and as defined in the General Data Protection Regulation (GDPR) Article 25(1) Data Protection by Design. The importance of PbD lies on the proactive consideration of privacy issues, so that possible privacy pitfalls can be anticipated and prevented before they materialise, rather than risking user's data privacy. To ensure PbD, the consortium will correctly embed in the system's specifications and design, and subsequently transfer into the implementation all necessary privacy properties and user's rights regarding their personal data collection, storing, and processing. These privacy requirements shall be gathered from the literature, as well as from potential user's feedback, and additionally from the respective regulation provisions, such as the GDPR.

A software engineering methodology will be followed that will embed the PbD framework, following the seven "foundational principles"[5]:

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[3] https://standards.ieee.org/standard/29148-2018.html

[4] http://universaldesign.ie/

[5] Cavoukian, Ann. "Privacy by design in law, policy and practice." A white paper for regulators, decision-makers and policy-makers (2011) (https://collections.ola.org/mon/25008/312239.pdf)

- Proactive not Reactive; Preventative not Remedial;
- Privacy as the Default;
- Privacy Embedded into Design;
- Full Functionality – Positive-Sum, not Zero-Sum;
- End-to-End Lifecycle Protection;
- Visibility and Transparency;
- Respect for User Privacy.

Subsequently to each step finalisation, appropriate checks and testing will be conducted in order to validate that the privacy requirements are indeed successfully transferred to the next step, most importantly towards the system implementation. With the application of PbD principles, a concrete universal design and software engineering methodology is formed for the design, and development of the eSticky system architecture, its components, and this in turn will translate into an end result for users and future customers of the eSticky product.

2.4 Confidentiality, integrity and availability

Common practices and appropriate technical measures regarding software security will be embedded along with the privacy properties, to ensure the "confidentiality, integrity and availability" (CIA)[6] of eSticky system (see Figure 1).
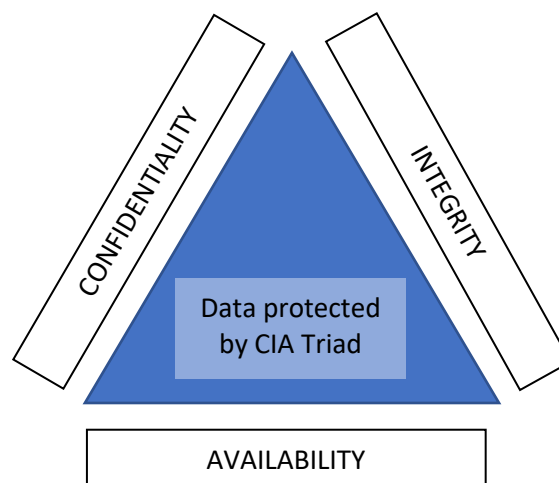

Figure 1. CIA Triad approach

2.5 World Wide Web Consortium standards

World Wide Web Consortium (W3C) standards[7] define an Open Web Platform for application development to enable developers to build interactive experiences, powered by data stores, that are available on any device. W3C develops the technical specifications and guidelines to ensure high technical and editorial quality, and to earn endorsement by W3C and the broader community.

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[6] https://www.f5.com/labs/articles/education/what-is-the-cia-triad

[7] https://www.w3.org/standards/

Reference documents of the W3C will be considered to ensure the design of accessible user interfaces for the mobile app, web portal and display devices in the project. Meeting these assumptions guarantees that a wider range of users will be able to use them.

2.6 Web Content Accessibility Guidelines

Web Content Accessibility Guidelines (WCAG)[8] is developed through the W3C process, with a goal of providing a single shared standard for web content accessibility that meets the needs of individuals, organizations, and governments internationally. The WCAG documents explain how to make web content more accessible to people with disabilities. Web "content" generally refers to the information in a web page or web application, including:

- Natural information such as text, images, and sounds;
- Code or markup that defines structure, presentation, etc.

WCAG 2.1 are stable, referenceable technical standards. They have 12-13 guidelines that are organized under 4 principles: perceivable, operable, understandable, and robust. For each guideline, there are testable success criteria, which are at three levels: A, AA, and AAA. WCAG applies to dynamic content, multimedia, "mobile", etc. WCAG can also be applied to non-web information and communications technologies (ICT). Using WCAG standards the consortium plans to ensure the design of accessible user interfaces for the mobile app, web portal and eSticky display devices.

2.7 Mobile Web Best Practices

Mobile Web Best Practices 1.0[9] specifies best practices for delivering Web content to mobile devices. The principal objective is to improve the user experience of the Web when accessed from such devices. The recommendations refer to delivered content and not to the processes by which it is created, nor to the devices or user agents to which it is delivered.

In discussing the limitations of mobile devices for delivery of Web content it is easy to lose sight of the fact that they are extremely popular and very common. This popularity largely stems at present from them being: personal, personalizable, portable, connected and increasingly multi-functional beyond their original purpose of voice communications.

In addition to these factors, the advantages of mobile devices will increasingly include: location awareness, one-handed operation, always on, universal alerting device. These practices are seem to be very useful for designing accessible user interfaces for the mobile app and eSticky displays.

2.8 Design for All

Another important goal of this project is that the system can be used by as many people of the target group as possible. Therefore the consortium will follow the "Design for All"[10] principle during all evaluation, design and implementation steps to fulfil this criterion.

Design for All is the intervention into products and services which aims to ensure that anyone, including future generations, regardless of age, gender, capacities or cultural background, can participate in social, economic, cultural and leisure activities with equal opportunities. Design for

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[8] https://www.w3.org/WAI/standards-guidelines/#wcag

[9] https://www.w3.org/TR/mobile-bp/#d0e128

[10] http://designforall.org/design.php

All/Universal Design should be implemented in all areas because the human beings are diverse and everyone has the wish, the need and the right of being independent and choosing the own life style without facing physical and social barriers.

Design for All criteria: respectful, safe, healthy, functional, comprehensible, clear information, spatial distribution, sustainable, affordable and appealing.

Design for All not always allows solving all needs with a single solution that fits everyone. One of these seven strategies should be chosen:

- To Everyone - a single solution suitable for all potential users.
- Adjustable - a single product that meets the different dimensional or functional requirement of people by means of devices or mechanisms.
- Products or services range - a range of products and services among which the person choose the one best fits.
- Compatible with commonly used accessories - adaptations or not marginalizing alternative solutions can be provided to guarantee the compatibility with accessories that a person must use.
- Premises/Product & complementary service - not always it will be possible to meet the needs of users only via a product, a complementary service will then be necessary.
- Use an alternative solution to the mainly used offering similar benefits - sometimes the characteristics of some individuals prevent them from using products or services in the usual way. A non discriminating alternative offering equivalent results is then advisable.
- Customized product or service - as is the case for most services provided by liberal professionals (such as doctors or lawyers).

Furthermore, the eSticky system will be practicable for every person, who tends to frequently lose things in his or her home environment or for persons, who often need to be reminded of some special activity. For example, this could be the unusual medication after a surgery. It will improve independence, mental state, social inclusion of different groups of end-users and moreover it can disburden people caring for people with memory disorders. The users will be more independent because of using the eSticky reminders in their environment.

3 Investigative methods, techniques and tools for user-centered design

User Centered Design (UCD) is an approach to designing human-computer interaction in which the needs, requirements and limitations of the end user are studied in detail at every stage of the design process. UCD is one of the basic methods of testing usability. To get to know the potential user well, the consortium should answer to the following questions in this project:

- Who is the user?
- What are his/her problems and limitations?
- What skills does he/she have?
- What will the user use the product/service for?
- What external restrictions may the user face, etc.?

Donald Norman[11] (American cognitive psychologist and researcher, specialist in the field of human-computer interaction) proposed the following iterations of UCD:

- Observation: to understand the problem of the target group to whom the product is targeted; involves observing potential customers in their environment and in situations where they could use the product;
- Generating ideas ('brainstorming'): the process of coming up with as many potential solutions as possible after determining the guidelines for a service or product;
- Prototype development: creation of a mock-up or prototype of potential solutions to be tested with users;
- Testing: involves observing the target group of users who use the prototype created by the designers. It is important to reliably reproduce the actual context of the use of the product.

According to UCD methodology, different methods are used, generating different costs, giving different results and data for further processing and evaluation, requiring different sampling sizes and which can be used at various stages of the design process. The following are six popular methods commonly used according to this methodology (Table 1):

Table 1. Examples of popular methods used in UCD methodology

Method	Cost	Output	Sample size	Stage of the design process
Focus groups	Low	Non-statistical	Low	Requirements gathering
Usability testing	High	Statistical and non-statistical	Low	Design and evaluation
Card sorting	High	Statistical	High	Design
Participatory design	Low	Non-statistical	Low	Design
Questionnaires	Low	Statistical	High	Requirements gathering and evaluation
Interviews	High	Non-statistical	Low	Requirements gathering and evaluation

By actively engaging users in this project and using a user-oriented design methodology, project partners will want to answer the above questions, gathering information from different users, at different stages of the project, to create a solution that will meet their requirements and needs, will be useful and effective, and will also make users want to acquire the solution developed in the eSticky project.

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[11] https://en.wikipedia.org/wiki/Don_Norman

3.1 Approach to end users involvement

The work carried out in the project, focusing users' involvement, their needs and requirements will be carried out in the following order:

- In the first months of the project (M1-M3) the methodology was based on initial investigations and existing results from requirements analysis conducted in other projects, products and solutions, where relevant and freely available;
- If this leaves any questions open after M3, an initial user-survey and co-creation approaches will be conducting to help generating the requirements focus groups with primary and secondary users to further assess the prototype and field trials with primary users;
- The results from the focus groups will generate input for the development of the prototype and will be continued to continuously improve the system, serving as a constant source of feedback;
- Finally the integrated prototype will be installed in the user's homes, and field test and trials will be conducted in order to define further requirements for the development of the final product.

It is planned that two main testing phases will be conducted in T2.3 *Involvement of Users in System Engineering* with user engagement (after submitting D2.1 *Report on user requirements and needs*, and D2.2 *Report on user-centred design methodology* in M3):

- Testing phase 1 (experimental evaluation and user feedback): 20 primary users per end-user site – M3-~M18 (the final M will be clarified during the project);
- Testing phase 2 (product configuration, eSticky training and implementation of demonstrators): 20 primary users per end-user site (number of iterations dependent on the number of devices provided for testing by HICS) – ~M18-M30 (the first M of testing dependent on prototype readiness.

The project parters will take into account the project milestones in planning testing phases:

- Design Sketch and UI Mockups - M13;
- Touchable Design Models available - M22;
- Integrated Prototype - M24.

3.1.1 Initial investigations and user-centric activities

At the beginning of the project (M1-M3 before involving end users to the project) the following activities were/are carried out:

- Initial defining the system and its reminder services (described in D3.1 *Report on System Architecture*, to be submitted in M4);
- Review of literature, past Active Assisted Living (AAL) projects and existing solutions for older people with memory problems (desribed in D2.1 *Report on user requirements and needs* and this D2.2, submitted in M3);
- Initial discussing about end-user needs, demands and expectations (desribed in D2.1 *Report on user requirements and needs*, submitted in M3 and discussed from the beginning of the project during consortium virtual meetings, i.e. kickoff meeting, architecture meeting, WP2 meetings).

3.1.2   Co-creation approaches

These approaches with end-user involvement include use of co-creative methods, experimental evaluation and initial user feedback. At this stage, there is no prototype of the solution yet, and activities with users focus on stimulating their imagination, determining the requirements and needs for the final solution. Various methods of co-creation approach to this phase can be used in the project:

- Living Labs[12] are both practice-driven activities that foster open, collaborative innovation, as well as real-life environments, where both open innovation and user innovation processes can be studied and experimented with, and where new solutions are developed (see Figure 2). The aim of Living Lab is to operate as intermediaries e.g. among research organisations, non-profit-organisations and companies in the project for joint value co-creation, rapid prototyping or validation to scale up innovation and businesses. There is no single Living Lab methodology, but all Living Labs combine and customize different user-centred, co-creation methodologies to best fit their purpose: User engagement at the beginning of the process; Multi-stakeholder participation with representatives of public and private sector, academia and general people; Activities in real-life setting to gain a thorough overview of the context and project result; Co-creation for mutually valued outcomes that are results of all stakeholders being actively engaged in the process from the very beginning.
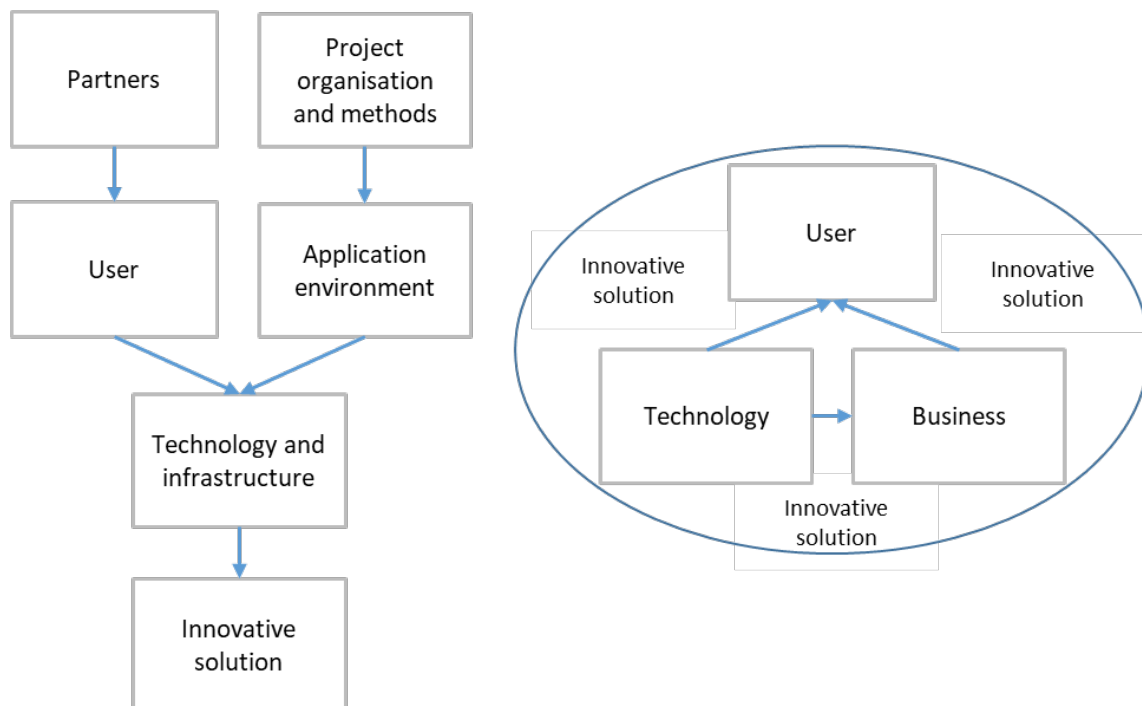
Figure 2. Key components of Living Lab environment

- User experience and usability tests

The usability test is a way to check user experience (UX) when creating interactive products, assess the business value of a project, and determine what to improve for the project result. The usability test is used to discover users, select them and use in designing work in subsequent stages (UX tests can be performed at various stages of the eSticky project).

Selected types of usability tests[13] that can be used in the project:

- Comparative and performance measurement tests;
- Co-discovery learning;
- Coaching method;
- Mobile tests;
- Tests on various prototypes and models;
- 5 seconds test (the user sees the interface of the application only for 5 seconds, and then is asked to enter things that he/she remembers);
- Rapid iterative test and evaluation (RITE).

It is worth taking into account the following tips in planning such tests[14]:

- One survey will not answer all your questions.

- A limited number of tasks in the study.

- Introduction of context in the content of tasks.

- Lack of suggesting questions in the content of the tasks.

- Attaching great importance to the content of greeting and thanks in the study.

- Ergonomics of surveys.

- Drawing conclusions based on differences.

- Examination of unrealistic paths.

- Walt Disney

The Walt Disney method[15] is a creativity technique to generate realistic and new ideas for the product and its services from different perspectives. It is used in conceptualisation phase. This approach is composed of Dreamer phase (users generate ideas without mental limits), Realist phase (users consider the steps required to put these ideas into practice) and Critic phase (users assess the possible advantages and disadvantages of these ideas), as can be seen in Figure 3. This method can be suitable in the eSticky project for seniors in good health condition, secondary and tertiary users, as well as stakeholders of the project.

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[13] https://crafton.pl/blog/test-ux-jak-sprawdzic-ux/

[14] https://blog.uxeria.com/zdalne-testy-uzytecznosci-10-rad-dzieki-ktorym-stworzysz-jeszcze-lepsze-badanie-ux/

[15] https://en.wikipedia.org/wiki/Disney_method

Figure 3. Walt Disney method

These methods are based on interaction in various groups to stimulate users' creativity, study their needs and requirements, and become familiar with their skills and preferences.

3.1.3 Test, trials and pilots

In the proper testing phase, the consortium partners will opt for more structured testing methods. When testing and demonstrating prototypes in user homes, end-user partners will use various documents, including check lists, observation sheets, etc., to write down all conclusions, user behaviors, their questions and doubts from this proper testing phase.

- Check lists

By conducting research and tests with users, the project partners intend to acquire knowledge that will be processed and properly used to develop and optimize the eSticky system. Depending on the research methods used, different types of data will be obtained, e.g.:

- Observer's note regarding the evaluation process with users;

- Checklists with answers;

- An ordered data set supplemented during the study in a database or spreadsheet by the researcher or observer;

- Pre-test and post-test interview, etc.

The checklist is an ordered, finite set of questions and answers ranked according to the selected scale, refers to the assumptions of the system and the actual state, allows one to examine the need improving the functional, technological and functional areas of the system under development. The use of a language that is not adapted to the recipients (e.g. the use of technical jargon or a professional language), overloading the checklist with questions and system details, and not applying the principle of presenting the most important things from the user's point of view (and not e.g. a consortium partners) are the most common errors in developing checklists for testing with users.

- Usability instruments

A system's and/or interface's level of usability can be measured in the project by inviting intended users of the system to participate in a usability testing session (see Figure 4). During a usability test session, a user is given a series of tasks to complete by using the system in question. The researcher (in our case, from Poland or Austria) records user behaviors, emotional reactions, and the user's performance as the he attempts to accomplish each task. The researcher takes note of any moments of confusion or frustration that the user experienced while trying to complete a task, and also tracks whether or not the user was able to satisfactorily complete each task. Analysis of data from several users provides user experience researchers a means of recommending how and where to re-design the system and/or its interface in order to improve its level of usability and thus, the user experience in general. Some usability instruments include user testing on system prototypes, a usability audit conducted by experts or cognitive modeling. Each of system and interface components have devices corresponding to the visual (sight), aural (sound), and haptic (touch) channels of the brain. Usability engineering studies these elements of the user's experience. From the project perspective user testing on system ptototypes is the most relevant instrument for checking usability of eSticky.
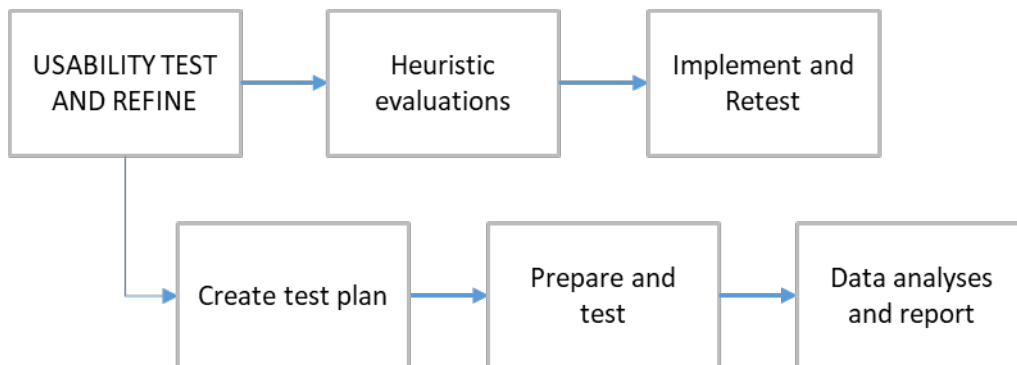
Figure 4. Phases of usability testing and refining

- Iterations

Iterative process offers a way to manage the inherent risk in eSticky system design. In iterative design, the software and whole system are refined by repeated trips around a design cycle: first imagining it (design), then realizing it physically (implementation), then testing it (evaluation). Using the results of user evaluation, the system may be redesigned, the prototypes will be improved, and more evaluations will be done, if necessary (see Figure 5). Hopefully, this process will produce a sufficiently usable eSticky system (taking into account time and resources provided in the project).
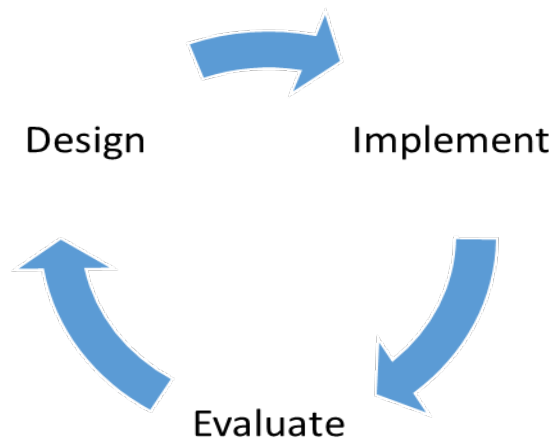
Figure 5. Iterative process approach

The development of the project requires constant interfacing and the involvement of the end users and their main associations, through the sending of specific questions in order to receive constant feedback on the results (eg. user interface, graphic interfaces, touch screen design, etc.).

3.2   Etnographic study

Ethnographic research is used to obtain data from users and may consist of observing and describing the behavior of a given user or group of users in their natural/routine environment (such as home, daytime residence, etc.), their lifestyle and analysis of social life. There are various ethnographic research techniques - qualitative, e.g. focus group interview or individual in-depth interview, and quantitative such as questionnaires/surveys that can be used online (this may be particularly important in the context of the COVID-19 epidemic threat, which has taken over around the world and can greatly hinder personal contacts with users and centers associating the elderly).

Observation is also a tool of ethnographic research, thanks to which the researcher analyzes what he/she sees and feels while being in a group of users. In observations, it is important to take notes and describe them appropriately. The more detailed the records, the easier it is to draw conclusions, especially if they are forwarded to the technical WPs and based on which the product will be designed and improved. The following subsections describe popular ethnographic methods that can be used in the project.

3.2.1   Focus groups

This method involves encouraging an invited group of intended/actual users to share their thoughts, feelings, attitudes, and ideas on a project solution (see Figure 6). The focus groups[16] are most often used as an input to design. They are a good means of getting information about people and their needs in the first phases of the project.

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[16] https://www.questionpro.com/blog/focus-group/
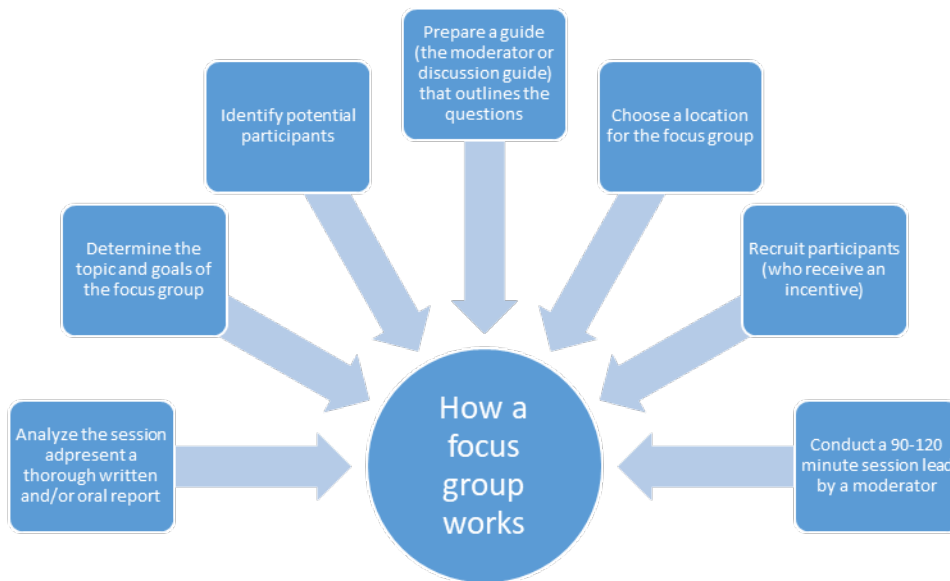
Figure 6. Idea of in-person focus group

3.2.2 Interviews

This method usually involves one interviewer speaking to one participant at a time (see Figure 7). A participant's unique point of view can be explored in detail during such interview. Any misunderstandings between the interviewer and the participant can be quickly identified and addressed. Interviews are usually employed early in the design process in order to gain a more detailed understanding of a area of activity or specific requirements. In the case of continuous epidemic threatment online interviews will be considered in the project.
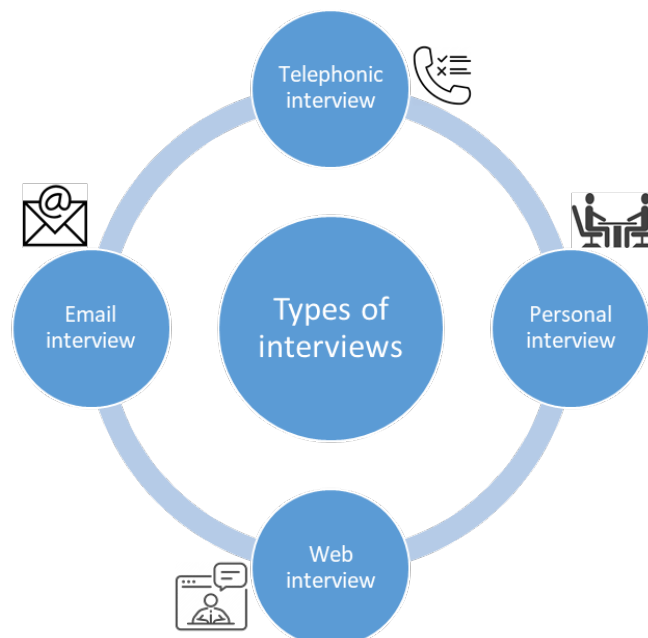
Figure 7. Types of interviews considered in the project

3.2.3 Questionnaires

It is a means of asking users for their responses to a pre-defined set of questions. Questionnaires and surveys are usually employed when a design team can only gain remote access to users, is seeking a larger sample size than can be achieved through direct contact. It can be administered through post or electronic means. To receive positive result of this method, the template should be well-designed by experienced researchers to not ask non-biased questions. The table below (Table 2) presents desirable and erroneous aspects in the formulation of questionnaires and surveys.

Table 2. Rules in writing questions

DO	DON'T
Keep questions under 20 words	Force users to choose an option that does not represent their real opinion
Address one issue at a time	Ask leading questions
Word questions clearly	Ask loaded questions
Provide precise options in closed-ended questions	Base questions on a false premise
Equally space the range of options inclosed-ended questions	Use authority figures to bias answers
Ask users to discuss desired outcomes	Ask users to predict the future
Provide background information only if necessary and keep that information factual	Ask users to create solutions
Keep questions concrete and based on the user's experience	Ask users to discuss unmemorable events
Limit questions to memorable events or ask participants to track their behaviour over time in a diary	Use jargon, slang, abbreviations, geek-speak
Provide memory aids like calendars to help participants remember previous events	Use emotionally laden words
Use terms that are familiar to the user	Use double negatives
Use neutral terms and phrases	Ask sensitive or personal questions out of curiosity
Ask sensitive or personal questions only if necessary	-

(source: https://www.slideshare.net/DCU_MPIUA/user-centered-design-interviews-surveys)

3.3 Contextual inquiry

Contextual inquiry is less a usability testing method and more like an interview/observation method that helps a product team obtain information about the user experience from the real users (see Figure 8[17]). Test participants (real users) are first asked a set of questions about their experience with a product and then observed and questioned while they work in their own environments. Getting all this information at the beginning of the design process will help the product team design a well-tailored experience. This method also works for shipped products. Contextual inquiry may be also a good method for the consortium to test a user's satisfaction with a product.
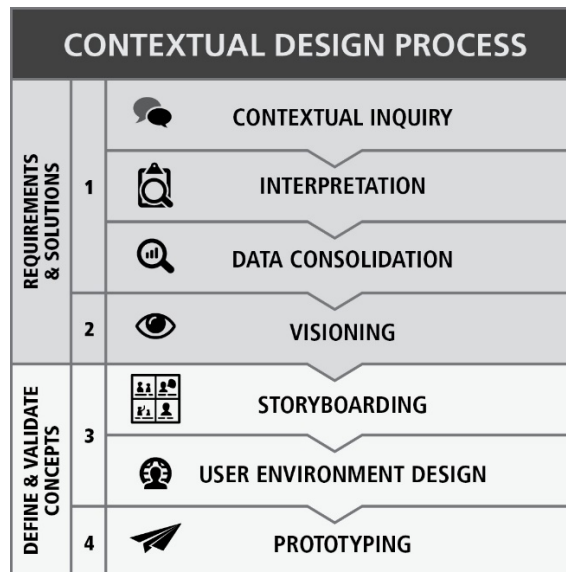
Figure 8. Idea of contextual design

3.4 Prototype testing

Tests of prototypes and software (e.g. on-line services, user interface prototypes) will be carried out with the participation of future users. Satisfaction measurement of tested prototypes will be carried out using a survey. In the eSticky project, the goal is to achieve the following indicators:

- Interest in buying of min. 60% potential end-users on the phase of validation of system;
- System failure rate not more than 5% on the stage of prototype validation;
- 100% of receiving notifications/messages via eSticky notes compared to conventional based systems - to be proven during user-tests;
- System tested with at least 40 users in two different countries;
- Max. 20% of dropout during user tests;
- Percent of acceptance of system by the end users - which is indicated by min. 90% of positive feedback solicited by specific procedures and user involvement activities;
- Min. 90% approval of discreet ambient notification in daily use - achieved during the user tests;

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[17] http://dlrtoolkit.com/contextual-design/

- Min. 95% of the integrated system, i.e. the home server with the eSticky displays that can be configured using mobile app or web portal, works as intended.

The purpose of testing prototypes will be to identify those elements that cause difficulties or lead to erroneous behavior of users and gather users' opinions on prototypes and suggestions for their improvement. At the end of the project, the above-mentioned indicators should be achieved.

During the project 40 prototypes are planned to be provided for user tests (20 in Poland and 20 in Austria). Users, who will participate in the evaluations of the integrated prototype (i.e. have stayed in the project until the end or at least close to the end) and grow acquainted to the eSticky system will be given the option to keep the prototype they are using (kind of incentive because of lack of providing material benefits for the users). When the final product comes to market, they will have the option to buy the product very cheap. If they will not want that, they can either keep the prototype for good. This is considered the fairest approach by the consortium, since it leaves it to the users if the prototype (which is for free, but might have bugs) or the final product (which will be more advanced) will be their choice.

3.5 Usability testing

This method allows to evaluate a product by collecting data from people as they use it. An user is invited to attend a session in which they will be asked to perform a some tasks while a moderator takes note of difficulties they encounter. Time how it takes them to complete tasks is a good measure of efficiency (see Figure 9[18]). The results of this method can be an input to design or at the end of a project. It represents a way finding out what the most likely usability problems with a product are likely to be. It requires some form of design to be available to test. Usability testing may help the end-user partners to uncover problems, discover opportunities, and learn about users.[19]
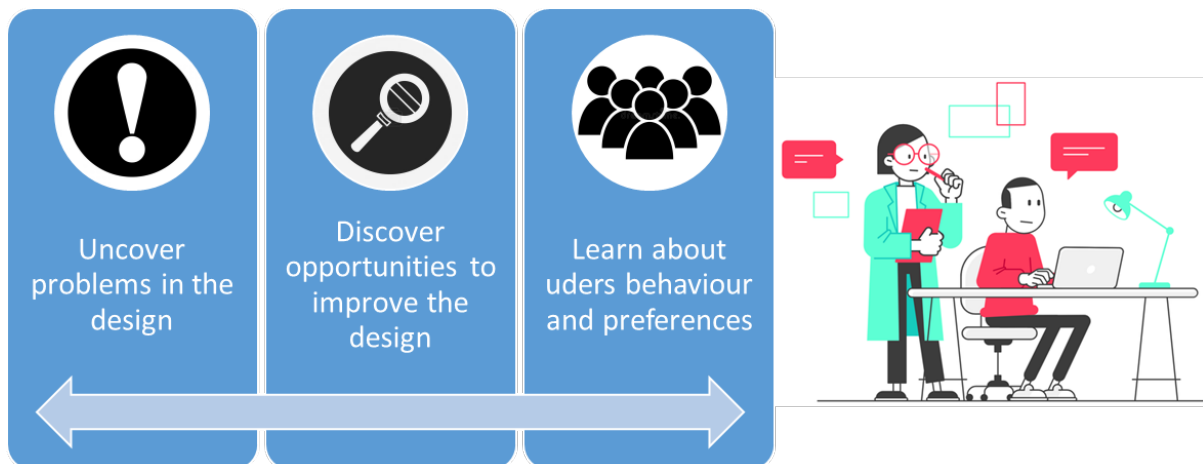
Figure 9. Lab usability testing

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[18] https://www.hotjar.com/usability-testing/methods/

[19] https://www.nngroup.com/articles/usability-testing-101/

3.6 Generative methods

Generative brainstorming sessions start with a problem that is not defined too broadly and too narrowly. The session should have a specific time frame, which allows better concentration and ensures creative dynamics of the group of participants. In the first brainstorming session, it is worth encouraging participants to "build ideas on the ideas of their predecessors." The greater the number of ideas generated and saved, the greater the likelihood that one of them will prove useful at a later stage. In brainstorming, the basic rule is to abstain from questions, comments or criticism to even the most illogical seemingly ideas that come up during the session. Below popular generative methods which can be considered in the project are described.

3.6.1 Affinity diagramming

The affinity diagram is a way to show and organize large number of ideas and data by a group of users. Materials needed for affinity diagram: classic sticky notes or cards, marking pens, big work surface like wall/large board. Affinity diagram may be used when the project is going to start a new product and one requires as many as good ideas to be follow for the product.

Steps in affinity diagram which needs to be follow:

- Write each idea on notes and place that all notes on large working surface, so that all notes will be visible for every team members.
- Exploring more ideas that seem to be useful for product.

The idea is to sit with the team and shortlist, and group all the information and ideas which are mentioned on notes and cards, remove the repeated ideas on notes, and group the other notes according to the parent family.

3.6.2 Card sorting

This method is used for suggesting intuitive structures/categories of the product. A participant is presented with an unsorted pack of index cards. Each card has a statement written on it that relates to a product. The user is asked to sort these cards into groups and then to name these groups (see Figure 10). The results of multiple individual sorts are then combined and analysed. Card sorting is usually used as an input to design. It is a way of suggesting good categories for a product's content and deriving its architecture.

Figure 10. Idea of card sorting

3.6.3   Participatory design sessions

This method does not just ask users for their opinions on design issues, but also actively involves them in the design and decision-making processes. It is usually used to generate prototypes that feed into an overall project's design process. An example would be a design workshop in which developers, designers and users work together to design an initial prototype (see Figure 11[20]).

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[20] http://dlrtoolkit.com/participatory-design/

D2.2 Report on user-cetnered design methodology
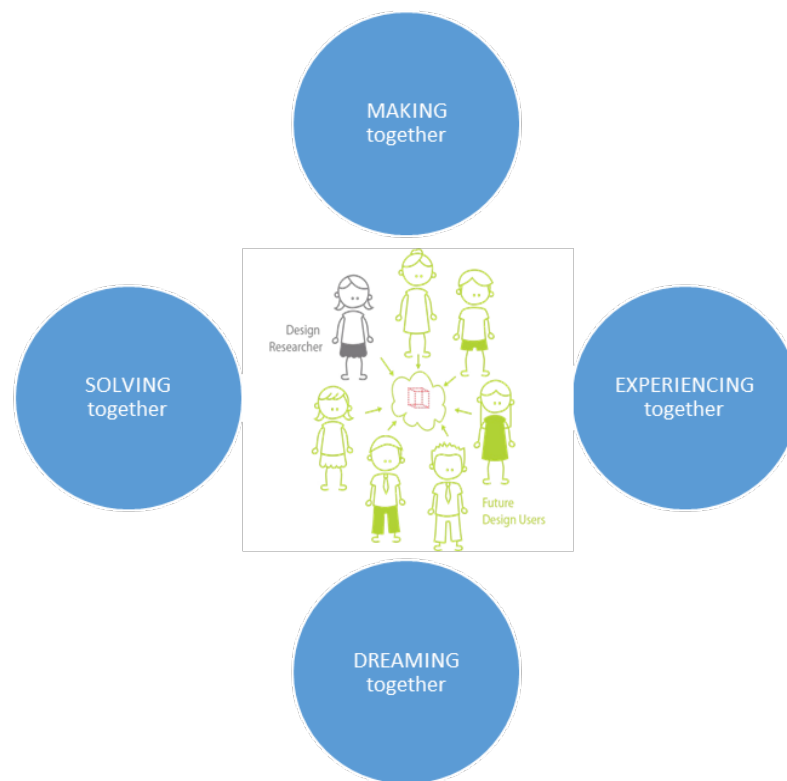
Figure 11. Participatory design method

At this stage of the project, the author would like to mention that this is a preliminary selection of tools and that the final set of evaluation tools and instruments will be defined along the project duration in the respective tasks.

3.7   Business tools

Apart from a traditional UCD methodology in the exploratory and creative phases of the innovation process, the wishes and needs of the end-users serve as input to the development of the new solution, as well as design of the business plan. In business plan development, end-users may be asked to provide input about customer behaviour and attitude, purchasing processes, regulatory and other decision-making. End-users are also crucial for validating the customer appreciation and evaluation of the solution, willingness to use it and willingness to pay for it (checking price sensitivity).

The goal of the user-centered design is to make products which very high usability, effectiveness and mapped well to the user requirements. Therefore in the business development phase various tools are considered to provide and study usability and effectiveness of product, e.g. as presented in below subsections.

3.7.1   SWOT analysis

It is a strategic planning technique used to help an organization identify Strengths, Weaknesses, Opportunities, and Threats (SWOT)[21] related to business competition or project planning. It is

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[21] https://en.wikipedia.org/wiki/SWOT_analysis

designed for use in the preliminary stages of decision-making processes. It is intended to identify the internal and external factors that are favorable and unfavorable to achieving project objectives, as presented in Figure 12:

- Strengths: characteristics of the business or project that give it an advantage over others.
- Weaknesses: characteristics of the business that place the business or project at a disadvantage relative to others.
- Opportunities: elements in the environment that the business or project could exploit to its advantage.
- Threats: elements in the environment that could cause trouble for the business or project.

STRENGTHS	OPPORTUNITIES
+ internal advantages + unique factors and resources + low cost factors and resources	+ external factors + chances of improvement areas + good elements that may be used for benefits
- internal disadvantages and limitations - areas that can cause improvement - factors for loosing sales	- external risks for the business - business obstacles - market of competitors
WEAKNESSES	THREATS

Figure 12. Tempate of SWOT analysis

3.7.2   PESTLE analysis

It is a concept in marketing principles and includes Political, Economic, Social, Technological, Legal, Environmental (PESTLE)[22] factors in business analysis (as presented in Figure 13). There are certain questions that one needs to ask while conducting this analysis, which give them an idea of what things to keep in mind. They are:

- What is the political situation of the country and how can it affect the industry or designed product?
- What are the prevalent economic factors?
- How much importance does culture have in the market and what are its determinants?

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[22] https://pestleanalysis.com/what-is-pestle-analysis/

- What technological innovations are likely to pop up and affect the market structure?
- Are there any current legislations that regulate the industry or can there be any change in the legislations for the industry?
- What are the environmental concerns for the industry?

Politics	Government body and their policy Financial support Government initiatives
Economy	Inflation and interest rates Labour and energy costs
Social	Population, lifestyle, culture Education, media
Technology	New technologies Information and communication system
Legal	Regulations and employment Government law and standards
Environment	Pollution and waste Recycling Force majeure

Figure 13. Factors in PESTLE analysis

3.7.3 Business Model Canvas

Business Model Canvas[23] is a strategic management and lean startup template for developing new or documenting existing business models. It is a visual chart with elements describing product's value proposition, infrastructure, customers, and finances. With this business model design template, an organisation can easily describe its business model. Usually canvas has nine boxes in four categories:

- Infrastructure: Key Activities; Key Resources; Key Partners;
- Offering: Value Proposition;
- Customers: Customer Segments; Channels; Customer Relationships;
- Finances: Cost Structure; Revenue Streams (see Figure 14).

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[23] https://en.wikipedia.org/wiki/Business_Model_Canvas

Figure 14. Business Model Canvas template

3.7.4   Stakeholder analysis

Stakeholder analysis[24] is a systematic way to analyse stakeholders by their power/influence and interest. High power, high interest stakeholders are key players. Low power and low interest

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[24] https://www.stakeholdermap.com/stakeholder-analysis.html#edenackermann

stakeholders are least important. Once one has mapped the stakeholders he/she can focus all efforts on the highest priority groups while providing sufficient information to keep the less powerful groups happy. The figure below (Figure 15) shows an example engagement strategy based on the interest/influence stakeholder map.
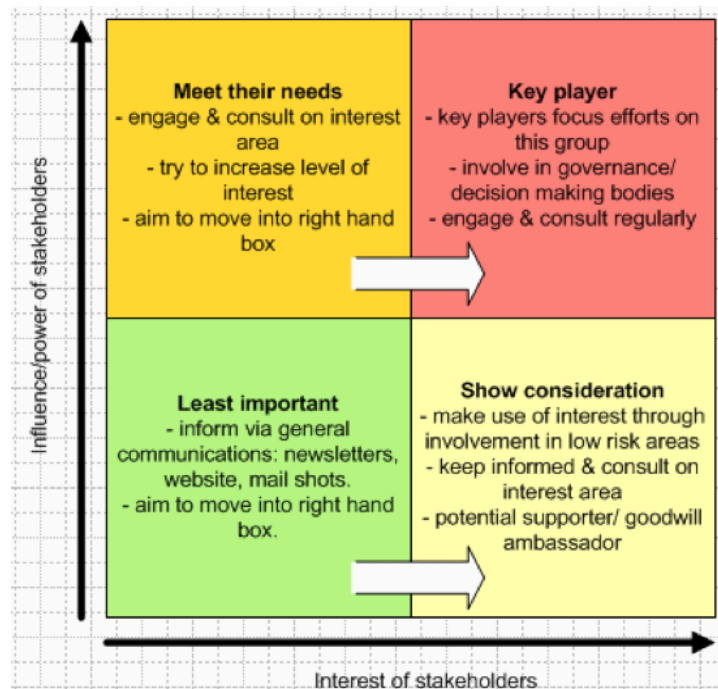
Figure 15. Stakeholders classification according to interest and influence on the project

3.7.5   User stories

One of the main characteristics of the agile methodology is that project team members do not usually have the luxury of time to document requirements extensively. There's also the imperative to gather feedback from users as early as possible in the project lifecycle, hence the preference for concise requirements known as user stories[25]. The user story is not the entire requirement but a synopsis of it. A user story can be described as a high-level statement of a requirement that does not go into excessive detail. It describes the functionality or feature that a product is expected to deliver to the user (from user perspective). Stories encourage iterative development and can be refined as many times as possible to reach agreement and understanding among stakeholders. User stories may be expressed by presenting the role, the goal or the value first. The idea of user stories is presented in Figure 16.

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[25] https://businessanalystlearnings.com/ba-techniques/2013/3/28/an-overview-of-user-stories#:~:text=A%20user%20story%20can%20be,to%20deliver%20to%20the%20user
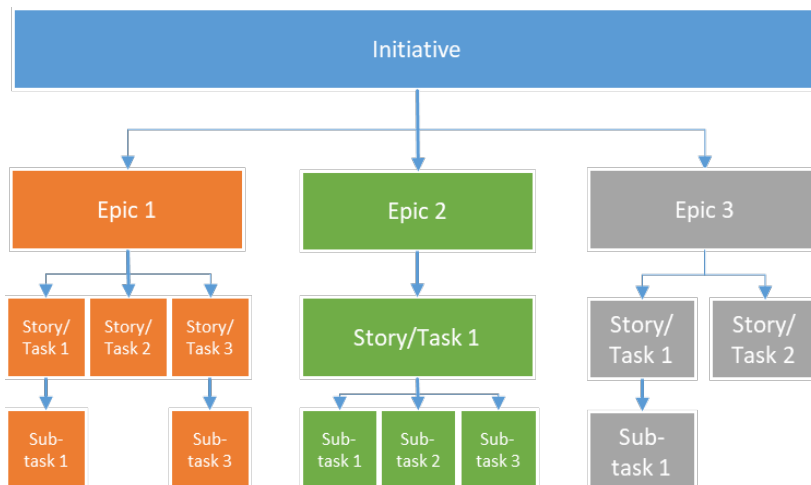
Figure 16. Idea of user stories

4 Analysis of usable products similar to the product being designed in eSticky

Ability of people living with dementia in learning and remembering how to use Assistive Technology (AT) devices is impaired. Existing products that offer reminders seem to have neglected this aspect and hence their design does not consider the type and range of cognitive impairments found with persons in this population.

The consortium partners see the novelty of the product in its design, its affordability and the lack of similar solutions. Resembling traditional sticky notes, the proposed eSticky displays are going to be affordable to the point that a person living with dementia can purchase multiple displays and stick them in different areas of his/her home. By having eSticky displays located in every room of the home, family members/caregivers can then predetermine, based on the normal daily routine of the person living with dementia, in what area of the home it will be more effective to set a reminder on the respective eSticky display. Reminders and prompts are planned to be easily set using a very simple mobile app or web portal both by carers and final users, after a very simple installation, further limiting barriers to the acquisition and set-up of the system.

Other products that can be compared with eSticky displays are summarised below. AT in the form of standalone devices can be bought off the shelf (e.g. clock, automatic pill dispenser, etc.). These products are not linked up to a larger system such as a community alarm or monitoring centre. Integrated systems on the other hand are linked, e.g. telecare can include a base unit and sensors and a monthly monitoring fee. The sensors are positioned around the home depending on needs of the user. The base unit receives a signal when a sensor has been triggered and then the monitoring centre or caregiver is notified. Procedures previously agreed with the patient's family are then followed in order to deal with a specific case.

Nevertheless, attention should be paid to the uniqueness of the solution proposed in this project. eSticky displays can lead to "Positive Health" by supporting persons with dementia abilities' to self-manage and live independently. The product proposed will be rather aimed at the Private Consumer Market and will particularly emphasise the aspect of independent living. Consequently, the buyers

would be the older adults themselves or their families and social networks. The market segmentation can specifically be defined as follows:

- Primary end-users: older adults with dementia who want to live independently in their own home.
- Secondary end-users: informal caregivers of persons with dementia such as family members and friends. Due to their reduced care needs of the primary end-users, they benefit indirectly.

Furthermore, even though eSticky is an integrated system it will be offered at a very affordable price; beating the individual cost of many of the standalone devices too. The product idea is a result of input received from the consortium end-user organisations, which point to a solution that is foremost affordable and easy to use and which can relieve family/caregiver burden. It is therefore envisaged that eSticky displays will be a useful and attractive AAL solution with high market potential.

4.1 Devices in the form of electronic displays

In this subsection four propositions of market products in the form of electronic displays are collected.

- Wand devices

Wand devices[26] (of HICS partner), a possible starting point for the development of the eSticky displays, are based on the worldwide leader mobile Android operating system and are already equipped with:

- 3G, WI-FI and Bluetooth Low Energy (BLE) standard radio communication protocols;
- Multifunction touchscreen for improving the usability of Home and Building Automation systems, environment smart functions and of Internet of Things (IoT) solutions;
- Health parameters monitoring;
- Personalized news and alert in a current world with own news feeds by category;
- Environmental monitoring unit - updated weather forecast by Wand Global Positioning System (GPS) location (indoor, outdoor);
- Front camera and ambience sensors;
- Automatic self configuration;
- Thanks to a "sniffing" algorithm, detecting all wifi devices connected to home network, interacting with Big Data obtained directly from worldwide web;

Wand line could be a hardware platform to develop the eSticky products (see Figure 17).

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[26] https://www.hicsperience.com/preorder/wand

Figure 17. Wand device

- Care.coach

Care.coach[27] is a platform for patients who can talk with an avatar, it engages and coaches patients to improve self-management of chronic conditions (see Figure 18). Conversations of a clinical nature are automated through software algorithms that implement clinical best practices, as well as reporting and alerts to stakeholders such as clinicians, caregivers, and family members.

The use of personal solutions can have a positive impact on the confidence, health and wellbeing of persons living with dementia. However, integrated systems tend to be more expensive than standalone devices, e.g. care coach will cost about $200 per month.

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[27] https://www.care.coach/

Figure 18. care.coach device

- Clocks with alarms and reminder assistance

The Day Clock[28] (Price: $74.95) clearly spells out the current time and part of the day, day of the week, date and month with no confusing abbreviations and with added alarm and reminder features. Large illuminated display can be seen from all angles and from up to 20 feet away by users with vision impairments. With 5 multi-function alarms, this is the clock of its kind to support users through wake-ups, medication reminders and appointments. Simply plug it in and Day Clock will display the time and date. Additional features: large, clear 8" Light-Emitting Diode (LED) display, adjustable brightness in day and night mode, display color - bright white or warm white alphabet and black background for maximum contrast, stand included or wall mountable. The Day Clock is presented in Figure 19.

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[28] https://www.alzstore.com/day-clock-with-reminders-p/0045.htm

Figure 19. Day Clock with alarms and reminders

- Talking Reminder Clock[29] (£69.95) is appropriate for elderly/dementia and much more (see Figure 20). It gives them structure and reassurance with 20+ reminders for regular activities like taking tablets, eating and drinking with visual and spoken prompts (e.g. take your tablets, feed your pet), time of day clock with 4 modes (e.g. 'Tuesday morning' or analogue clock), possibility to add personalised reminders via Universal Serial Bus (USB) or Secure Digital (SD) Card, adjustable stand or wall-mountable, bright back-lit screen (adjustable for day and night).

Figure 20. Talking reminder clock

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[29] https://www.techsilver.co.uk/product/talking-reminder-clock/

- My Home Helper[30] (approximate cost: £200) holds and displays information in one place with very flexible display that can be customised to suit user, includes a day/calendar clock, daily and weekly diary, photos, news headlines, appointments, instant messaging (SMS and Web), talking text and video calling (see in Figure 21). Alerts can be set to require a response. It has timed and random voice reminders and time can be set. The producer has 3 different price plans with the substriptions (monthly, quarterly, annual). If the user chooses not to renew the subscription the myhomehelper tablet will continue to work, however, the user will not be able to make any changes to it or use any of the on-line services.

Figure 21. My home helper

4.2   Watches and wristbands for seniors

There are a lot of watches and wristbands for seniors that combine different functions (see Figure 22). For example watches[31] available on the market are equipped with:

- GPS localisation – to monitor places where seniors are. In the application, one can check the exact location of the senior in real time and set own zones, such as home or clinic. After leaving the place by senior, the guardian receives immediate notification of this fact;
- SOS alarm – after using the SOS button a notification asking for help will immediately appear on the guardian's phone;
- Pulsometer – the pulse can be monitored both by the owner of the watch by wearing it on the wrist, and by the caregiver using the application;
- Medicine reminder – the carer can save reminders for seniors about the need to take medicine in a dedicated application);
- Telephone function – it makes and receives calls from 10 contacts, which the guardian saves in the application.

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[30] https://www.alzscot.org/my-home-helper and https://www.myhomehelper.co.uk/home/home.aspx

[31] https://bezpiecznarodzina.pl/zegarek-gps-dla-seniora

Simpler wristbands for seniors[32] are equipped with GPS localisation, SOS alarm, receiving calls and listening to the surroundings.

However, in addition to the price for the smartwatch itself, the device requires the activation of the package with a subscription of Subscriber Identification Module (SIM) card and a free package of minutes for calls, and unlimited data transfer. For example subscription packages for 3, 6 or 12 months are offered. It is worth noticing that the device will not work without an active package.

Figure 22. Smartwatch for seniors

4.3 Sound players

Motion Activated Sound Player – Memo Reminder[33] (£24.95): This wall-mountable motion activated sound player will play your recorded voice message when movement is detected. If by the front door, ideal for dementia wandering reminders, security alerts and more. Its key features: motion activated sound player, record own message (up to 20 secs), plays when motion detected (5m at 30°), dementia wandering reminder e.g. "Go back to bed dad, it's night time", security reminder e.g. "Remember to lock the door Anne", available with AC adaptor + wall timer. However, it does not contain any display. The motion activated sound player is presented in Figure 23.

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[32] https://bezpiecznarodzina.pl/lokalizacja-seniora/opaska-dla-seniora-sos-bs02

[33] https://www.techsilver.co.uk/product/voice-activated-sound-player/

Figure 23. Motion activated sound player

4.4 Automatic and electronic pillboxes

Automatic and electronic pillboxes[34], i.e. devices for dispensing and reminding of medicines, are also widely available on the market. Below the examples of some of them are presented:

- Point Automatic Pill Dispenser – 28-Day Portable Medication Planner and Organizer – Dispense Vitamins and Tablets Up 6 Times Per Day – Includes Flashing Light, Alarm and Safety Lock[35] (Price: $84.99): Each slot has room for about 18 tablets, at each pre-set time, the dispenser turns and releases the appointed slot's contents, the dispenser can be locked at all times to prevent accidental overdose in forgetful patients or young children, a customizable alarm rings and a red light flashes each time medication needs to be taken, the alerts are set to ring and flash for 30 minutes or until the dispenser is turned over to release contents (Figure 24).

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[34] https://www.amazon.com/s?k=timmer+pill+box

[35] https://www.amazon.com/VitaWorks-Automatic-Pill-Dispenser-Medication/dp/B07RY3WVLG/ref=sr_1_2?dchild=1&keywords=timer+pill+box&qid=1590048746&sr=8-2

Figure 24. Automatic pill dyspenser

- Weekly Pill Cases Organizers with Timer Reminder Pill Organizer 2 Times a Day Detachable Pill Box 7 Days AM PM Pill Container[36] ($17.99): One can set the time, the alarm reminds to take medicine, the medicine box can be separately disassembled and can be carried in a pocket for easy carrying, one color per day, clearly marked the date (Figure 25).

Figure 25. Weekly pill organizer with timer

- TabTime Timer, Electronic Pill Reminder with 8 Alarms per Day, Essential for Parkinson's Patients[37] ($29.99): Eight independently set alarms go off at the same time every day, set once and they go off until the battery needs to be replaced, pocket sized, simple to set up - just three buttons (Figure 26).

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[36] https://www.amazon.com/Organizers-Reminder-Organizer-Detachable-Container/dp/B07V6DSNP3/ref=sr_1_4?dchild=1&keywords=timer+pill+box&qid=1590048746&sr=8-4

[37] https://www.amazon.com/Deaco-Medicine-Reminder-Alarms-Without/dp/B00HLO981U/ref=sr_1_5?dchild=1&keywords=timer+pill+box&qid=1590048746&sr=8-5

Figure 26. Electronic pill reminder with alarms

- Automatic Pill Dispenser & Medication Reminder/Family Text/Email Alerts[38] (£199.95): This smart pill dispenser gives the correct medication at the right time (set by the user) and sends text/email alerts if pills are not taken (see Figure 27). It includes audio & visual reminders to take meds (ideal for dementia), set dosages/alerts from anywhere (free online portal), dispenses correct quantity of meds at pre-set times, up to 24 medication dispenses/reminders per day, 28 pill storage, self-locking shutter (helps prevent overdose).

Figure 27. Automatic pill dispenser and reminder with alerts

However, such reminders and pill dispensers have only one function regarding the need to take medicines at specific times and in specific doses.

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[38] https://www.techsilver.co.uk/product/pill-dispenser-reminder/

4.5 Applications for tablets and smartphones

There are a lot of Apps for dementia patients and carers[39]. Particularly interesting among them seem to be the following ones:

- Dementia Digital Diary[40]: A live clock and diary that is remotely configurable. The app tells the time and also lets the user know whether it is morning, afternoon, evening, or night rather than focusing on minutes and seconds etc. Dementia Diary will also clearly display the next three calendar events for the user, and can be updated remotely, provided the device is connected to the internet. It is available for free on Android.

- Dementia Clock[41]: Designed to be installed onto an unused tablet to act as a clock. The Dementia Clock uses visual cues to let the user know what time of day it is. Remaining time-oriented can help a dementia patient to maintain their independence, remember when to eat, and also let them know when it is night time as a cue that they should go to bed soon. It is available for free on Android.

- MediSafe Meds & Pills Reminder[42]: People with dementia will typically have problems with short term memory and may forget to take their regular medication. This app will alert them when it's time to take their various types of medication, and also when it's time to reorder a prescription. It is available for free on Android and iPhone operating system (iOS).

- MyTherapy[43]: It offers peace of mind to dementia patients and their families. It features reliable medication reminders, as well as comprehensive tracking of blood pressure, blood glucose etc in easy to use charts. Many doctors also use the MyTherapy app's built-in reports to better understand their patients' progress. The app has been scientifically proven in its effectiveness by Europe's largest university hospital, Charité Berlin. Additionally, family and friends can receive notifications for missed medication! It is available for free on Android and iOS.

- It's done![44]: This app helps instantly recall completion of routine tasks whenever one can't remember whether or not he/she did them earlier. When that uneasy thought occurs, "Did I remember to…?", "It's Done" helps one confidently confirms the task is done. No need to check or re-check. Unlike calendar and task apps that nag one to do things, "It's Done" simply confirms completion of routine tasks. It eliminates the feeling of uncertainty. It is ideal for those suffer with short-term memory loss due to brain injury, dementia, post-traumatic stress disorder (PTSD), or other related medical conditions. "It's Done" app can even notify others by text or email that a task is done. It has handy reminder alarms for time-sensitive tasks (e.g. take medicine at 9 A.M., etc.).

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[39] https://www.uksmobility.co.uk/blog/2016/07/25-useful-apps-for-dementia-patients-and-carers/

[40] https://play.google.com/store/apps/details?id=com.fashmel.alzclock

[41] https://play.google.com/store/apps/details?id=com.wearingthegreen.pc.otdementiaclock

[42] https://play.google.com/store/apps/details?id=com.medisafe.android.client

[43] https://play.google.com/store/apps/details?id=eu.smartpatient.mytherapy

[44] https://play.google.com/store/apps/details?id=com.ajlesterassoc.itsdone

4.6 Other market products

The other products in the market (UK website)[45] include the following solutions:

- Prompt and reminder devices offer memory prompts and reminders through visual, verbal or audible cues. Prices range from below €80 for the simplest product to over €1000 for the most complex.
- Medication reminder and dispenser devices help people in remembering to take their tablets. They range from simple flip lid pill boxes labelled with the day of the week and time of day, to automatic pill reminders and dispensers which give an audible and visual alert when it is time to take a tablet. A vibrating device is available for users with hearing or visual impairment and price ranges from €12-€45. The more advanced devices can have costs in the €200 range.
- Item locator devices are used to locate commonly mislaid items in the home such as keys, wallets, glasses cases etc. These devices generally work within a 60-100 foot indoor area and price ranges from €20-€70.
- Date and time devices offer support to people who have difficulties keeping track of the day or time, ranging from large wall mounted clock calendars which show the day, date and time, to electronic calendars that show the same information digitally. These products range in price from €20 to €120.
- Voice recorders and memo minders are used to support people with difficulties in remembering to carry out tasks. Short verbal messages (usually up to 20 seconds) can be recorded with memo minders and be placed at a suitable location. As the person walks past the device a sensor will recognise this and play the message. On some, you can even set reminders with the included timer device function. These products range in price from €5 to €130.
- Signs, notices and other environmental aids are simple visual devices to aid memory prompts, such as signs or labels that can be placed on doors, notice boards, or wipe boards for pinning or writing reminders and messages. These products range in price from €3 to €180.
- Activity assessment and planning devices and apps support people who have difficulties in organising their thinking processes in order to do every day personal care and leisure activities (e.g. online tool for assessing cognitive ability level from which automatic guidance will be produced). These products range in price from €3 to €12.

4.7 Conclusions from the analysis of usable market products

As was described in T2.2 of the Description of Work (DoW) user requirements will be inferred by careful analysis of usable products similar to the product being designed. The goal of the user-centered design in eSticky is to make products which have very high usability. This includes how convenient the product is in terms of its usage, manageability, effectiveness and how well the product is mapped to the user requirements. From above analysis of usable market products the following conclusions and advices for the design of eSticky product can be summarized:

- The device design must be as simple as possible (older people are afraid of technologically advanced solutions that are often proposed on the market);

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[45] https://www.atdementia.org.uk/productCategory.asp?cat_id=1 or https://asksara.livingmadeeasy.org.uk/

- There are many devices on the market with various technological advancement and a range of prices. eSticky must be a cheap product to encourage customers to buy;
- There are many electronic solutions on the market, based on displays and not only, but none of the identified ones offer a solution that is used by people of different ages and health condition - based on traditional sticky notes in a modern setting;
- Reminder displays offered on the market are quite expensive and usually an elderly person can afford to buy a single device that he/she places in one room of home. The goal of eSticky is to enable the future user to buy such a number of cheap displays that he/she can place in different parts of his home;
- Many devices available on the market require the purchase of additional subscription packages for a given time to configure and manage the services of these systems, which scares users away. In eSticky, it is planned to design a simple mobile application or configuration using a web portal, which will be possible both for primary users and their caregivers/family.
- Display notifications must be large and legible;
- In countries where older people do not yet use so often technology to communicate, talking to virtual avatars can be something strange and embarrassing;
- Texts and notifications on the display must be visible from different angles and from a long distance. It should also be taken into account that older people usually have vision defects, so the messages must be very legible;
- Voice alarms must also be loud with the ability to tune the volume on the device, since the elderly also have worsening hearing impairment;
- Prevent the device from discharging, if necessary notify it loudly and in advance;
- The largest possible display with automatic adjustable brightness during the day and at night;
- Ensuring adequate display contrast and compliance with accessibility requirements (as noted in this report);
- Attached stand or allowing simple wall mounting;
- The ability to respond to displayed alerts so that confirmation by the user is required;
- Configurable sound and visual alerts with clear, conspicuous colors and buttons;
- Simple to configure and simple menu - as few buttons as possible;
- The ability to set notifications and alerts from anywhere;
- Informing the user whether it is morning, afternoon, evening or night for his full orientation;
- It would also be useful to notify not only when it is time to take different types of medication, but also when it is time to reorder a prescription;
- Noting and storing history that the activities have been confirmed by the user;
- A vibrating device for people with vision and/or hearing impairment;
- Short verbal messages (usually up to 20 seconds).

It should be noted that the final features and functionalities will evolve over the course of the project. The purpose of this analysis is to show what competitive solutions are currently available on the market and what values would be worth implementing in the eSticky system. The current market of solutions for seniors and people with memory problems is saturated with a variety of products. eSticky displays have a chance to stand out on the market thanks to the simplicity of

construction, aesthetic form and affordability for users in the countries of the project partners and beyond them.

5   Requirements for preparing documents and templates in eSticky

All information documents and sheets in the countries of end-user partners (in Poland and Austria) must be developed in national languages. The consortium partners plan to use various sheets according to the project phase. Below, the preferences and requirements for the documentation being developed, depending on the type of user and target group to which the project information is to be dedicated, are presented:

- Primary users – information understandable to all, easy-to-read language;
- Secondary users – information understandable for them, easy-to-read language connected to their role in the project and as the guardian of primary users - describing the role of information for primary users;
- Tertiary users – detailed information with methodology, purposes and expected effects focused on user needs and demands;
- Other users – detailed information focused on the area of expertise of these users, different for various specialisations, e.g. for business members, policy makers, tech product vendors, telecare service providers, etc.

Documents and templates designed for users should include the following information:

- Project name and purpose;
- Decription of the consortium and researchers;
- Information about project funding;
- Description of devices and services that are planned to be created in the project;
- Decription of target groups and further customers;
- Purpose of end user participation;
- Privacy and data management in the project;
- Benefits and risks for users;
- Contact information.

Currently, at the time of writing this report, the project phase is still very early and the architecture of the eSticky system is being developed. However, Appendix 1 is tempted to develop preliminary materials for the first consultations and working groups with users in the project.

The project also developed the first sheets and templates for use during system testing phases with users. The following are the forms that have been prepared to date (their final shape may evolve as the project progresses and the partners' knowledge of the system being developed):

- Declaration of consent to participate in a study with a project decription – described in D2.1 *Report on user requirements and needs*;
- Questionnaire for primary users – described in D2.1 *Report on user requirements and needs*;
- Questionnaire for secondary users – described in D2.1 *Report on user requirements and needs*;
- Questionnaire for tertiary users – described in D2.1 *Report on user requirements and needs*;

- Observation sheet to be used during testing prototypes by the users – the template placed in Appendix 2 of this report;
- System usability scale template based on the System Usability Scale (SUS)[46], which was developed by John Brooke while working at Digital Equipment Corporation, 1986. The template of SUS for eSticky is placed in Appendix 3 of this report;
- User evaluation of satisfaction based on Quebec User Evaluation of Satisfaction with Assistive Technology QUEST (Version 2.0)[47] – the template of this user satisfaction survey to be used in eSticky project is available in Appendix 4.

6 Summary and Conclusions

This report contains the first suggestions for methods and tools to be used in user involvement for determining requirements and testing the eSticky system. Proposals for various methods involving users in designing process were included, as well as proposals for business tools for analyzing whether users would be willing to pay for an eSticky device. The analysis of competitive products was carried out and the first conclusions from the market of electronic solutions for seniors with memory problems were also presented. Moreover, the report includes the first, preliminary materials for consultation and working groups with users at various stages of the project, as well as sheet templates for use with users and general guidelines for preparing documents/templates in the eSticky project.

In order to ensure the efficiency and usability of working with users in the eSticky project, various standards and guidelines will be taken into account, including ISO, Universal Design or Design for All, privacy, confidentiality and accessibility issues. To provide a mobile device with a simple user interface, W3C, WCAG and Mobile Web Best Practices standards are also included.

The importance of the methods and tools involving the user is all the greater because the project has various stages planned, taking into account the initial considerations and activities involving users, co-creation approaches and the appropriate phases of testing the initial prototypes of the eSticky device.

This report has a planning role and guides which methods and tools can be useful in the user engagement activities, in which the user is at the center of the design process of the new eSticky product.

7 Appendices

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[46] http://measuringux.com/SUS.pdf

[47] https://www.midss.org/sites/default/files/questeng.scoring_sheetpdf_0.pdf

Co-creation sessions for end users in eSticky project

The project eSticky aal-2019-6-179-CP has received funding under the AAL Joint Programme funded by the European Union

Introduction to eSticky

- Brief overview of the project and consortium
- Role and planned contribution of users to the project
- Project information sheet and consent form

Brief overview of the project and consortium

- Title: Electronic Sticky Notes for Dementia Care (eSticky)
- Duration: 04.2020 – 09.2022 (30M)
- Consortium:

  1) HICS s.r.l. – Italy (coordinator),
  2) Kompetenznetzwerk KI-I – Austria,
  3) University of Cyprus – Cyprus,
  4) Harpo Sp. z o.o. – Poland,
  5) Assistenz24 GmbH – Austria,
  6) Werner Daxberger – Austria,
  7) Gerd Rosenauer – Austria

Brief overview of the project
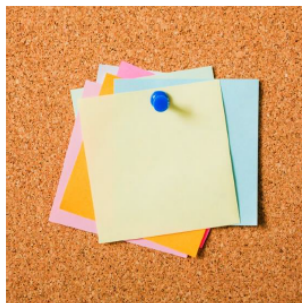
Traditional sticky notes

TAKE YOUR PILLS
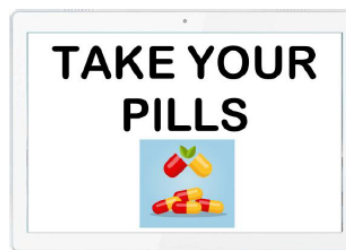
Electronic sticky notes (eSticky)

Brief overview of the project

The reminder is shown on the display.
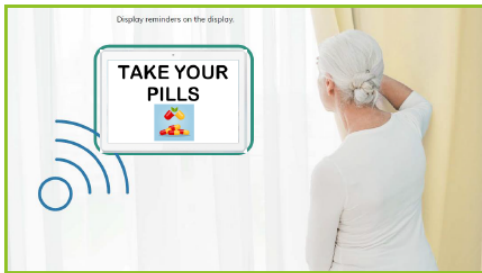
The user confirms that the action has been carried out.
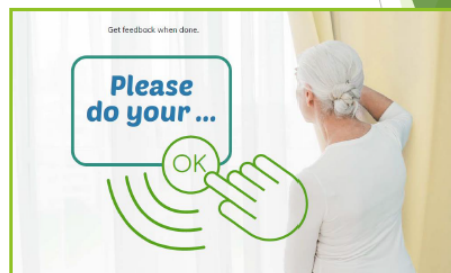
Role and planned contribution of users to the project

- **Primary users**: older adults with age-related oblivion, people with beginning stages of dementia and people with beginning Alzheimer's disease (early or medium state)

- **Secondary users**: family members and informal caregivers

- **Tertiary users**: care organizations (care centers offering 24/7 assistance, hospitals, clinics, retirement homes, nursery homes) and formal staff (healthcare professionals)

How we would like to work with you – 1st phase

We would like to know who you are.	What are your problems and limitations?	What IT skills do you have?	What will you use the product for?	What restrictions may you face?

How we would like to work with you – 1st phase

Have a drink of water
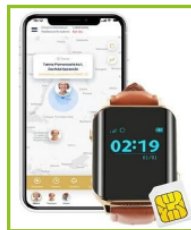
How we would like to work with you – 1st phase

| Which new products will be good to have? | How to make a product easier to use? | How to make a product more useful and effective? |

How we would like to work with you – 1st phase

- Understand the problem
- Involve in your environment
- Generate ideas (brainstorming)

Questionnaire for users

How we would like to work with you – 2nd phase

- Demonstration of mock-up or prototype
- Observing you in using the protype
- Exchange of questions, doubts and explanation of difficulties
- Checking how long it takes you to complete tasks
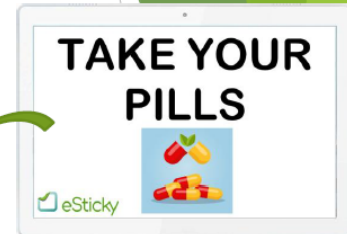
How we would like to work with you – 2nd phase

Observation sheet – we would observe and note how you deal with our system

Project information sheet and consent form

References

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- https://www.amazon.com/VitaWorks-Automatic-Pill-Dispenser-Medication/dp/B07RY3WVLG/ref=sr_1_2?dchild=1&keywords=timer+pill+box&qid=15900487468

- https://www.amazon.com/Organizers-Reminder-Organizer-Detachable-Container/dp/B07V6DSNP3/ref=sr_1_4?dchild=1&keywords=timer+pill+box&qid=15900

7.2 Appendix 2 – Observation sheet for prototype testing

Observation sheet – eSticky

eSticky system phase of evaluation:

....

Visit number: ....

Country/place: ....   Date: ....

Name/code of participant: ....

Observations:

....

....

....

....

....

....

....

....

7.3 Appendix 3 – System usability scale template

eSticky

System usability scale (SUS)[1] – eSticky

Participant: .... Country/Place: .... Date: ....

For each of the following statements mark **one** box that best describes your reactions to the eSticky system today.

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	1	2	3	4	5
2. I found the system unnecessarily complex	1	2	3	4	5
3. I thought the system was easy to use	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	1	2	3	4	5
5. I found the various functions in this system were well integrated	1	2	3	4	5
6. I thought there was too much inconsistency in this system	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly	1	2	3	4	5
8. I found the system very cumbersome to use	1	2	3	4	5
9. I felt very confident using the system	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	1	2	3	4	5

[1] This questionnaire is based on the System Usability Scale (SUS), which was developed by John Brooke while working at Digital Equipment Corporation. © Digital Equipment Corporation, 1986.

7.4 Appendix 4 – User evaluation of satisfaction template

eSticky

Quebec User Evaluation of Satisfaction with Assistive Technology

(QUEST 2.0)[1] – eSticky

Participant: .... Country/Place: .... Date: ....

The purpose of the QUEST questionnaire is to evaluate how satisfied you are with your assistive device and the related services you experienced. The questionnaire consists of 12 satisfaction items.

- For each of the 12 items, rate your satisfaction with your assistive device and the related services you experienced by using the following scale of 1 to 5.

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

- Please circle or mark the one number that best describes your degree of satisfaction with each of the 12 items.
- Please do not leave any question unanswered.
- For any item that you were not „very satisfied", please comment in the section Comments.

Thank you for comleting the QUEST questionnaire.

[1] L. Demers, R. Weiss-Lambrou & B. Ska, 2000

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eSticky
ASSISTIVE DEVICE

How satisfied are you with,

1. the **dimensions** (size, height, length, width) of your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

2. the **weight** of your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

3. the **ease in adjusting** (fixing, fastening) the parts of your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

4. how **safe and secure** your assistive device is?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

5. the **durability** (endurance, resistance to wear) of your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

6. how **easy** it is to use your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

7. how **comfortable** your assistive device is?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

8. how effective your assistive device is (the degree to which your device meets your needs)?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

SERVICES

How satisfied are you with,

9. the service delivery program (procedures, length of time) in which you obtained your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

10. the repairs and servicing (maintenance) provided for your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

11. the quality of the professional services (information, attention) you received for using your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

12. the follow-up services (continuing support services) received for your assistive device?

1	2	3	4	5
not satisfied at all	not very satisfied	more or less satisfied	quite satisfied	very satisfied

Comments:

Below is the list of the same 12 satisfaction items. **PLEASE SELECT THE THREE ITEMS** that you consider to be the **most important** to you. Please put an X in the 3 boxes of your choice.

☐ 1. Dimensions   ☐ 7. Comfort
☐ 2. Weight   ☐ 8. Effectiveness
☐ 3. Adjustments   ☐ 9. Service delivery
☐ 4. Safety   ☐ 10. Repairs/servicing
☐ 5. Durability   ☐ 11. Professional service
☐ 6. Easy to use   ☐ 12. Follow-up services

![eSticky]

QUEST – Scoring sheet

This page is for scoring the answers to your questions.

DO NOT WRITE ON THIS PAGE.

- Number of non-valid responses _____ ....

- Device subscale score _____ ....

  For items 1 to 8, add the ratings of the valid responses and divide this sum by the number of valid items in this scale.

- Services subscale score _____ ....

  For items 9 to 12, add the ratings of the valid responses and divide this sum by the number of valid items in this scale.

- Total QUEST score _____ ....

  For items 1 to 12, add the ratings of the valid responses and divide this sum by the number of valid items.

- The 3 most important satisfaction items:

  ....

  ....

  ....