FOSTERING SOCIAL INTERACTION OF HOME-BOUND AND LESS EDUCATED ELDERLY PEOPLE

User Centred Design for EASYREACH

Deliverable No.		**D1.1**	
Work Package No.	**WP1**	Workpackage Title	**User Study & Architectural Design**
Authors (per company, if more than one company provide it together)		**L. Albani and G. Lombardi (FIMI)**	
Status (F: final; D: draft; RD: revised draft):		**F**	
File Name:		**EASYREACH Deliverable D1.1- v. 1.doc**	
Project start date and duration		**01 November 2010, 28 Months**	

Table of contents

DOCUMENT HISTORY

Version	Date	Comments	Author
1.0	15 February 2011	Creation of the document	FIMI (L. Albani, G. Lombardi)
1	June 11, 2011	Final release – vers. 1	FIMI (L. Albani, G. Lombardi)

List of abbreviations

AAL	Ambient Assisted Living
AAL JP	AAL Joint Program
AMI	Ambient Intelligence
CMU	Central Management Unit
EPAF	EasyReach Participatory Analysis Framework
GHTF	Global Harmonization Task Force
GT	Grounded Theory
GUI	Graphic User Interface
HCI	Human Computer Interaction
JP	Joint Program
PA	Participatory Analysis
PD	Participatory Design
PICTIVE	Plastic Interface for Collaborative Technology Initiatives through Video Exploration
PU	Public (referred to the dissemination level of a document)
QoL	Qualify of Life
S&T	Scientific & Technological
TAF	Task Analysis methodology
TG	Topic Guide
UCD	User Centred Design
UI	User Interface
UPA	Usability Professionals' Association
USID	User Sensitive Inclusive Design
WP	Work Package

EXECUTIVE SUMMARY

The objective of this deliverable *D1.1 "User-Centred Design in EASYREACH"* is to describe the approach the Project will follow for the involvement of the users in the different phases of the project, including validation of the final solution.
User centred design seeks to place the user at the forefront of the design effort and as the main source of information.

The rationale for the need of following a User Centred Design (UCD) methodology in EASYREACH project is explained together with the need to adapt the available methodologies (e.g. Participatory Design) to the specificity of the users addressed by EASYREACH i.e. the older adults.

The active participation of the users to the project will allow a deep analysis and understanding of their requirements and to design effective solutions in line with their needs and desires and to bridge the gap between the experiences of the developers and those of the population they are designing for.

The user-centred design approach followed by EASYREACH is intended to foster the acceptance of the proposed solutions by the final users through the intuitiveness and ease-of-use of the developed solutions and the awareness of the resulting benefits.
The most critical phase in the UCD process is represented by the gathering of the user requirements.
In EASYREACH we will employ a "modified approach" of the Participatory Analysis methodology, specifically devoted to the older users and incorporating aspects of established techniques to participatory design such as USID (User Sensitive Inclusive Design), TAF (Task Analysis methodology) and PICTIVE (Plastic Interface for Collaborative Technology Initiatives through Video Exploration).

The EasyReach Participatory Analysis Framework (EPAF) will be developed through three steps:

- Step 1: Working with older users – Recruitment and Preparatory phase,
- Step 2: Information gathering process through the generation of scenarios,
- Step 3: Deeper understanding of the requirements through the use of a low-fidelity prototyping process.

The sequential application of them comprises the user need analysis (Easyreach Participatory Analysis Framework – EPAF).

Step 1

Step 1 deals with how to effectively recruit older users along with general principles for conducting meetings with older users.

Step 2

Step 2 deals with early focus group activities; it is based on the Task Analysis Framework and the primary aim is to construct current positive or best case and negative or worst case scenarios to be presented to the meetings participants before moving on to analyse why these scenarios are the way they are. Using this insight into why things might be good or bad, the project then moves on to look at how these issues might be improved and it is from this examination that potentially useful new features for systems are generated. Finally, meetings move on to look at how these new features might become hindrances rather than benefits for the participants.

Meetings are audio recorded and transcribed, the transcript is analysed alongside the meeting facilitators' notes in order to generate a list of requirements and obligations which designers need to fulfil to satisfy participants. Analysis is performed under the Grounded Theory (GT) approach. It can then be used to generate the Topic Guide (TG) for the Step 3.

Step 3

In Step 3 participants are invited to take part in physical prototyping work, this may be using "paper" or it may involve "Plastic prototyping using low fidelity materials". The sessions follow the Topic Guide (TG) constructed in Step 2 and generate specific requirements in terms of features and functionality. Also in this case the analysis is conducted under Grounded Theory. Although in this instance, the methodology has to deal with video analysis and physical artefacts, the output is still a refined list of requirements. Requirements generated at this stage are typically more specific than those generated in Step 2.

After the development stage, the users will be involved again in the Usability Tests aiming at assessing their acceptance of the proposed solutions.
Usability tests will involve not only the users but also a group of experts.
With regard to the older adults, two models of Usability Questionnaires are presented.

Finally in the Annexes of this document we consider the standards framework relevant for Usability and we provide guidelines for the generation of scenarios to be used in the Step 2.

1. Introduction

According to the ISO 9241 part 11, the following definition applies to ***USABILITY:***
"Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use (it is extremely important to design and devise the user-centric process based on an in-depth, clear-cut understanding of the context of use and the expected nature of user).
Usability is the study of the ease with which people can employ a particular tool or other human-made object in order to achieve a particular goal."

According to ISO/IEC 9126 Usability is "a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users. These attributes include:

- *Understandability*
- *Learnability*
- *Operability*
- *Attractiveness*
- *Usability Compliance."*

1.1 Rationale for the user-centred approach in EASYREACH

EASYREACH intends to develop an innovative and sustainable ICT solution to allow elderly and less educated people to participate in the benefits of IT-based social interactions. The project will build a system that supports many styles of social interaction between users and will employ very simple and familiar devices: a TV set, a set-top box and a remote control resembling a small TV remote but capable of capturing user's gestures and of taking pictures.

Fig.1 - The HW components of EASYREACH

The users of the EASYREACH system are the older adults and – as secondary users - the family members, the informal caregivers and the overall community.

In order to achieve the EASYREACH objectives, we will perform a deep analysis of the requirements of all the involved stakeholders.
The user-centred design approach followed by EASYREACH will foster the acceptance of the final users through the intuitiveness and ease-of-use of the developed solutions and the awareness of the resulting benefits. User centred design seeks to place the user at the forefront of the design effort.
The users of the EASYREACH system are the older adults and – as secondary users - the family members, the informal caregivers and the overall community.

We aim to achieve the user satisfaction on the basis of the "quality" of the system's use with respect to the promised interface and functionalities. Elements of the user satisfaction we will address include:

- ease and comfort in the use;
- functional completeness (with respect to users' expectations and in comparison with similar products);
- quality and clarity of the GUI.

The UCD guidelines herein extend their applicability to the whole Product Creation and Design cycle and cover :

- User and Stakeholders Groups profile identification,
- User Requirements extractions,
- product development,
- realization of pilot plans and verification activities.

There exist a variety of user-centred design process models; in general, all of them follow the standard ISO 9241-210:2010 *"Ergonomics of human-system interaction - Part 210: Human-centred design for interactive systems"* which provides requirements and recommendations for human-centred design principles and activities throughout the life cycle of computer-based interactive systems. It is concerned with ways in which both hardware and software components of interactive systems can enhance human–system interaction.
This standard reviews the older ISO 13407: 1999 "*Human-centred design processes for interactive systems"*, which defined a general process for including human-centred activities throughout a development life-cycle, but does not specify exact methods.

In EASYREACH we will take into account also the recommendations of the Usability Professionals' Association (UPA) that promotes usability concepts and techniques worldwide. We will accommodate and customize each of the activities proposed by UPA for UCD to the specific EASYREACH project tasks, results, deliverables (including not only technical results but also business goals according to market analysis and exploitation plans).

Active participation of real users in all the phases of the development and validation processes of the project will be of paramount importance to achieve end user satisfaction with the developed products.

The EASYREACH UCD methodology represents a set of recommendations for the inclusion of older in the design process. Which recommendations to apply is at the discretion of the design teams themselves and a number of factors may have a bearing on this, including the profile of intended users, accessibility to participants, the technical context of the application and the intended participatory design process to be employed.

1.2 Designing ICT for Older People

It is recognized that the development of ICT for older people is quite different from the development of traditional systems for the younger target population. For this reason EASYREACH has explicitly selected Participatory Design (PD) as the approach to be adopted. The goal is that through closer involvement of users, developers and designers will get a deep understanding of the particular concerns and needs of older people, in terms of the contexts in which the applications will be deployed, their general disposition and their previous experience of ICT.

There is a wide range of factors that make developing technology for older people distinct from traditional development. Most importantly these include taking account of the wide variation in cognitive abilities (which diverge with increasing age profile), a generally cautious outlook with which older people view technology (and ICT in particular), and the gulf between the experiences of the developers and those of the population they are designing for.

.

It is essential that the approach followed for the extraction of the user requirements bridges this gulf of experience and is flexible and open enough to capture the full range of needs and concerns that older users are likely to experience.

Many approaches and methodologies are being adopted to facilitate Participatory Design; nevertheless we notice that literature related to participatory design for older users is not substantial.

2. User Centred Design (UCD)

2.1 A general overview

User-centred design approach puts the intended users of a system at the centre of its design and development. The users are involved at key points to make sure the system achieves their requirements.
It's very important that participants reflect the profile of the actual users of the system because UCD addresses questions about users and their tasks and goals, and then will use the findings to make decisions about development and design.
Some of the questions a design should answer are:

- Who are the users of the system?
- What are the users' tasks and goals?
- What are the users' experience levels with system like this, and with technology?
- What functions do the users need from the system?
- What information might the users need and in what form do they need it?
- How do users think the system should work?

In a UCD approach it is typical to follow an iterative process, until the usability goals of the project are reached.

The ISO 13407 standard (revised by the new ISO 9241-210:2010) provides guidance on achieving quality in use by incorporating user centred design activities throughout the life cycle of computer based system. User centred design should be a multidisciplinary activity, which incorporates human factors and ergonomics knowledge and techniques to enhance effectiveness and productivity by improving human working conditions and counteracting the possible adverse effects of use on human health, safety and performance.
The Fig. 2 shows the various user-centred activities.

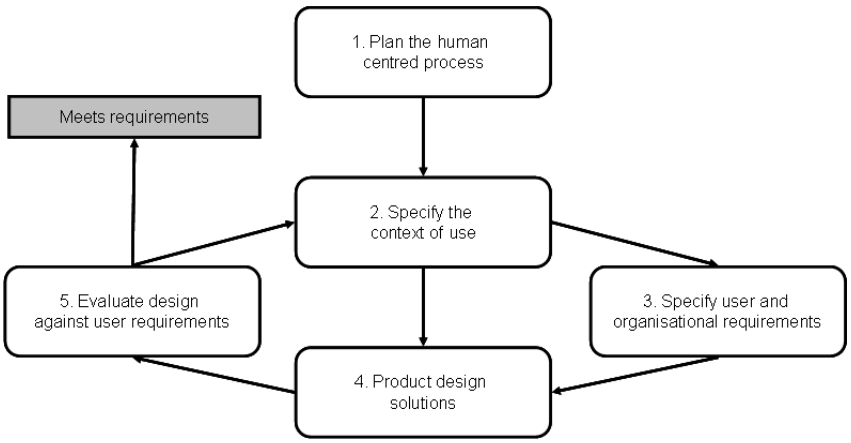

Fig.2 - Interdependence of user centred activities

Here below a short explanation for each block:

Plan the human centred process
Obtain commitment to employ user-centred design philosophy in the development process. That means that project will have time and tasks for involve user in requirements elicitation, testing and other technical aspects where they are needed.

Specify the context of use
The details of the context will guide early decisions and provide a basis for specifying the context in which usability should be evaluated.
These are some of the characteristics to be known about context:

- The characteristics of intended users,
- The tasks that users will perform,
- A breakdown of the global task,
- Goals of the system for each type of user and characteristics of tasks which may have influence on usability (frequency, duration),
- Allocation of activities between the human and technological resources,
- Environment of use,
- Define minimal and optimal system requirements,
- Define also relevant characteristics of the physical and social environment.

Specify the user and organisational requirements

This task will create an explicit statement of user and organisational requirements, connected to the context. Characteristics to take into account:

- Quality of human-computer interface,
- Quality and content of the tasks,
- Task performance, including the transparency of the application to the user,
- Effective cooperation and communication between different categories of users and other relevant parties,
- Performance of the system against operational and financial objectives.

For each class of user we need to consider the following objectives (see ISO 9241 part 11):

- Efficiency: Criteria to determine the attain of a minimum level of effective performance
- Effectiveness: Criteria to determine the success or failure of task performance
- Satisfaction: Criteria by which the users may be judged to have interacted with the system to their internal degree of sufficiency (normally subjective)

By many experts requirements elicitation and analysis are considered a crucial step of a system development.

Produce design solutions
Create potential design solutions. We can use the state of the art and the experience and knowledge of the participants. The anatomy of the process is:

- Use existing knowledge and develop a solution,
- Elaborate a more specific design,
- Show prototype to users and observe users performing specified tasks,
- Use feedback to improve design,
- Iterate the process until it meets the objectives.

Evaluate designs against user requirements
Evaluations are very important activities in user-centred design. The results will be meaningful as the context in which the system has been tested is equivalent to the context of the real use (in other words, avoid unrealistic contexts).

2.2 UCD methods

Various UCD methods have been proposed; here below some of the most popular ones are listed:

Method	Cost	Output	Sample size	When to use
Focus groups	Low	Non-statistical	Low	Requirements gathering
Usability testing	High	Statistical & non-statistical	Low	Design & evaluation
Card Sorting	High	Statistical	High	Design
Questionnaires	Low	Statistical	High	Requirements gathering & evaluation
Interviews	High	Non-statistical	Low	Requirements gathering & evaluation
Heuristic evaluation	Low	Non-statistical	Assessment by experts	Evaluation
Parallel Design	High	Non-statistical	Low	Design
Task Analysis	Low	Non-statistical	Low	Requirements gathering
Use Cases / Scenarios	Medium	non-statistical	Low	Requirements gathering and Design

Table 1 – UCD methods

Focus groups
In Focus Groups the users of a system share ideas, feelings, thoughts,… on a certain subject Focus Groups are mainly used as an input to design. They generally produce non-statistical data and are a good means of getting information about a specific domain.

The effectiveness of the Focus Groups is depending on the experience of the moderator and analyst.

Usability testing
In Usability Testing the system is evaluated collecting data from people using it. While the user works with the system, someone takes notes about the difficulties the user encounters with (It's also interesting to know what he is trying to do and the reason why, the time spent in tasks completion, etc. …).
This method is a good way to find out usability problems of a system. It can be used as an input to design or at the end of a project.

Obviously usability testing requires some form of design to be available to test (also if it is made on paper)

Card sorting
Card sorting is a method for suggesting intuitive structures/categories. A participant is presented with an unsorted pack of index cards. Each card has a statement written on it that relates to a component of the system.
The participant will have to sort cards into groups and then to name these groups. The results of multiple individual sorts are then combined and analysed statistically.
It's used when there is a need for some type of categorization. Card sorting is usually used as an input to design.
This method generates statistical data.
The user may need a little training before execute this activity.

Questionnaires
With the use of questionnaires the users answer to a predefined set of questions. The result of this activity provides statistical data.
Questionnaires are used when designers can only gain remote access to users of a system and when the targeted sample size is larger than it can be realistically achieved through direct contact
Questionnaires allow statistical analysis of results. It is very important that the questionnaire is well-designed and asks non-biased questions.

Interviews
An interview usually involves one interviewer speaking to one participant at a time.
With this method the participants' unique point of view can be explored in detail. An advantage is that misunderstandings between the interviewer and the participant are likely to be quickly identified and addressed.
The reports of interviews must be carefully analysed by experienced practitioners.
Interviews are used early in the design process because they are good to gain a more detailed understanding of a domain/area of activity or specific requirements.
The effectiveness of the method depends on the experience of the interviewer and analyst.
Group interviews are possible too.

Heuristic evaluation is a method in which one or more reviewers – preferably experts – assess a product according to a list of design principles (commonly referred to as heuristics) and list where the product does not follow those principles.

Parallel design is a technique where multiple designers create mock-ups of the user interface and the best aspects of each design are used in the final design.

Task analysis is a method that involves learning about users' goal and understanding the tasks that users will perform on the product.

Use Cases include a description of how users will use a particular feature of the system. Use cases provide a very detailed look at how users interact with the product including the steps a user will take to accomplish each task.

All these methods can help improve the usability of devices/solutions. The following table organizes usability methods according to where they take place in the three steps of the user-centered design process (Analysis, Design, Testing).

	Analysis of the requirements	Design	Testing
Card Sorting	✓	✓	✓
Interviews	✓		
Focus Groups	✓	✓	
Heuristic Evaluation	✓		✓
Parallel Design		✓	
Prototyping		✓	✓
Surveys / Questionnaires	✓	✓	✓
Task Analysis	✓		
Usability Testing	✓	✓	✓
Use Cases	✓	✓	

Table 2 - Evaluation example

2.2.1 Questionnaires

We propose to use a Likert Scale questioning system coupled with open feedbacks. The Likert Scale is a simple question format in which the surveyed party is presented with a statement and asked how much he agrees or disagrees with the statement.

Typical categories on a Likert Scale would range across five options:

1. Strongly Disagree
2. Slightly Disagree
3. Neutral / No Opinion
4. Slightly Agree
5. Strongly Agree

We suggest to supplement the Likert scale with an additional option (open questioning) to add further detail with regards to why the user holds his opinion about the statement he is presented with.

Here below we report some recommendations:

- We have to avoid a large amount of questions – each one devoted to a specific requirement of the system to be developed; we could risk to irritate participants by taking up a large amount of their time with the negative result of reducing the quality of their responses.

Instead we aim to develop a refined system which does not focus on asking about specific features but emphasises emotive responses to the system.
Ideally, the total number of questions has to be less than twenty in order to allow a swift application of the process with multiple participants.

- When reading individual requirements a distinction also needs to be made between functional requirements and user experience requirements.
  The functional requirements are those which simply ask for a feature, in these cases there is no need to waste participants' time by questioning them on this, facilitators can ascertain the presence of a function by checking themselves.

  With regards to user experience requirements (those that refer to the way a participant should *feel* about something) the statement should be something affirmative and positive about that feeling or experience. In this way the higher the participants score a response (the more they agree) the better the design is.

- Furthermore it is better to read the outcomes of the Participatory Analysis starting from the end i.e. from back-to-front; in this way in our analysis we avoid to include requirements that were superseded by other ones in the course of the PA process.

Table 3: Sample Layout for Likert Scale Questions

Question	Strongly Disagree 1	2	Neutral 3	4	Strongly Agree 5
I found that the device was easily integrated into my life					
Any additional comments					
I liked the look of the device					
Any additional comments					

A. Administering Questions

The manner that the questionnaire is administered is very important: as many questionnaires as possible need to be administered in person rather than by simply presenting the participants with the question sheet and asking them to fill it in. This serves two purposes, first it reduces the chance of a poorly phrased question biasing the result smaller, and second

it allows the questionnaire administrator to probe the participants and increase the richness and quality of the feedback.

The person administering the questions should give the participant one sheet to fill in and read the question to the participant from a corresponding sheet. The participant can then answer in their own time and should be encouraged to ask the facilitator if the question is unclear. When a question is unclear the facilitator should take note, such questions will need to be rephrased in future iterations if common problems occur. Whether a participant is happy or unhappy about a requirement, the facilitator should try to identify the features that this feeling is tied to. If a particular feature from the requirement document is causing problems then this should be noted in the supplementary information.

B. Collating Answers

The output of the assessment of the User Centred Design will be a set of answers tied to a variety of User Experience requirements.
It is proposed that these results be presented alongside the relevant requirements in table form along with a summary of user comments; for features the results should indicate the presence of a feature.
The open feedback should be collated in the form of short summaries next to each point; in addition, functions which may be mentioned when criticising the user experience should have notes placed next to them indicating their failure to comply with a certain feature.

An example is given in the following Tables which highlights how the feedbacks can be presented:

Table 4a: User Experience Concepts

Concept	Average Score	User Comments
UE2.A	4.5	Users praised the way that the device made them want to eat more healthily and made them aware of the need to improve their diet, they also liked the way it made this easier to do
UE3.B	2.0	Users complained about the need to carry a mobile device with them interfering with their routine and the need to

Table 4b: Functionality Concepts

Concept	Presence	User Comments
FF2.A: Screen Savers	Not Present	No comments
FN2.A: Paper List (FF1.A)	Not Present	Users complained that the system interfered with their daily routine to much (UE3.B) citing being forced to carry a device with them in shops
R5.A Recipe Suggestions	Present	Users praised the customisability of the device (UE2.A) citing in open questioning the way the system made their task easier by presenting them with pre customised shopping lists

3. Participatory analysis and user requirements gathering

3.1 Approaches to participatory analysis

Participatory analysis is the term sometimes given to the requirements analysis stage of a participatory design project.
In the EASYREACH Participatory Analysis methodology we will incorporate aspects of three established approaches to participatory design:

(1) User Sensitive Inclusive Design **(USID)**: in particular, the principle to address the challenges of working with older users groups. Being sensitive to the wide range of abilities and concerns of older users, we can optimise both the methods of communicating with older users and the settings in which this engagement is undertaken.

(2) Task Analysis methodology (**TAF**) is applied to participatory design by developing shared scenarios as a key mechanism by which the relevance of the application can be brought to life and the assumptions of the design team can be exposed to the users. Furthermore, scenarios allow users to understand how the application can impact their everyday routine and help them to communicate to the design team the specifics of the context in which the technology will be deployed.

(3) Plastic Interface for Collaborative Technology Initiatives through Video Exploration (**PICTIVE**) is a method of eliciting information through the use of low-fidelity prototyping. It facilitates the understanding between users and design teams, and also allows concrete, though informal, documentation of user concerns. Low-fidelity prototyping can also address the reluctance of many older users to critique more technology-based prototypes.

The rationale for advocating this aggregation is two-fold:

- firstly the lack of a common consensus on a single best approach;
- secondly the complimentary nature of the approaches.

Consequently we have drawn on the elements of each (which are to some degree apparent across them all) that best allow the design and development teams to elicit the key requirements of applications for older people and prepare for the design phases that will follow.

Finally to analyse all the collected data, we will make use of the **Grounded Theory**.
Grounded Theory is a widely used method for the analysis of qualitative data used in the social science disciplines. The technique is relatively simple and adapts well to the needs of designers to extract requirements from focus groups.

3.2 EASYREACH Participatory Analysis methodology

By its nature, the requirements in the participatory design process will change as users are exposed to new iterations of the system under development and provide feedback on it. Through the involvement of the users in the initial stages, the process of participatory analysis can reduce some of these pressures. The user can then work together with the designer and the developer to create a set of requirements that will be relatively stable. Despite it, previous work has shown that the requirements do need to initially remain broad to allow for easier alteration and change during the development cycle.

In order to include users early in the design process, it is necessary to identify and recruit an appropriate spectrum of participants from the target user group. This process is perceived as being one of the larger costs of the participatory design process.
Another challenge is the user group itself as older users can present their own set of unique issues when involved in group activities. The designers need to take responsibility for designing, moderating and facilitating group activities carefully so as to prevent these issues from disrupting the focus groups and losing potentially useful information. It is important to understand the relative strengths and weaknesses of the older user groups to best elicit information from them, for example, that "…(Older users) were very good at critiquing designs, mediocre at designing and very poor at imagining next-generation technology" (Massimo and Baeker 2006)

In the following subsections, we detail the three elements of the methodology, referred to as Step 1, Step 2 and Step 3, the sequential application of which comprise the EASYREACH Participatory Analysis Framework (EPAF).

3.2.1 Step 1: Working with older users

Step 1 adopts the key recommendation of the User Sensitive Inclusive Design (Newell et al, 2003; Connell et al, 1997; Newell & Gregor, 2000; Gregor et al, 2002) and addresses the key issues in recruiting, running and moderating group work with older individuals.

A. Recruitment of older users

The process of recruiting older users to group work can be challenging, it is important to try to ensure that a representative range of individuals are involved in the work (Newell & Gregor 2000).
When deciding on numbers for an activity (e.g. a focus group), experience has shown that it is better to over recruit initially as older adults are more prone to cancelling at the last minute for unforeseeable reasons. It is suggested that participatory analysis activities should

attempt to recruitment at levels of around 20% above the numbers anticipated as being required (Barrett and Kirk 2000).

Age and age variation

There is a large age range in the population over sixty-five. In this sense, older users, even when identified as 65+ will have specific generational differences that impact on attitudes, previous engagement with technology, health, finance, and social issues (such as privacy and gender roles). Even when additional factors (culture, cognition, etc.) described below are taken into account, treating users over the age of 65 as a homogenous group is unlikely to give rise to generally applicable findings and can cause problems in group work.

The recruitment process must take specific care to recognise where differences in attitude and behaviour that arise from generational differences are relevant to the application being developed and select participants accordingly.

Cultural, ethnic and national variation

Variations in attitudes and behaviour within older users amplify acknowledged cultural diversity. This is particularly true of the older population for whom the impact of cultural globalisation is less that the younger population. Older users are likely to exhibit significantly more diversity with respect to national and cultural differences in attitude and experience. This is particularly salient where we need to consider the role of older people in society itself, where EU countries vary significantly in terms of family relations, responsibilities of families towards older people (and vice versa).
The recruitment process must either select participants that reflect national and cultural variation or identify explicitly the profile of participants and national and cultural context in which they live.

Cognitive and physical ability

A significant portion of older users will demonstrate aspects of cognitive and physical decline as part of the consequence of the normal ageing process (though users suffering specific chronic age-related conditions such as dementia are not addressed within the scope of EASYREACH). Consideration should be shown with regards to how the designers will approach the problems and variation of their cognitive decline and seek to characterise whether this is an explicit dimension of their design process.

Though quantitative profiling of participants is unlikely to provide useful data for designers, it is recommended that where relevant the recruitment process should include records of self-reflection by participants on the nature of cognitive and physical state using questionnaires or structured interviews. Eliciting users' conception of their own cognitive and physical decline can also be a useful means of identifying user concerns surrounding the

usability of ICT and the applications under development as well as assisting designer in the selection of an appropriate setting and format for the participatory design exercises.

Sensory ability (hearing and eyesight)

In addition to variations in cognitive abilities (such as memory), the normal ageing process gives rise to a wide range of sensory abilities, in particular eyesight and hearing. Recruitment should attempt to span this range to some degree and take into account their level of sensory impairments with a view of better understanding the character of the group of participants and the likely impact of this on the design itself and the design process. Indeed, sensory incapacity has a significant impact on the manner in which participatory activities are convened and conducted and the tools and materials used.

Sensitively choosing an appropriate setting and structure for exercises and meetings, in accordance with the abilities of the users, is an important factor in the conduct of participatory analysis. In addition, recruiters need to be aware of how the method of contact they employ to recruit elderly users may affect participation (Lines & Hone, 2002), for example phone calls can prove challenging for the hard of hearing whilst letters can prove difficult to read for those with visual problems (Barrett & Kirk, 2000).

Diversity of personal circumstances

Considerable variation also exists in the range of personal circumstances in which older users find themselves. These should be considered separately from the social, cultural and national variety discussed above. Of most significance are the living arrangements of an individual, which can range from living alone, co-habiting with a partner (married or otherwise), people living with younger or older relatives (many older people are carers), people living with extended families, people living in sheltered accommodation, and people living in residential accommodation. Other factors, including financial resources, support from friends and the local community, all contribute to a characterization of the personal circumstances in which an older user lives. Aspects of these circumstances are likely to impact upon the attitudes of older people (and the people around them), and towards ICT and the relevance of the application of ICT proposed. Developers and design teams should articulate their intended user base such that it includes personal circumstances and seek to recruit participants accordingly.

B. Organising and running participatory exercises

Participatory analysis exercises can include small group discussions, focus groups, workshops and design workshops and need to be configured (i.e. physical and social setting) and moderated in a manner that is sensitive to the capabilities and preferences of older people. This will both maximise their productivity and create an experience that is sufficiently pleasurable that participants will consider continuing participation into the

design phase (Lines and Hone 2002). A number of factors in the configuration of these activities are likely to have a bearing on their success:

- *Location*: Many older users either do not have ready access to means of transport, or only use public transport with some difficulty. Participatory analysis exercises should be located in a building that is both familiar and readily accessible, in particular, in rooms associated with residential facilities (for participants not living at home) or at locations that are already hubs of social or community networks (e.g. such as social community centres or village halls).

- *Lighting*: General deficits in sight, as part of the normal ageing process, mean that rooms in which participatory analysis exercises are conducted should be brightly lit, preferably by natural daylight.

- *Distractions and conveniences*: Locations should be quiet and free from anticipated distractions, or high ambient noise levels. Participants should have ready access to toilets and washing facilities which they should be made aware of from the outset. The appropriateness of including refreshments, both before during and after the activity, should be considered.

- *Time*: The selection of an appropriate timing and structure for activities depends on the profiles of the participants. However, in general participants should be made aware of the structure and timing, and explicitly given the opportunity to withdraw at any time to relieve any perceived pressure of participation. Even when sessions are apparently going well, timings should be rigidly adhered to guard against the risk participants feel implicitly pressured to participate to a greater degree and longer than they intended.

The atmosphere in which participatory analysis (and design) exercises has a big impact on both the success and utility of the activity and the ongoing engagement of participants in the design process (Eisma et al. 2003).
Highly structured techniques (including interviews) have been found to provide less insights and raise less issues relating to design than informally run activity based events. Eisma et al reports the experience of various activities undertaken at Dundee University which has had extensive experience of designing and evaluating ICT for older people. In addition to emphasising the importance of "hands on" activities (Spep-2 and Step-3 describe our recommendations in relation to these) they also stress the importance of the setting and the expectations of the participants in relation to social dimensions of the activity. In particular, the creation of a friendly atmosphere could assist users to "mutually inspire" each other as a result of the hands-on activities and the social interactions that arise through collaboration. Facilitators of participatory analysis activities must as a result be careful not to "drive" the activity too rigidly, and communicate effectively to participants that in participatory analysis and design there is no "correct" answer.

The creation and conduct of such exercises relies on both the capabilities of the facilitator and careful selection of participants when composing the groups for the activity. Facilitators must be careful to use appropriate and accessible language when leading discussions and

providing instructions; seek to maintain the focus of the activity during group work; ensure that participants are given the opportunity to contribute and be especially aware of the fact that many older users are not familiar with many aspects of technology.

3.3 Step 2: Feature and Scenario Consideration

3.3.1 Relation to the task Analysis methodology (TAF)

Step 2 is based upon the use of the Task Analysis methodology (TAF) which depends heavily on the use of scenarios[1] to explore the design space and develop requirements for a project (Carroll and Rosson 1992). The scenario work follows a five-step plan in which the first three steps consist of the development of common usage scenarios and the claims which are associated with the actions and artefacts involved in the scenario (claims that note the positive and negative aspects of each device). In the following stages, the designers and participants develop on the previous scenarios by envisioning new features that might be of use and seeking to optimise the positive consequences for users whilst minimising the negative.
The group then moves on to envisioning new scenarios with those new features utilised in them.
The process should allow designers greater insight into routine and daily activities. The generation of scenarios in this case is a challenge, if scenarios are unrealistic or incomplete then users might fail to provide key insights; for this reason, care must be taken when developing scenarios of use.
In the Annex 2 of this deliverable we report some simple guidelines on scenario description.
A further concern is the possible effort required.

In Step 2 rather than utilising potentially very time consuming ethnographic methods for the information gathering stage (Chin, Rosson et al. 1997) we are proposing direct use engagement through workshops.

Design teams might conduct several meetings with different groups of participants (depending on the availability of participants). Since the proposal is a significant compression of the task Analysis methodology, multiple groups are required to address different aspects of a usage scenario. Groups will reconvene for a second meeting in which Step 3 low-fidelity prototyping sessions will be run.

[1] A user scenario is a description of a series of actions and events that the user can perform over the system. Scenarios help to identify tasks and facilitate the design of the system.

- *Information Gathering*: During this initial stage of meeting, the designer facilitates discussions with participants concerning current interactions with a given system or general aspects of their daily life that an application is intended to support. We recommend that these scenarios are documented and presented to the participants by the designer during group work (for later reference).

- *Scenario Generation*: In this stage, the designer facilitates the group to move on to the development of scenarios based upon the information gathered in the initial stage. It should be noted that it may be possible to simultaneously gather information and develop scenarios with the user present when they offer anecdotes about their own experiences relevant to the subject.

- *Claims Analysis*: This stage requires the involvement of both the designer and the participants in which they can postulate on ways in which the current scenario's artefacts and actions affect them, both negatively and positively. Examples of this might be a participant's feeling silly or annoyed when becoming frustrated with error messages, or a participant feeling a sense of achievement when using e-mail.

- *Feature Considerations*: Now based upon the claims, the participants can move on to describe new features they might envision a system having. Here the user can propose various ideas, the designer should act to steer the design where possible with regards to what is reasonably feasible. The claims can be used to help in this stage by having participants envision ways to reduce the negative impacts of a feature and increase the positive impacts.

- *Scenario Considerations*: Finally, the designer and participants work together to consider how the new features might interact within the context of the old scenarios and through this explore the possible new scenarios. Documented accounts of the scenarios and claims (in a participant-accessible format) will form the basis of the preparatory material to be used in the Step 3 low-fidelity prototyping sessions.

3.3.2 Specialist Prompt Development and Deployment

Often older users can particularly struggle when it comes to envisioning future technologies. In addition, the TAF framework can struggle to fully capture the user's experiences with regards to everyday activities which they might not view as tasks per se. Prompting of some form can serve to rectify this. By developing and deploying either, a written story based around Use Cases previously generated, or a piece of film, participants who then watch it can more readily envision the possibilities available through technology.

It is crucial that the format of any video or story produced does not constrain or overly direct users towards any specific features or aesthetics for a device. To do it, the device should never be explicitly described or shown. In addition, functionality should be kept as vague as

possible, the focus should instead be placed on the interactions between actors in the story and the ways in which any system might influence them. These influences can be positive or negative, ideally, aspects of both should be featured and in this way, users can project their own emotional reactions and prejudices onto the actors and give voice to them through a discussion of how they think that the actors feel in a given scenario. Achieving this deliberate ambiguity requires thought and planning, design teams may need to recruit outside assistance to perform this work.

The participants should be presented with the video after the discussion of their own information gathering and scenario generation but before the participants need to discuss features or envision future scenarios. This structuring allows the video to be fresh in participants' minds when they begin the discussion of the future features and reinforces for users who might be uncertain the possibilities that technology presents.

3.3.3 Transcript Analysis through Grounded Theory

Step 2 data, when transcribed, will be in an appropriate form to conduct grounded theory based analysis on. Under this paradigm, the researcher begins by identifying interesting or significant sections of the work. He marks or codes these sections discussing important or interesting ideas. Coding is an intuitive task, it requires a researcher read through the transcripts of Step 2 and meetings, preferably having been present at the meetings themselves, and pick out from them anything which strikes them as interesting or significant. Software tools such as NVivio are available to make this task simpler and quicker (see also section 3.5).

At first, the coded sections may not appear to have any common links, but afterwards the coded elements can be grouped into concepts. Concepts can be intuitively understandable themselves, particularly when working with data from explicitly targeted group work guided by facilitators who are aware of areas the group needs to cover from the Use Cases. Grouping data into concepts can be done on a second pass of a transcript focusing on the coded sections or even in some cases done on the first read-through of a transcript.

Having identified the different concepts that the transcript contains, these can be grouped into different categories. Under the hierarchy of concepts and categories, coded work can be re-examined and from this analysis, theories can be drawn out and identified. Theories at this stage should aim to examine the broad desires for a user from a device. It is at this stage that designers need to show an awareness of the underlying motivations and factors that might impact on their application area. Categories should be broad, need to touch upon the aspirations of a user and include all points directly related to them; some points may be duplicated.

One of the purposes of Step 2 is to set the stage for Step 3, the broad requirements on user experience, functionality and form factor need to be reconciled with the existing Use Cases for the devices being created and developers need to discuss whether they feel there need to be substantial changes in the functionality or form factor of the devices or systems design teams intend to develop. With the changes made, the designers should move on to create a Topic Guide for Step 3; in this, they need to detail all the key subjects to be addressed and

they should be critical of how realistic this will be in the time given for the Step 3 meetings. Key topics should be selected based on two criteria, firstly those elements which tie most strongly to the user interface aspects of any design because this is the strength of the PICTIVE process and secondly the areas which need more clarification. At this stage, it is important to bear in mind the idea that the participants will probably cover less ground than might be expected,.

If there is enough time between Step 2 and Step 3, it can be beneficial to perform early design work prior to the Step 3 meetings to develop prototypes. Development teams can make the decision as to the best nature for a prototype given time constraints but suggestions would include mocked up PowerPoint interfaces to devices, Wizard of Oz style interaction or mocked up scenario specific devices. Obviously, this area is highly application specific and heavily influenced by the available resources, expertise and time so specific guidelines are hard to issue but particular emphasis should be placed on developing aspects of interaction which participants struggled with conceptualising in meetings, this will elicit feedback more easily.

3.4 Step 3: Low-fidelity prototyping

Step 3 addresses the role of low-fidelity prototyping borrowed from the PICTIVE process (Schuler and Namioka 1993) which relies on filming a workshop with users building low fidelity prototypes with materials such as paper and pens. The use of very basic creative materials fulfils widespread observations that groups of older people become more engaged in focus groups where there is a hands-on activity to be performed. Additionally, the use of everyday tools (such as pens and papers) democratises the process of inquiry in group work as participants are afforded the opportunity to contribute on an equal (and in some cases better) footing as the designers and developers.

In Step 3 we propose the direct application of the four PICTIVE stages commencing with pre-workshop briefing and preparation, followed by conduct of the actual workshop, documentation and validation of the results.

3.4.1 Preparation

In Step 2 we introduced the concept of producing a Topic Guide for the Step 3 workshops. The Topic Guide is based on both the Use Cases for applications and the requirements extracted from the participants. When selecting areas from the Use Cases and Step 2 it is best to consider the areas which need the most clarification still, the areas which relate directly to aspects of the User Interface and the areas which are potentially the most

interesting to hear more from the participants on. Ultimately, the process of selecting items for the Topic Guide will rely on the designer's intuition to a substantial degree.

All attendees to a workshop should be provided with material that sets the scene of the participatory analysis and design. It is important that this material is developed without pre-determining the technical shape of the design. Preparatory briefs for participants will draw heavily on the results of the scenario generation work conducted as a part of Step 2.
Workshops should be small, involving only two to four users and at least one facilitator per group and one recording operator. This is due to the involved nature of the task and challenges accessing the shared workspace. The sessions must be video recorded and so need to be conducted at a location with suitable facilities for this. The participants themselves should not be the subjects of the recording (where possible), but instead the shared workspace they work on is filmed (e.g. the tabletop on which the workshop is conducted and around which the discussion is held).

The duration of the workshop will depend on the nature of the given task and the capabilities of the participants. Flexibility with regards to time will be critical in this process; participants need to feel unhurried and free to move on tangents during discussion .

3.4.2 Participant Introduction and Workshops

The introduction serves to set the scene for the rest of the workshop, in essence the idea is to ensure that all the participants have some sort of common frame of reference. If the same participants are being used in the PICTIVE process as are being used in the Step 2 then participants are effectively briefed in those meetings to some extent

The facilitators of the workshops prepare both through the creation of participants pre-event assignment and the preparation of appropriate tools for the exercise. Tools can be classified under two categories, office tools such as pens, paper, post-it notes, coloured pencils, rulers, erasers etc. and specialist tools, for example, paper in the shape of interface windows, or actual devices, that facilitate the activities of the workshop.

3.4.3 Analysis of the outcomes of the Step 3

When analysing the video from the PICTIVE process the same basic premise as seen for transcript analysis is followed. From a practical standpoint, this requires some more in depth work on the part of the analyst as the video is not transcribed so the process tends to be longer. In addition, video editing software is required to annotate the film, although a text document could be used to keep track of the conversation for this and pull out relevant clips. The process of selecting interesting and relevant clips is analogous with coding the transcript as discussed in the focus group analysis. The same process can be used to deduce the significant topics.

In addition to this however, further work needs to be done in order to extract information from the physical artefacts developed during the process. These large sheets should be photographed using high resolution camera's to capture the overall layouts presented. After this is done, the Group Facilitators and analysts begin their analysis.
The useful information present in the physical documents can be reduced into three categories:

- Form Factor,
- User Experience and
- Functionality requirements.

Each of these areas contains multiple concerns or requirements expressed by the user.

- ✓ Concerns over Form Factor revolve around the look and feel of a device, these include issues with regard to the presentation of information and the nature of any device the users might have to carry.
- ✓ User Experience requirements are considerably more vague and overarching, they can be general points about concern of the usability of a device or fears over the use that stored data might be put to, as such User Experience relates to all facets of any system, particularly the socio-technical interplay between the person and the machine.
- ✓ Functionality relates to the core option that the system can present, the requirements in Functionality are the most concrete and may be the same as those expressed in use-cases or they may differ.

It is critical that the teams make clear the point behind each issue and make clear to the design team that the requirement taken from the data may not be the exact one being articulated by the participants, it is entirely possible that the participants say one thing but mean another, the fuller analysis of the data conducted by the design team making this clear to them. The purpose of including the raw data is so that, should the requirements for the project shift or features have to be dropped, the design team can see why each of these things would happen and the interrelationships between different points.

3.5 The use of the "Grounded Theory" for the analysis

In EASYREACH we intend to adopt the GROUNDED THEORY for the extraction of the user requirements from the outcomes of the Step 2 and Step 3 (see also previous sections 3.3.3 and 3.4.3).
.
The "Grounded Theory" is a widely used method for the analysis of qualitative data and it is relatively simple.
The following diagram shows the various stages:

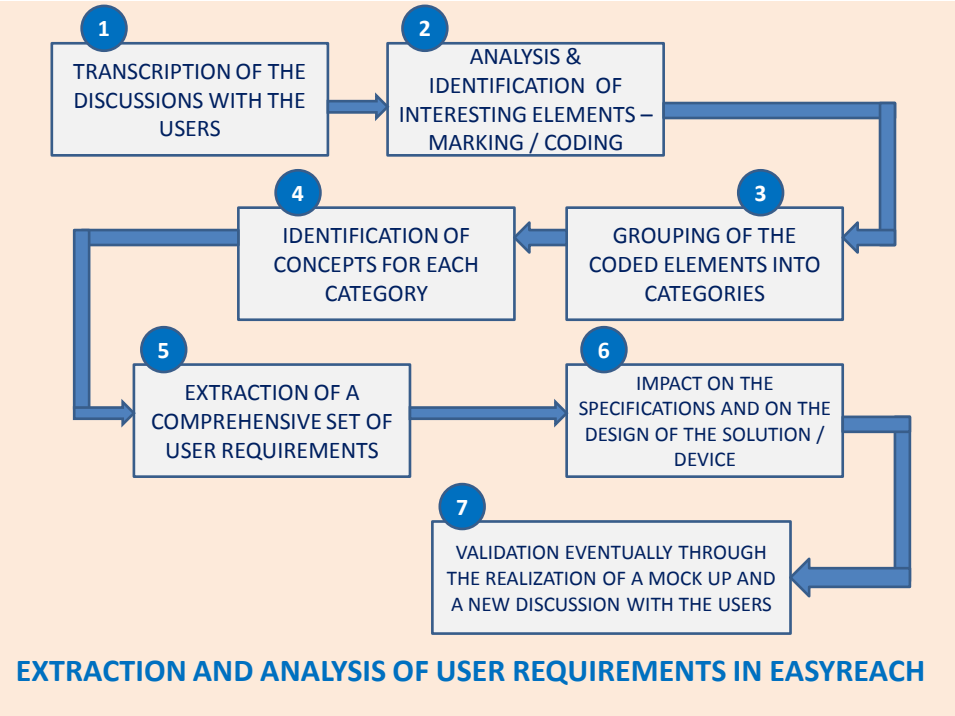

Figure 3 - User Requirements Elicitationand Analysis in EASYREACH

A short description of the different stages of the process is given here below:

Stage 1: Transcription of the discussions with the users during the Workshops and the User Forums where use cases and scenarios were presented to the users, often supported by drawings / sketches and or low fidelity prototypes of the solutions considered in the scenario (previous Steps 2 and 3).

Stage 2: Analysis of the transcription and Identification of interesting elements / ideas; marking or coding of them (to pick out from the discussions anything which strikes the analyst / supervisor as interesting and significant).

Stage 3: Grouping of the coded elements in CATEGORIES.

Stage 4: Identification of CONCEPTS for each category (broad concepts related to the aspirations of the user).

Stage 5: Identification of a comprehensive set of REQUIREMENTS (desires of the user from the EASYREACH overall solution and / or the EASYREACH specific device/service). These requirements will be related to form factor (look & feel), functionality, user experience (usability, concerns over the use (e.g. data privacy, safety), psychological approach towards technology, etc.).
This stage requires that designers look beyond what the users say and try to discern what a user means.

Stage 6: Extraction of elements impacting the specifications and the design of the solution / device.

Stage 7: Validation of the Requirements eventually through a new discussion or a questionnaire with the users supported by a mock up or a first prototype of the developed solution / device.
It is highly recommended to execute and to consolidate the stage 7 in a working team including other experts and possibly medical professionals.

3.6 Validation

Due to the fact that the requirements document is created without the input of the user, it is necessary to validate the requirements once they are developed. This is best done by developing a prototype or mock-up (in the case of interfaces) or by presenting the user the requirements documents directly; validation will be somewhat application dependant as more longitudinal services will require some careful consideration.
Validation tests could be done in workshops with the users and complemented with questionnaires.

4. Usability tests after the development phase

After the development phase, there are different types of tests to execute for any development and all of them are needed. In a user-centred environment usability testing has a priority because from these tests developers will know if the system developed satisfies user expectations. The tests will involve both users and experts.

Please note that although testing phase is run almost at the end of the project, the preparation of the Usability Tests should start at the time the requirements are defined thinking about and planning the tests cases that later will have to be developed and executed (there should exist traceability between requirements and test cases). Moreover some activities like peer-reviews, inspections may be done during the different phases of the lifecycle of the project.

4.1 Testing with the involvement of the users

The usability tests involving the users can be executed by following the same approach of the Step 3 of the EASYREACH Participatory Analysis method described in the previous sections.
It is suggested to supplement the test with a questionnaire.

We propose two alternative questionnaires:

a. The System Usability Scale (SUS) – based Questionnaire,
b. The 4 dimensions questionnaire

4.1.1 System Usability Scale (SUS)

		STRONGLY DISAGREE				STRONGLY AGREE
		1	2	3	4	5
1	I think that I would like to use this system frequently					
2	I found the system unnecessarily complex					
3	I thought the system was easy to use					
4	I think that I would need the support of a technical person to					

		STRONGLY DISAGREE				STRONGLY AGREE
		1	2	3	4	5
	be able to use this system					
5	I found the various functions in this system were well integrated					
6	I thought there was too much inconsistency in this system					
7	I would imagine that most people would learn to use this system very quickly					
8	I would imagine that most people would learn to use this system very quickly					
9	I felt very confident using the system					
10	I needed to learn a lot of things before I could get going with this system					

Using SUS

The System Usability Scale is generally used after the respondent has had an opportunity to use the system being evaluated, but before any debriefing or discussion takes place. Respondents should be asked to record their immediate response to each item, rather than thinking about items for a long time.
All items should be checked. If a respondent feels that they cannot respond to a particular item, they should mark the centre point of the scale.

Scoring SUS

SUS yields a single number representing a composite measure of the overall usability of the system being studied. Note that scores for individual items are not meaningful on their own.
To calculate the SUS score, first sum the score contributions from each item. Each item's score contribution will range from 0 to 4.
For items 1,3,5,7,and 9 the score contribution is the scale position minus 1.
For items 2,4,6,8 and 10, the contribution is 5 minus the scale position.

Multiply the sum of the scores by 2.5 to obtain the overall value of SU.

SUS scores have a range of 0 to 100.

4.1.2 An alternative Usability Evaluation Questionnaire

Another example of Application Usability Questionnaire that could be used in the prototype-testing is reported here below:

Appearence

Question		Answer			
1.-	Do youlike the user interface?	1	2	3	4
2.-	Is the font and colour appropriate?	1	2	3	4
3.-	Is the colour setting of icons/pictograms/windows/pull-downs/standard menu approriate to you?	1	2	3	4
4.-	Are all existing links obvious?	1	2	3	4

Ergonomy / Ease of use

Question		Answer			
1.-	Do you always know in which part of the program you operate ?	1	2	3	4
2.-	Is the navigation within the tool understandable?	1	2	3	4
3.-	The menu items were well organized and functions were easy to find?	1	2	3	4
4.-	Is the structure of the tool appropriate to a specific workflow / working procedure?	1	2	3	4
5.-	Are elements and frames arranged on the screen according to requested functionalties?	1	2	3	4
6.-	Is the use of the tool user friendly and intuitive?	1	2	3	4
7.-	Do you think that it is necessary some time to get familiar with the application?	1	2	3	4

Understandability

Question		Answer			
1.-	Is the graphical user interface understandable enough?	1	2	3	4
2.-	Do you inmediately understand the function of each button?	1	2	3	4
3.-	All the functions you expected to find on the button bar were present?	1	2	3	4
4.-	Are headings, descriptions and buttons understandable and explicit enough?	1	2	3	4
5.-	Is the structure of the user interface clear and easy to understand?	1	2	3	4
6.-	Are the messages from the tool understandable?	1	2	3	4
7.-	Are the instructions and forms easy to understand?	1	2	3	4
8.-	Are the help information satisfactory?	1	2	3	4

General performance of the tool

Question		Answer			
1.-	Is the performance of the system appropriate?	1	2	3	4
2.-	Do all functions of the application run and end with success?	1	2	3	4
3.-	Is the generation of pages adequate concerning needed time?	1	2	3	4

Answers	
1.-	Not Necessary
2.-	Not really important
3.-	Important
4.-	Very Important

4.2 Testing with the experts (Usability Heuristics)

Heuristics that can be used when inspecting usability of the results.
Usability heuristic is a type of inspection on usability where experts must consider if elements of the system (usually user interface) follow established usability principles.
The method is as follows:
- **Get experts**: Some experts on usability are needed, better if they know about the topic of the system. After some studies Nielsen determined that a team of 3 to 5 evaluators can find out the most of the usability errors.
- **Assessment:** Each expert assesses the system on his own. It's advisable to do it twice and following the list of heuristics.
- **Documentation**: The experts document their findings and share them with other experts. Finally they produce a summary with a list of all the usability problems found.

Usability heuristics is mainly applied to interface design; though it might be applied to the hardware, the problem is the lack of standardization and the absence of checklists to execute this activity on hardware.

Software:
Some years ago Rolf Molich and Jakob Nielsen proposed their heuristics for "heuristic evaluation" ; later Nielsen refined them and proposed his "ten usability heuristics".
Although many other experts have proposed their method, this ten heuristics approach has been always the starting point for those other proposals.

Usability heuristics	Description
Visibility of system status	The system shall keep the user informed about what is going on
Match between system and the real world	The system shall speak user's language
User control and freedom	When user chooses a function by mistake, he/she shall need a "emergency exit" (support undo and redo)
Consistency and standards	Follow the platform conventions (same word same action, different word different action)
Error prevention	Eliminate error prone conditions, or check

Usability heuristics	Description
	them and ask for confirmation (It's better prevent an error than show a good error message)
Recognition rather than recall	User should not have to remember information form dialogues. Ehen necessary instructions for use the system shall be visible or easily retrievable.
Flexibility and efficiency of use	Include accelerators for experienced users. Allow users to tailor frequent actions
Aesthetic and minimalist design	Dialogues shall not contain irrelevant information or rarely needed.
Help users recognize, diagnose, and recover from errors	error messages shall be expressed in plain language, indicate the problem and suggest a solution.
Help and Documentation	It may be necessary to provide help and documentation even though if the system can be used without documentation

Hardware:

There is no "official" list of heuristics on this topic (generic hardware). Some professionals have proposed their own ideas.

In EASYREACH we suggest to follow the guidelines published by GHTF, even if they were mainly developed for healthcare.
GHTF is an acronym for Global Harmonization Task Force. This alliance is a partnership between some regulatory authorities and industry and its aim is "enhancing patient safety"; "and increase access to safe, effective and clinically beneficial medical technologies around the world".
Here is a brief list of general hardware heuristics extracted from an idea created by Chauncey Wilson form WiiDesgin and Dick Miller from Hewlett-Packard.

- Switch and controls accessible but protected from inadvertent activation;
- Controls identifiable (new users or users under stress);
- Controls designed for persons with physical disabilities;
- Arrangement of control and displays is compatible;
- Connections coded to avoid putting wrong plug in a wrong socket;

- Legal warning and hazard notes visible;
- Avoid repetitive motions that could cause repetitive motion injuries;
- Management of batteries. Warning before going empty allowing save date, ease of replacement;
- There aren't any rough edges that could cause injuries or damage;
- The system has been subject of a crash test (level will depend on the type of the device);
- Considerations about sound based feedback (volume, consistency, overlapping…);
- Consistent interaction patterns;
- Control/response ratio;
- System can be used by multiple users , under different conditions;
- Dimensions of the hardware (5-95 percentile user);
- The design follows the population stereotypes;
- Feedback about any malfunction;
- Special tools for maintenance;
- Product dimensions are adjustable;
- Easy load of materials;
- Controls to protect from some catastrophic errors.

5. The overall User Centred Design approach in EASYREACH

The following diagram summarizes the various steps of the UCD approach followed in EASYREACH.

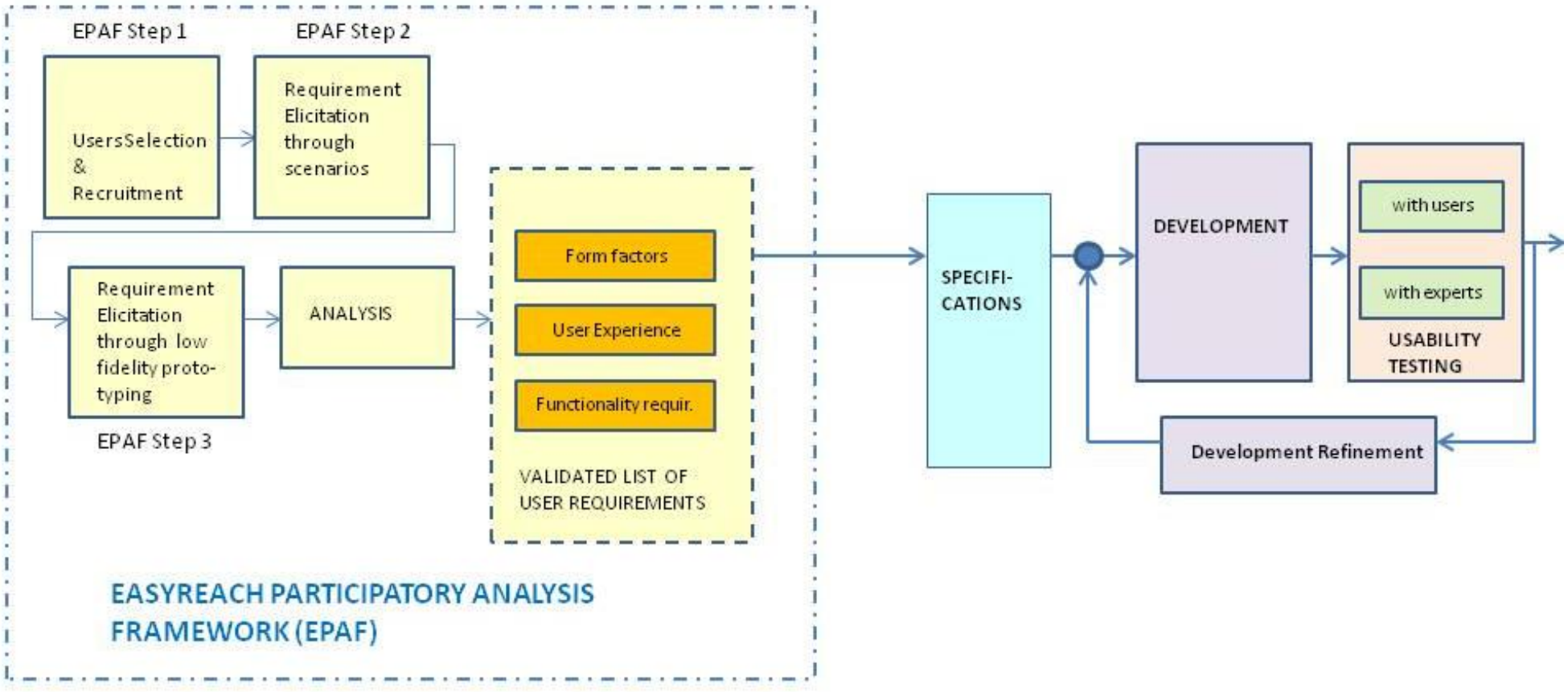

Fig. 4 –The User Centred Design approach in EASYREACH

Annex 1 - Standardization framework related to usability

In usability design and testing an important aspect is represented by the standardization framework.

Standards referring to usability can be related to:
1. The use of the product (effectiveness, efficiency and satisfaction in a particular context of use);
2. The user interface and interaction;
3. The process used to develop the product;.
4. The capability of an organization to apply user centered design.

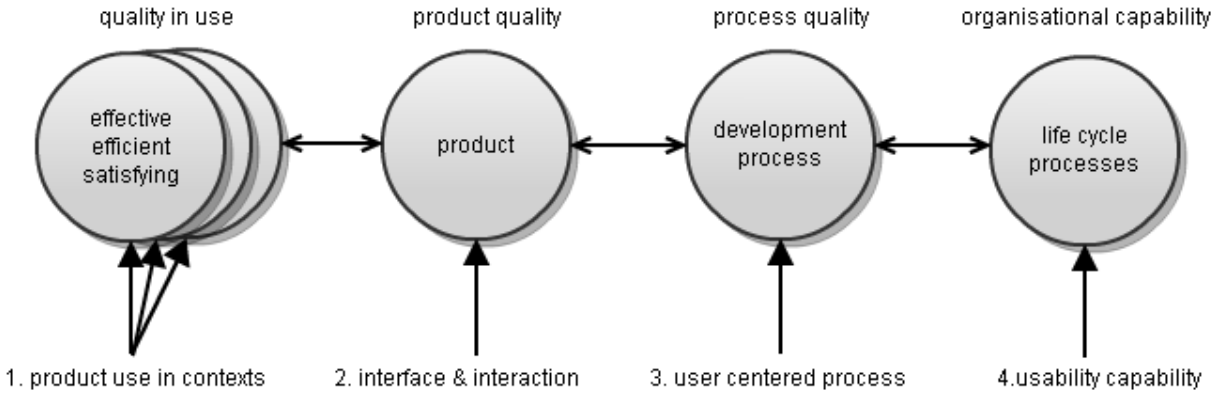

Figure A1-1 : Categories of standard

The figure illustrates the logical relationships: the objective for the product is to be effective, efficient and satisfying when used in the intended contexts. A prerequisite for this is an appropriate interface and interaction. This requires a user centered design process, which to be achieved consistently requires an organizational capability to support it.

USER CENTRED DESIGN	
ISO 9241-210:2010	***Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems:*** It provides requirements and recommendations for human-centred design principles and activities throughout the life cycle of computer-based interactive systems. It is intended to be used by those managing design processes, and is concerned with ways in which both hardware and software components of interactive systems can enhance human–system interaction.

A. Product use in context

Product use in context	Principles and recommendations	Specifications
Context and test methods	ISO/IEC 9126-1: Software Engineering - Product quality - Quality model	ISO DIS 20282-1: Ease of operation of everyday products – Context of use and user characteristics
	ISO/IEC TR 9126-4: Software Engineering - Product quality - Quality in use metrics	ISO DTS 20282-2: Ease of operation of everyday products – Test method
	ISO 9241-11: Guidance on Usability	ISO/IEC FCD 35062: Common Industry Format for usability test reports
	ISO/IEC DTR 19764 Guidelines methodology, and reference criteria for cultural and linguistic adaptability in information technology products	Draft Common Industry Format for Usability requirements

B. Interface and Interaction

Interface and Interaction	Principles and recommendations	Specifications
Software interface and interaction	ISO/IEC TR 9126-2: Software Engineering - Product quality – External metrics	ISO/IEC 10741-1: Dialogue interaction - Cursor control for text editing
	ISO/IEC TR 9126-3: Software Engineering - Product quality – Internal metrics	ISO/IEC 11581: Icon symbols and functions
	ISO 9241: Ergonomic requirements for office work with visual display terminals. Parts 10-17	ISO/IEC 18021: Information Technology - User interface for mobile tools
	ISO 14915: Software ergonomics for multimedia user interfaces	ISO/IEC 18035 Icon symbols and functions for controlling multimedia software applications
	ISO TS 16071: Software accessibility	ISO/IEC 18036 Icon symbols and functions for

Interface and Interaction	Principles and recommendations	Specifications
		World Wide browser toolbars
	ISO TR 19765 Survey of existing icons and symbols for elderly and disabled persons	ISO WD 24755: Screen icons and symbols for personal, mobile, communications devices
	ISO TR 19766 Design requirements for icons and symbols for elderly and disabled persons	ISO FCD 24738: Icon symbols and functions for multimedia link attributes
	ISO CD 23974: Software ergonomics for World Wide Web user interfaces	ISO/IEC 25000 series: Software Product Quality Requirements and Evaluation
	IEC TR 61997: Guidelines for the user interfaces in multimedia equipment for general purpose use	
Hardware Interface and Interaction	ISO 11064: Ergonomic design of control centres	ISO 9241: Ergonomic requirements for office work with visual display terminals. Parts 3-9
	ISO/IEC TR 15440 Future keyboards and other associated input devices and related entry methods	ISO 13406: Ergonomic requirements for work with visual displays based on flat panels
		ISO/IEC 14754: Pen-based interfaces - Common gestures for text editing with pen-based systems

C. Development process

User centered process	Principles and recommendations	Specifications
Development process	ISO 13407: Human-centred design processes for interactive systems	ISO/IEC 14598: Information Technology - Evaluation of Software Products
	ISO TR 16982: Usability methods supporting human centred design	

D. Usability capability

Usability capability	Principles and recommendations	Specifications
Usability capability	ISO TR 18529: Human-centred lifecycle process descriptions	
	ISO PAS 18152: A specification for the process assessment of human-system issues	

ANNEX 2 : EASYREACH Scenarios - Guidelines

In this Annex we provide some guidelines on how the scenarios have to be defined. The use cases and scenarios descriptions are to be used to extract the requirements for each part of the EASYREACH system. Scenarios should be designed and discussed with the users in at least two iterations, in order to push the requirements elicitation.
The scenarios are an easy to understand way to explain to the stakeholders how the EASYREACH system works and which its main benefits are.
The description of each of the scenarios should follow the recommendations reported here below to include the necessary details for the users to understand the scenarios:

Scenario 1: Title

Picture	Image showing the scenario;
Scene description	Description in a short story format;
Workflow	Step by step description of the story in a formal way, naming the actors and the parts/systems of the EASYREACH architecture involved: Step 1: . … Step 2: .....
Alternate workflow	Alternative workflow that can happen when the actor interacts with the EASYREACH system;
Assumptions	Pre-conditions for the scenario to be possible;
Post-conditions	Post-conditions after the scenario has happened;
Involved part of the EASYREACH system	Name the parts of the EASYREACH solution involved in the operation workflow described above. It is important to define the EASSYREACH solution parts or components (HW and SW) using a common glossary of the EASYREACH project before scenarios description is made;
Human actors	Use generic categories (from the set specified in EASYREACH stakeholders);
Outcome and user benefits	Outcome of the scenario. Benefit obtained from the operation of the EASYREACH system;
Innovation	Description of the main advances over the state-of-the-art brought by the involved EASYREACH system's parts and technologies.

Note that it is possible to add also in the scenario a figure showing the UML use case diagram, but this is more intended for system developers, so we recommend to include it in the technical use cases description.

ANNEX 3 - PRIVACY

At European level, EASYREACH will respect the definitions and the regulation provided by

- Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data.
- Directive 97/66/EC of the European Parliament and of the Council of 15 December 1997 concerning the processing of personal data and the protection of privacy in the telecommunications sector.
- Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector. This Directive on privacy and electronic communications complements 95/46/EC with specific emphasis on the processing of personal data in the electronic communications sector, thereby ensuring an equivalent level of protection of fundamental rights and freedoms in all member states.
- Council of Europe Recommendation No. R(97)5 on the protection of medical data adopted of 13 February 1997.

In order to guarantee the maximum level of protection for end users' privacy, EASYREACH will define, with the involvement of end user communities, additional data protection rules and laws of the Country where the involvement of the users will take place.

References

Barrett, J. and S. Kirk (2000). "Running focus groups with elderly and disabled elderly participants." Applied Ergonomics **31**(6): 621-629.

Carroll, J. M. (2000). "Five reasons for scenario-based design." Interacting with Computers **13**(1): 43-60.

Carroll, J. M. and M. B. Rosson (1992). "Getting around the task-artifact cycle: how to make claims and design by scenario." ACM Trans. Inf. Syst. **10**(2): 181-212.

Chin, G., M. B. Rosson and J. M. Carroll (1997). Participatory analysis: shared development of requirements from scenarios. Proceedings of the SIGCHI conference on Human factors in computing systems. Atlanta, Georgia, United States, ACM.

Connell, B. R., M. Jones, R. Mace, J. Mueller, A. Mullick, E. Ostroff, J. Sanford, E. Steinfeld, M. Story and G. Vanderheiden. (1997). "Universal Design Principles." 2008.

Dickinson, A., R. Eisma, A. Syme and P. Gregor (2002). UTOPIA. Usable Technology for Older People: Inclusive and Appropriate. A New Research Agenda for Older Adults, BCS HCI, London.

Eisma, R., A. Dickinson, J. goodman, O. Mivial, A. Syme and L. Tiwari (2003). Mutual inspiration in the development of new technology for older people. Include 2003, London.

Gregor, P., A. F. Newell and M. Zajicek (2002). Designing for dynamic diversity: interfaces for older people. Proceedings of the fifth international ACM conference on Assistive technologies. Edinburgh, Scotland, ACM.

Lines L. & Hone K.S. (2002) Research methods for older adults. Workshop: A New Research Agenda For Older Adults, held at BCS HCI 2002, Sept 3 2002, London, UK. S. Brewster & M. Zajicek (eds). p36-37.

Lumsden, J., R. Leung and J. Fritz (2005). Designing a Mobile Transcriber Application for Adult Literacy Education: A Case Study. International Association for DEvelopers of the Information Society (IADIS) International Conference Mobile Learning 2005, Qawra, Malta, IADIS.

Massimo, M. and R. Baeker (2006). Participatory Design Process With Older Usres. Bicomp Workshop.

Newell, A. F., A. Carmichael, P. Gregor and N. Alm (2003). Information technology for cognitive support. The human-computer interaction handbook: fundamentals, evolving technologies and emerging applications, Lawrence Erlbaum Associates, Inc.**:** 464-481.

Newell, A. F. and P. Gregor (2000). User sensitive inclusive design - in search of a new paradigm. Proceedings on the 2000 conference on Universal Usability. Arlington, Virginia, United States, ACM.

Olsson, E. and A. Jansson (2005). "Participatory design with train drivers -- a process analysis." Interacting with Computers **17**(2): 147-166.

Savitch, N. and P. Zaphiris (2004). Learning from people with dementia to develop research methods for older people. British HCI 2004: HCI and the Older Population. Leeds.

Schuler, D. and A. Namioka (1993). Participatory Design: Principles and Practices, Lawrence Erlbaum Associates.