

 SEVENTH FRAMEWORK PROGRAMME	Project Acronym: GiraffPlus Project Title: Combining social interaction and long term monitoring for promoting independent living Grant agreement no.: 288173 Starting date: 1st January 2012 Ending date: 31st December 2014
--	---



User Requirements and Design Principles Report

WP related to the Deliverable:	WP1 User requirements and Functional Specifications
Nature:	R
Dissemination Level:	PU
Version:	V2.0
Author(s):	Amedeo Cesta, Gabriella Cortellessa, Francesca Fracasso, Andrea Orlandini (ISTC-CNR) Carin Fredriksson, Marie Lidskog, Ingvor Pettersson (HA-OrU) Peter Engfeldt, Annette Forsberg (OLL) Britt Östlund (LUND) Marcello Turno (ASL-RMA) Carlos Gutierrez (SAS)
Project Participant(s) Contributing:	ISTC-CNR, ASL-RMA, HA-OrU, OLL, LUND, SAS
Contractual Date of Delivery:	31 th March 2012 (M3)
Actual Date of Delivery:	16 th May 2012

Document History

Version	Date	Type of editing	Editorial
0.1	20/03/2012	Initial draft	CNR
0.2	31/03/2012	Contribution from other partners integrated	CNR, All
1.0	23/04/2012	Final Draft	CNR
1.1	27/04/2012	QA	ORU, UMA
2.0	08/05/2012	Final Version	CNR, ORU
2.1	13/05/2012	Final Version Submitted	ORU

Disclaimer:

No confidential Material is included therein.

Deliverable Summary

This document reports on the work performed in *Task 1.1 User requirements analysis* and *Task 1.2 GiraffPlus Environment Design Principles*. Specifically, it describes the results of a deep involvement of users, both *primary* (elderly living in their apartment), and *secondary* (health care professional or family members and friends) recruited in our studies. The report details the qualitative and quantitative research carried out in the three countries of Sweden, Spain and Italy, to elicit user requirements and expectations in terms of type of services as well as system design and appearance.

Some qualitative cross-cultural analysis has also been performed in order to highlight differences emerged during the studies in the three countries. Result of this effort is list of user requirements and a set of preferences on different mockups of a component of the system that can be both used to influence the future architecture definition and functional specification of the GiraffPlus system. The work described in this deliverable constitutes the starting point of *T1.3 Technological Component Assessment and Selection* and overall provides useful hints to the whole system development.

Results: the main results can be found in Sections 5.3 related to the literature review, Section 6.2.2 where the focus group results are presented, Section 6.2.4 which describes the questionnaires analysis and finally Section 7.4 which lists the main findings of the workshop with users.

These main findings have been then translated into two main tables containing **the user requirements described respectively in Section 8 and Section 9**.

Table of Contents

1	List of Figures	6
2	List of Tables	7
3	Introduction	8
3.1	Scope of the document	8
3.2	Deliverable structure	9
4	GiraffPlus key concepts	9
4.1	End Users.....	9
4.2	Services and Parameters	10
4.2.1	Long-term monitoring.....	11
4.2.2	Social Interaction	11
	Part I – User requirements analysis.....	13
5	Literature review.....	13
5.1	Introduction and aim	14
5.2	Method.....	14
5.2.1	Search strategy and selection criteria	14
5.2.2	Data analysis.....	14
5.3	Results	15
5.4	Discussion and Conclusion	17
6	User requirements elicitation.....	19
6.1	<i>Objectives and motivations</i>	19
6.2	<i>Method</i>	19
6.2.1	Focus groups.....	20
6.2.2	Focus Group Results.....	22
6.2.3	Questionnaires design and administration	26
6.2.4	Questionnaires Results	30
6.2.5	Discussion.....	40
6.2.6	Assigning Priority to User Requirements	43
6.3	A global cross cultural analysis of user needs	44
	Part II – GiraffPlus environment design principles	47
7	Environment design principles	47

7.1	Industrial design approach, models/mock-ups	47
7.2	Development of design sketches.....	48
7.2.1	Development of a design brief	48
7.2.2	Playfulness as a basic concept.....	49
7.2.3	Design Sketches	49
7.3	Workshops with users.....	51
7.3.1	Involving elderly.....	51
7.3.2	The structure of the workshop.....	55
7.4	Results and Analysis.....	56
7.4.1	Priorities of design models.....	56
7.5	Analysis.....	57
7.5.1	Assigning Priority to User Requirements	59
Part III Detailed List of User Requirements for the GiraffPlus system		60
8 Requirements from Part I		61
9 Requirements from Part II		75
Part IV – Final Considerations		86
10 Additional suggestions for the GiraffPlus development		86
10.1	GiraffPlus scenarios of usage.....	86
10.1.1	Scenario N. 1: monitoring a physiotherapy protocol.....	87
10.1.2	Scenario N. 2: monitoring after the de-hospitalization	87
10.1.3	Scenario N. 3: daily activity monitoring by an informal caregiver.....	89
10.2	Preventing role of GiraffPlus	90
11 Conclusions		91
12 Appendixes		92
12.1	References.....	92
12.2	Additional references from the literature Review.....	95
12.3	References for the Industrial design approach	105
12.4	Discussion guide, health care professionals.....	108
12.5	Discussion guide for focus group with older persons	109
12.6	Detailed focus group results in Sweden.....	110
12.7	Detailed focus group results in Spain.....	118
12.8	Detailed focus group results in Italy	122
12.9	Questionnaires	127

12.9.1	Questionnaire for Care Givers	127
12.9.2	Questionnaire for Health Professionals	136
12.9.3	Questionnaire for Over65	141
12.10	Detailed means and standard deviations among subjects within Countries	150
12.11	Workshop method, structure, guide and analysis.....	154
12.11.1	The workshop method with older participants according to Task 1.2	154
12.11.2	The structure of the workshop	155
12.11.3	Guide for workshop leaders	156
12.11.4	Analysis and delivery of result.....	156

1 List of Figures

Figure 1 Methodology to gather user requirements in the GiraffPlus project	19
Figure 2 Areas of monitoring for the GiraffPlus system: a twofold perspective	26
Figure 3 GiraffPlus areas of monitoring: identification of subareas.....	27
Figure 4 Subscales average scores for each Country	31
Figure 5 Subscales average scores for each subject group.	31
Figure 6 Average scores for “Social interaction” item per subject (left) and per country (right)	33
Figure 7 Average scores for each item of “Physiology Monitoring” subscale per subject and country	35
Figure 8 Average scores for each item of “Activity Monitoring” subscale per subject and country	37
Figure 9 Minimalistic option with alternatives.....	50
Figure 10 Furniture-like option with flowerpot and alternatives.....	50
Figure 11 Dragon animal-like option with alternative playful design.....	51
Figure 12 Sample of the workshop: number of participants per age	52
Figure 13 Workshop at “Associazione Arca di Noè” in Italy.....	53
Figure 14 Workshop at “Associazione Arca di Noè” in Italy.....	53
Figure 15 Workshop in Sweden	54
Figure 16 Workshop in Sweden.....	54
Figure 17 Scenario N. 1: monitoring a physiotherapy protocol	86
Figure 18 Scenario N 2: monitoring after de-hospitalization	88
Figure 19 Scenario N 3: Daily activity monitoring by an informal caregiver	89

2 List of Tables

Table 1 Description of Focus Group Participants in each country.....21

Table 2 Number and mean age of questionnaires’ respondents from each Country29

3 Introduction

The GiraffPlus system aims to address several main issues related to the prolongation of independent living for elderly people. A first issue is **early detection** of possible deterioration of health so that problems can be remediated in an early stage and timely involvement of health care and family can be assured. A second issue is to provide **adaptive support** that can offer services to cope with age-related impairments. A third issue is related to ways of supporting **preventive** medicine so as to contribute to promote a healthy lifestyle and delay the onset of age-related illness. It is indeed increasingly evident that for an ageing society it is more cost-effective to invest also in methods for prevention rather than focusing only on the treatment of the illness when it occurs (Sahlen et al 2008). This document summarises the work done to elicit the user needs with respect to the GiraffPlus system.

3.1 Scope of the document

The main objective of this document is to present the results of the user requirements analysis for the GiraffPlus system and in particular to report on the work performed in *Task 1.1 User requirements analysis* and *Task 1.2 GiraffPlus Environment Design Principles*. Specifically, our choice has been to ground the definition of the main functionalities of the GiraffPlus Intelligent Environment on information coming directly from the users' perspectives. The aim of this work has been to directly and deeply involve end users by asking their opinion with respect to what the GiraffPlus system should *be able to monitor*, which *kind of support the GiraffPlus users should receive*, as well as *how this support should be delivered*.

Two main aspects have been considered in this effort:

1. Understanding user requirements in terms of type of *services* and *parameters to monitor*
2. Studying the users' preferences with respect to *system design* and *physical appearance*

To address the first aspect, we performed qualitative and quantitative analysis involving potential real users of the system. We also performed a review of literature on how independence can be promoted for elderly persons. To investigate the second issue we relied on qualitative research designing specific workshops held in the three countries which entailed the creation of three different mock-ups of the system to be evaluated.

The work described in this deliverable summarizes the main findings and presents the derived list of user requirements, each of which has also been assigned a level of priority. This effort will be the basis of the overall GiraffPlus system development. User requirements will be translated into functional specifications for the system and will also influence the design of the system architecture. The strength of this approach relies on the fact that the realization of the prototype will most likely match what users (both primary and secondary) consider as *useful* and *acceptable*. The document presents the results of this effort and provides some additional considerations that can be exploited for the entire development of the system.

3.2 Deliverable structure

The deliverable structure begins with an introductory section which presents the key concepts of the GiraffPlus system. Then, the document presents two main parts: Part I which is devoted to the user requirements analysis in terms of services and parameters to be monitored. This part in turns presents a short review of the literature, the work done to elicit the user requirements and the list of user requirements identified. Part II presents the work undertaken to elicit the design of the environmental principles for the GiraffPlus system also listing a set of associated user requirements. The deliverable ends with Part III where some additional considerations for the system development are drawn together with some general conclusions.

Results: the main results can be found in Sections 5.3 related to the literature review, Section 6.2.2 where the focus group results are presented, Section 6.2.4 which describes the questionnaires analysis and finally Section 7.4 which lists the main findings of the workshop with users.

These main findings have been then translated into two main tables containing the user requirements described respectively in Section 8 and Section 9.

4 GiraffPlus key concepts

The GiraffPlus project aims to develop and thoroughly evaluate a complete system able to collect elderly people's daily behaviour and physiological measures from distributed sensors, perform context recognition and long-term trend analysis. The gathered information is used to provide customizable visualization and monitoring services for caregivers. It is worth to underscore the key concepts that are recurrent in this deliverable. Specifically, this section introduces: (i) the relevant kinds of users to be considered for the GiraffPlus system and (ii) the main typologies of services the system aims to deploy. Such key concepts will be at the basis of the GiraffPlus intelligent environment.

4.1 End Users

A particular attention should be given to the type of end-users who could benefit from the GiraffPlus system. In fact, as proposed in the project DoW and in the present document, end-users should have a decisive voice in the selection (i.e., priority definition), development and application of these types of products and services. The active dialogue with end-users is essential to ensure that products and services reflect and respond to their real needs and expectations.

In this light, the variety of effort put in place by the EU to cope with the ageing population end-users. Examples include the European Joint Programme (JP) on Ambient Assisted Living (AAL). The common point of all those initiatives is the importance of the user role and its centrality in influencing system development.

An interesting study we inherit from the introductory material for that JP is their classification of end-users (<http://www.aal-europe.eu>). With a slight adaptation of that classification for the project, end-users can be subdivided in two different groups:

- **Primary end-users** are the persons who will be actually using the GiraffPlus system/services. In fact, the elderly play the main role of recipients of the support necessary to be able to live at home, i.e., the intelligent environment, but above all as "experts" of their own everyday lives.
- **Secondary end-users** are persons directly being in contact with a primary end-user. This group benefits from the GiraffPlus system directly when using its services (at a primary end-user's home or remotely) and indirectly when the care needs of primary end-users are reduced. Usually, formal and informal secondary users may have different expectations from the system functionalities. For this reason, in order to further investigate this aspect, we will subdivide secondary end-users into two different sub-groups:
 - **Healthcare Professionals.** An individual healthcare provider who may be a healthcare professional in medicine, nursing, or a field allied to health.
 - **Caregivers.** An *informal* caregiver is a close relative or a friend who takes care of the primary end-user or in general has regular contact with him/her. A *formal* caregiver is a person trained to take care of the elderly especially with a social emphasis (rather than a medical one) on the type of support. Municipalities or social health cooperatives usually provide and train the formal caregivers.

Both kinds of secondary end-users would focus their attention on different aspects of the system functionalities. In fact, most often professionals focus on normative needs that can be generalized to a population, while caregivers are more driven from what is meaningful and supportive for the elder people they take care of. The coexistence of these different views and perspectives highlights the need for **personalized services** and **flexible solutions** the system should be able to provide.

4.2 Services and Parameters

The GiraffPlus system tries to exploit technology to offer tangible benefits for elderly people and to delay institutionalization as long as possible. A set of services is envisaged that will contribute to support the main objective of the GiraffPlus project: the prolongation of the independence living for elderly people. These services can be grouped in two sets: long-term monitoring and social interaction services.

4.2.1 Long-term monitoring

A first type of service the system should deliver is related to *long-term monitoring* of elderly activities and parameters. More specifically, a set of GiraffPlus services will be oriented towards the measurement of parameters of interest that may directly or indirectly indicate deterioration or decline of health i.e. early detection. Although, appropriate sensors exist and are in use today outside the domestic context, simply integrating these devices in a user's home will not suffice to enhance a caregiver's ability to prevent and observe the early onset of cognitive and/or physical decline. Rather, the physiological and environmental data, which is sensed, will be monitored and intelligently interpreted in order to provide useful indications to caregivers.

The GiraffPlus system will use a number of sensors that are pervasively integrated in the home or can be used by the elderly to collect vital signs measurements (for further details see **D1.2 Technological Component Specifications**). On one hand, the IntelliCare Company has developed and thoroughly tested a user-friendly system - Look4MyHealth - that takes several vital sign measurements like weight, blood pressure, blood glucose and pulse oxymetry, through dedicated sensors, in a comfortable and thorough way at the patient's home. On the other hand the Tunstall Company will provide an initial set of environmental sensors for integration in the home. The set of sensors currently used by Tunstall in their alarm system includes smoke sensors, temperature sensors, fall sensors, sensors that provide door usage information (how many times does the client use a certain door in the apartment or the door of a food cupboard), bed/chair occupancy information, and electric appliance usage.

Thereby, relying on data collected by means of the above mentioned type of sensors, the system will be able to recognize and react to more sophisticated human behaviours, and will better detect and respond to long-term physiological trends. Therefore, one of the services to be provided by the system is to deploy techniques for **automatic trend analysis** and correlation at the signal level, as well as higher-level inference methods to assess the existence of conditions that are not directly indicated by simple sensor data. This requires selective and intelligent use of sensors as well as the recognition of meaningful patterns and the consequent synthesis of high-level indications that can be relayed to caregivers. These indications can then be used by the care givers to guide their decision making process and give input to the system about relevant parameters for monitoring, thereby enabling an effective "human-in-the-loop" process.

4.2.2 Social Interaction

There is also a prominent fear that the technology will substitute contact with healthcare personnel and caregivers. This is a major concern for the elderly, who are already prone to the feeling of isolation and loneliness. It is therefore important that the technological solutions are intertwined with social contact and integrate, facilitate and promote interaction with people. Indeed the recent technologies that have a widespread impact on people of all ages are often those which promote social interaction e.g., mobile phones, social networking, and video conferencing.

In this regard, a tele-operated mobile robot, called Giraff, is inserted in the system to allow secondary end-users to visit the assisted person in his/her home via an embodied robotic presence through which the visitor can communicate and at the same time move about in the environment (see again D1.2 for details). The Giraff robot will be placed in the home of the elderly and will be used to connect to healthcare professionals as well as family members. The Giraff robot has already shown the capability to be an attractive communication tool both for the elderly and the secondary users. In fact it is already in use in several municipalities in Sweden and Denmark and has been tested in several homes with the general acceptance of the involved users. Elderly comment mostly on the sense of control and integrity they feel by being able to approve who visits them and when. They also like the fact that there is no user interface and no technology interaction required (other than pressing a button). Secondary users comment on the convenience of making Giraff visits, and also on the feeling on confidence they have in knowing those they are caring for are safe. This element in the GiraffPlus system will enable the delivery of services that are more “social oriented”.

Part I – User requirements analysis

In order to select the kind of services that the GiraffPlus system will provide, we performed a deep user requirement analysis involving both primary and secondary users in three countries: Sweden, Spain and Italy.

More specifically we adopted a multi-dimension approach that resulted into three main directions of work:

1. Analysis of existing literature on relevant indicators for independent living
2. Qualitative study to identify user requirements on the GiraffPlus system
3. Quantitative study to validate and prioritize the user requirements

The first step was devoted to study exiting literature related to the main factors that contribute to endanger the level of independency of an elderly people at home.

The idea was in fact to try to understand the relevant factors that represent a risk for the decline of elderly persons, and thus, should be monitored over time. Monitoring these parameters can represent a way to anticipate possible problems of a person living alone, and at the same time can influence and inspire the selection of services that the technology could provide to support the person at home.

Having this reference in mind we then focused our effort on gathering feedback from real users (both primary and secondary), by involving them directly to give their opinion on the services the GiraffPlus system should provide. This was done by first organizing a set of focus groups in the three countries. A critical analysis of these requirements has then been made and used to create *questionnaires* to be administrated again to both primary and secondary users in the three countries. The questionnaires directly reflected the list of services and parameters to be monitored that emerged from the focus groups work. The idea of these questionnaires was to have an indication on the level of perceived *usefulness* and *acceptability* of the services. These two measures were finally used to identify the different priorities for the user requirements list.

This first part of the document describes in details these three steps and lists the obtained user requirements with their associated priorities.

5 Literature review

In this section we report in a synthetic way the results of a literature review related to the important factors concerning elders' daily activities, which is an important knowledge base in the development and testing of new technology with the aim to enhance independence. The choice here has been to focus on these aspects since they are instrumental to guide the type of parameters that is worth to monitor through the GiraffPlus system, and consequently to inspire the selection of services. Topics covered by this survey are directly related to possible user requirements. Other complementary aspects pertaining to additional issues of the system development are described in other deliverables (D1.2 and D1.3).

5.1 Introduction and aim

The increase in the number of elderly people living at home in contrast to decreased work force is a challenge for the health care systems worldwide. Using technology may be a way to meet these challenges. When developing technical solutions it is important to first investigate in what way independence in the home can be promoted for elderly people. The home has a central place in the lives of aged people, meaning security, freedom and a meeting-place [1].

The results from the literature review are part of the knowledge base in the development of the GiraffPlus system aiming to enhance the safety and security in daily life of the elderly as well as detection of signs of early deterioration of health.

The aim of the literature search was to find studies concerning ***“What factors are of importance for independence in daily activities/daily life of elderly persons living in ordinary housing?”*** These factors could both inspire services identification for the GiraffPlus system, and guide and support the evidence gathered through the analysis with real users.

5.2 Method

5.2.1 Search strategy and selection criteria

A systematic literature search was performed in the Medline/Pubmed, CINAHL, ASSIA, PsychInfo and Social Services Abstract databases. The subject terms (Mesh-terms, Cinahl-headings and similar) used were Aged/Elderly/Aging, Activities of Daily Living/Daily activities/Activity level/Ability level/Self Care skills/Leisure activities/Home maintenance, Mobility, Housing/Housing for the elderly/Independent living/Home environment/Community living, Autonomy, Ageing in place, Review. These subject terms were used in different combinations. The search was limited to scientific articles published in English, with an abstract, peer-reviewed and published between 2005 – January 2012. Experimental and non-experimental researches were included in order to fully understand the phenomenon. Articles were selected if they included results concerning which factors can promote independence in elderly daily life in ordinary housing and factors able to detect signs of deterioration. Articles were excluded if they concerned editorial letters and conference proceedings. The original searches in all databases yielded approximately 900 articles, including different research designs, both quantitative (e.g. RCT, pre-post studies) and qualitative (e.g. case study) approaches.

5.2.2 Data analysis

Initially all included articles were screened according to titles and abstracts. Those articles that met the inclusion criteria were scrutinized further. The extracted data for each article, relevant for the search question, was organized into a basic matrix to get a first overview of the data. The matrix contained two issues:

- i) *Suggested activities/events/data etc. that is relevant and important to pay attention to in order to promote independence or detect deterioration of health and*

ii) *Why is this data relevant and important?*

The analysis continued by classifying the extracted data according to the International Classification of Functioning, Disability and Health (ICF) developed by the World Health Organization [2]. ICF is a global theoretical framework for classification of health and health related domains. It describes interactions between specific health conditions and activities, participation, body functions and contextual factors. The data were sorted according to the ICF chapters (first-level):

- *Activity and participation,*
- *Body functions,*
- *Environmental factors,*
- *Personal factors*

A category with unclassifiable data according to ICF was named “*Other*”. The next step was to organize the data according to each of the different ICF chapters to the second-level of the classification, meaning that e.g. the Activity level was subdivided into e.g. Mobility, Self-care and Interpersonal interactions and relationships. These matrices enhanced the visualization across the primary sources and served as a starting point for comparison of the results of the studies. The results of the literature review are based on 132 articles. Four researchers were working individually and in collaboration with the data to enhance the validity. The presentation of the results is based on the International Classification of Functioning, Disability and Health [2] with some modifications.

5.3 Results

The results classified to **the Activities and participation component** showed that a decreased capacity to perform Activities of Daily Living (ADL) (personal hygiene, dressing, eating etc.) and Instrumental Activities of Daily Living (IADL) (cleaning the house, cooking, doing laundry etc) were predictors of physical decline, of survival, quality of life but also of recurrent falls. A decreased capacity in ADL was also associated with poorer cognitive functioning. Remaining independent was found to be an important goal for the elderly person [3-9].

Concerning the Activities and participation component, also a great attention in the studies was taken to activities relating to **mobility**; walking, balance in sitting and standing and changing body positions. Functional limitations are common in elderly people and affects mobility. To be mobile is highly valued by the elderly and may identify individuals at risk of deterioration. Limitations in mobility often cause falls and may lead to an inhibiting fear of falling. Both decreased walking ability and decreased balance ability are associated with an increased risk of falling, and are predictors of decline in capacity to perform activities in the daily living [6, 8, 10-17].

Persons with disabilities can have problems with **changing of body position** such as getting in and out of bed, rising from a chair and managing stairs. Activities such as pulling/pushing, lifting/carrying and reaching different objects are factors that can be used to predict disability

onset. More specifically lifting and grip strength are predictors of decline of ADL and IADL, and handgrip strength is also associated with nutritional status and falls [12, 15, 18-20].

Concerning **household tasks**, the results showed that maintaining the ability to do some household tasks (e.g. cleaning floor, changing bed linen) contributed to maintain independence. Further, difficulty in doing heavy housework was a potential predictor of falls [14, 21-23]. Some of the studies concerned different aspects of **self-care**. To be able to take a bath and to dress oneself was found to be predictors of ADL-independence. Difficulty in getting dressed elevated the risk of falls. Concerning medication it is an important factor when it comes to self-care as improper intake of medication was found to be a risk factor for falling [14, 17, 24-26].

Concerning **interpersonal interactions and relationships**, the results showed that social relationships and social engagement is highly valued, contributing to good quality of life and better health for the elderly. It is considered very important to maintain relationships, especially with family and friends. Social support is a predictor of social and home participation and was also found to be related to nutritional health. Loss of relations might lead to poorer health including sleep problems. Further, the results showed that several visits of different professionals during the week at different times could limit the elders' life [27-33].

To maintain activities classified as **recreation and leisure** is central for gaining in quality of life but also for independence in daily life. Recreational activities, such as reading books, listening to music and doing crosswords enhanced the resources of elderly people including keeping their mind active. Memory training is important to the elderly and performing intellectual activities is an opportunity to prevent disability and increases the likelihood of better IADL-functioning [29, 31, 34, 35].

Concerning body functions the literature review showed that several different functions might be risk factors of increased dependency. Visual impairment is related to impaired daily function and is a risk factor for falls [36, 37]. Hearing loss is a predictor of functional decline [36, 37]. Cognitive impairment is an important factor related to poorer nutritional status and increased need for assistance and care [5, 26]. Pain is potential factor of recurrent falls and relates to onset of impaired daily functioning [37]. Disturbed sleep is associated with decreased ADL capacity, risk of falls and poor quality of life [38, 39]. Decreased functions of the cardiovascular systems are risk factors of decline in ADL and recurrent falls [40-42]. Decline in endurance is a clinical symptom of frailty and limited occupational performance. Decreased functions of the digestive, metabolic and endocrine systems may cause loss of body weight, negatively affect the nutritional status and blood sugar levels. This may be an early sign of dysfunction. A good nutritional status is important to preserve independent living [11, 43]. Decreased urinary function is associated with increased dependency in ADL and risk of falling [16, 38]. Decreased musculoskeletal function includes loss of muscle strength and impaired range of motion. Impaired muscle strength is strongly associated with difficulties in transfers and ADL, predictor of falls and tiredness [9, 10, 44].

Concerning environmental factors a few studies showed that assistive technology significantly affected independent living functioning and that technology was predictor of social participation. Technology in form of bed sensors, flood sensors and extreme temperature sensors improves

social functioning and a feeling of safety. Smoke detectors were found to preserve independent living. In addition studies showed that people valued the home highly and living in their own flat contributed to a good quality of life [32, 45-47].

Concerning personal factors, which includes age, gender, marital status and living conditions, shows that the age and living alone are risk factors of ADL-decline. Further, age as well as marital status are also predictors of elevated risk of falls. Elderly people living with others promote functioning as well as greater life satisfaction [47-49].

Concerning other factors it was found that having a diagnosed illness is predictor of decreased functioning, increased dependency in ADL, risk of recurrent falls and is negatively related to nutritional health. These outcomes are related both to physical and mental illnesses. Co-morbidities are also common in elderly people and increase the risk of decline [5, 50, 51].

5.4 Discussion and Conclusion

This literature review provides us with insight on important factors concerning elders' daily activities, which may be an important knowledge base in the development and testing of new technology with the aim to enhance independence. It also shows that most of the risk factors of dependency are related with each other.

The ICF has been used in this review as a method to classify the results from the included studies. ICF is also a model to describe interactions between Health, Activities and participation, Body functions and structures and Contextual factors. It has been obvious in this review that many factors interact with each other, which need to be taken into consideration when deciding which activities and services should be monitored in each person's home. The studies that were reviewed, demonstrated that research to a great extent concerned the Activities and participation as well as Body functions components.

Whatever the cause, a decreased physical functioning is a predictor of ADL-dependency and risk of recurrent falls. People with higher levels of functional health status have less probability of institutional care. Several studies support that a positive spiral of an active lifestyle enhances muscle strength, walking, balance and ADL and together promotes health and independence. Major factors that may cause dependency are poor nutritional status, having one or more illnesses/impairments, cognitive decline and fear of falling. Another important factor to pay attention to is polypharmacy. Polypharmacy can contribute to increased risk of drug adverse effects, drug interactions and increased risk of falls [52, 53].

Smart home technologies: a few of the articles in this review concerned smart home technologies. The intention of the current literature review was not to study the evaluation of technologies for independent living. However, the result of an additional search in the Cochrane database showed that a systematic review was published in 2009 and explored the effectiveness of smart home technologies for people with physical disabilities or cognitive impairment living at home [54]. A thorough search in several databases was conducted where 2380 citations were found. Only four

studies were found that met the inclusion criteria, an intervention that used smart home technology. These four studies were excluded due to poor methodological quality. The conclusion of the Cochrane review is that it is a current lack of empirical evidence to support the use of smart home technology within health and social care. A recent systematic review found that using smart home technologies tended to increase independence in persons with impairments, but the level of evidence was regarded as low due to small study sizes and few randomized trials [55]. These results point to the need for further evaluation and research in this area.

This literature review emphasizes important factors concerning the possibility to enhance or maintain independence that may be taken into consideration in the development of the GiraffPlus system.

Concerning **activities and participation**, ADL and IADL were frequently addressed, especially mobility, walking e.g. getting around inside, going out, walking speed, stride length, balance e.g. body posture, sitting and standing balance, changing of body position, falls and physical activity as well as self-care activities such as showering, toileting, eating, following medication and daily habits e.g. eat at stated times, out of bed at stated times are of importance for the daily life of elders. Further maintaining the home e.g., meal preparation but also social relations and hobbies e.g., different kinds of physical and intellectual activities are of importance for good quality of life and health.

Concerning **body functions** the following factors are of importance for the daily life of elders. Sleeping patterns, body weight, blood sugar level, urinary function, cognitive functioning, visual and hearing status, as well as muscle strength and endurance (how much a person moves inside the dwelling) are important factors that, when impaired, affect daily life. Technology that complements for impaired vision and hearing may support independent living.

Concerning **environmental factors** the following was found to be important for maintaining the home a secure place; sensors that monitor temperature, smoke, flood which improves social functioning and a feeling of safety. The studies/articles also showed that elderly people valued the home highly and living in their own home contributed to good quality of life.

To comment on the important factors above, they are at different hierarchical levels and some are not possible to monitor. However, the results of this literature review are still useful and can be used, together with the results of the focus groups, to decide which factors are important, possible and acceptable to monitor in the elders home, thus influencing both the users and system requirements for the GiraffPlus system.

6 User requirements elicitation

In addition to the analysis of the literature on factors that may have an influence on the independence of elderly persons, we carried out in parallel a qualitative analysis of user needs, devoted to understand the preferences of the latter in relation to monitoring services of the GiraffPlus system. This section explains the objective of the study, the chosen method and summarizes the main results, which are strongly in line with previous research.

6.1 Objectives and motivations

The objective of this task is to gather users' needs and opinions with respect to the GiraffPlus system. Specifically, the objective is to identify different needs of both possible primary users and secondary users and influence the functional specifications of the system since the very beginning of the development.

The aim is to directly involve elderly users to understand their needs and preferences with respect to the system services and to express what they find *useful* and *acceptable* in terms of monitoring. Additionally, caregivers and physicians are asked to contribute in outlining what activities, events, physiological/psychological data and behaviours are important to observe in order to (1) ensure early detection of possible deterioration of health (2) what support would be useful to assist in coping with age-related impairments and (3) what is needed to support preventive medicine.

6.2 Method

Figure 1 provides a sketch of the methodology adopted to obtain users feedback on the services the GiraffPlus system should be able to provide.



Figure 1 Methodology to gather user requirements in the GiraffPlus project

As already mentioned, in order to gather the user requirements we adopted 1) **focus groups** with both primary and secondary users for defining a set of services and parameters to monitor; 2) the results of the focus groups have been then used to build **questionnaires** with a set of services and parameters that were assessed on a 5-point Likert scale both in terms of *usefulness* and *acceptability*. The aim of the questionnaires was to validate the list of services and assign to each of them a level of priority/importance.

6.2.1 Focus groups

Focus groups with primary and secondary users were conducted in order to collect the perspective from users on their needs and what is important to observe to support independent living. A **focus group** is a form of qualitative research in which a group of people is asked about their perceptions, opinions, beliefs and attitudes towards a product, service, concept or idea (Stewart et al 2007).

6.2.1.1 Aim

The aim of the focus groups was to discuss what activities, events, physiological/psychological data and behaviors could be important to observe to ensure early detection of deterioration of health; what support could be useful to assist in coping with age-related impairments; and what data could be needed to support preventive medicine.

6.2.1.2 Participants

Two to four focus groups were performed in each country. There were some groups with health care professionals (doctors, nurses, occupational therapists, physiotherapists, psychologist, receptionists, home care professionals or other profession) working with care for elderly persons and some groups with elderly persons, possible future primary users or secondary users (informal caregivers) of the GiraffPlus system. Each group consisted of 8-15 members.

In Sweden there were four groups, three with health care professionals and one with elderly persons. The elderly persons were recruited from participants in an international conference about technology for independent living. All senior participants at the conference received a letter with information about the project and an inquiry if they were willing to participate in a focus group. The persons that were positive, signed and returned a paper about informed consent. They were then contacted by phone to decide on time and place for the interview.

The professionals were one group recruited from primary care centers in Orebro, Sweden and two groups recruited from community elderly care in Orebro, Sweden. One group typically works in elderly care in rural area and one group were from elderly care in a city area. Inclusion criteria were professionals with long experience of working with elderly and with specific interest in elderly care. They all received information letters and, if willing to take part, signed a paper about informed consent. The study was approved by the Research Ethics Committee in Uppsala, Sweden (Dnr 2011/465)

In Italy there was one group with health care professionals and one group with elderly persons. Health care professionals were recruited among Medical doctors and Paramedical staff working in the territory and involved in home care, Health Professional working in cooperatives. Elderly persons were recruited among relative of patients, many of them involved in care giving with disabled relatives.

All participants were recruited through ASL RMA and focus groups were held at the ASL premises under the supervision of the ASL personnel thus adhering to the Ethical Code of that Organization.

In Spain there was one group with Health care professionals, two groups with home day care assistants and one group with the elderly. A moderator and one or more observers led the focus

groups. Elderly people were recruited from patients registered in the Primary Care Health Centre. Some of them were also members of the "Comision de Participacion Ciudadana", which is a group that integrates some patients, health professionals and managers locally to work together for a better Health Service. Caregivers were recruited from the Home Assistance Service (Servicio de ayuda a domicilio) provided by the local municipality. Health Professionals were recruited at the Primary Care Health Centre.

A previous approval by Research Ethics Committee was obtained and an oral consent for participation and recording of FG was requested to participants.

Overall a total of **98 participants** were recruited in the three countries to provide their feedback on the GiraffPlus services. Table 1 presents additional details on the Focus group participants in each country.

Country	N. Participants	Users	Observers
Sweden	9	Elderly users	1 physiotherapist, 1 occupational therapist
Sweden	7	Nurses, physiotherapists, occupational therapist, medical doctors	1 physiotherapist, 1 occupational therapist
Sweden	9	Nurse, nurse assistants, social assistants, occupational therapist	1 physiotherapist, 1 occupational therapist
Sweden	8	Physiotherapist, Nurse, Nurse Assistants, Social Assistants, Occupational Therapist	1 physiotherapist, 1 occupational therapist
Italy	10	Medical doctors, physiotherapists, nurses, psychologists, health workers, sociologist	2 psychologists, 3 engineers, 1 psychiatrist
Italy	10	Elderly	2 psychologists, 1 engineers, 1 psychiatrist
Spain	15	Doctors, nurses, clinical assistants and receptionists	1 doctor, 2 nurses
Spain	11+10 (2 groups)	Social assistants and nurse assistants	Group 1: 1 doctor, 2 nurses Group 2: 3 nurses
Spain	9	Elderly	1 Community nurse, 1 nurse
Total	98 among primary and secondary users		

Table 1 Description of Focus Group Participants in each country

6.2.1.3 Data collection

The moderators followed a discussion guide to generate interest in the topic, involve all the participants, and keep the discussion on track. One or more observers assisted the moderator. The role of the observer was to listen to the discussion, take notes and interact with the moderator when necessary. Notes from the observer could be used in directing the moderator in one way or another.

Each focus group was a one and a half hour long discussion about health deterioration due to aging, elderly persons' expectations and need of support, how this support should be delivered, what should be monitored, and what constitutes an alarm. There was one discussion guide for the professional group and one for elderly persons (discussion guides see Appendixes in Section 12.4 and Section 12.5).

The focus group discussions were tape-recorded and transcribed verbatim.

6.2.1.4 Method of analysis

The analysis of the transcripts from the focus groups was first done separately in each country. The aim of the analysis was to identify examples and suggestions of what activities, events, behaviors and physiological/psychological data the participants described as important and relevant to observe in order to detect deterioration of health and/or need for care or help. An additional aim was to identify the participants' thoughts about support needed for the elderly persons.

A manifest qualitative analysis was used. This means that the analysis were close to the direct wordings in the text without deeper interpretation of latent meanings. The analysis was done by reading the text back and forth to get a picture of how the participants talked about different aspects of the identified factors.

First of all, the text was read through to get a whole picture of the content. Secondly, suggested factors/activities/events/data that was mentioned by the participants was identified and marked in the text. The next step was to identify in the text if the focus group expressed that the marked data was an important factor to observe. If considered important, the suggested data was put in a table (see Appendixes in Section 12.6, Section 12.7 and Section 12.8 for a detailed presentation of the main findings in each country). For each factor the participants' motivation or arguments for this being an important factor were described. Furthermore, for each factor discussions about needed support was identified and described. Another important aspect that was identified in the analysis was if the participants describe how a specific factor could induce a risk if occurring together with other factors.

As mentioned, the detailed results for each country are presented in the Appendices. Here we describe the main results subdividing them according to categories. Some of them are also recurrent in the literature review thus confirming the previous findings.

6.2.2 Focus Group Results

The results of the focus groups have been organized according to macro-categories that seem to be relevant to consider for supporting both primary and secondary users. Detailed results are presented in the appendices while here we describe a summary of the main findings and suggestions for the technical support the GiraffPlus system could provide. Overall the results were very similar in all three countries. Four main areas recurred in all countries: 1. *Body functions and physiological parameters*; 2. *Changes in daily activities and routines*; 3. *Psychological and social factors*; 4. *Environmental factors*.

1. Body functions and physiological parameters

In all three countries both primary and secondary users claimed that a decrease of body functions is something important and relevant to observe for early, and also for acute, detection of deterioration of health. Examples of things that could be of importance to monitor are: *general health deterioration, vision decline, cardiovascular function, blood sugar, weight, body temperature, cognitive decline, urinary incontinence/ urinary infection, muscle weakness*. These factors are also found in the literature review as being related to degree of independence and need for support. They are also in the literature identified as detectors of risk for health problems, malnutrition and falls.

Suggestion for technical support

The GiraffPlus system could be used to monitor some of these parameters (the feasible ones) and send information to both informal caregivers and health professionals on their progressive status. If the information signals a threatening situation an alarm or a warning should be generated.

2. Changes in daily activities and routines

Another area of interest to monitor is related to the monitoring of changes in the “usual routines” of elderly at home. This was discussed in all three countries mostly by the caregivers. Detected changes in daily routines of the elderly person were described as possible signs of deterioration of health and increased need for support. Caregivers described it important to monitor events like: *loss of routines, inability to manage the daily activities, changed patterns of activity and mobility in the home, more time spent in bed than usual, leaving home at unusual time, mobility decline*. This result is supported by several references in the literature review that describe the ability to manage activities of daily living as important for independence and quality of life and also as an important detector of risks, for example risk for falls.

Suggestion for technical support

The GiraffPlus system could include/entail assistive devices, home adaptation and sensors that notice if the elderly has not moved around for a given period, or has not used the toilet for a long time. Sensors could also be used to send alarms or warnings to caregivers when routine differs from the normal. In addition events registered for a given period could be analysed and used by secondary users to assess the evolving situation.

a. Decline in managing activities in daily living

Especially secondary users expressed the monitoring of the ability to manage personal care and home activities as a possible domain for the GiraffPlus system. Decline in these areas could signal health deterioration, risk for malnutrition and increased need for support. Aspects that could be monitored are: *number of visits to the toilet by night; eating and drinking deterioration; personal hygiene; ability to cope with diabetes, ability to and time spent on preparing food, forgetting to turn off the light or the stove*. A specific attention has then been given also by elderly to the *ability to handle medications*.

Suggestion for technical support

Possible services offered by the GiraffPlus system could be: system alarming when flushing routine differs from the normal; alarm when fridge not has been opened for long periods. Monitoring if and how the persons have been eating, reminder systems that tells the persons to take their pills. Electronic dispenser endowed with reminders to primary and secondary users.

b. Falls

This is a recurrent and particularly relevant area identified in the focus groups especially with elderly users but also with caregivers. Both *falls* and *fear of falling* have been reported in all focus groups. In addition, people have expressed the concern that no one could find them when they have fallen. Also in the literature the risk of falls and the fear of falling are evident as a recurrent factor that is discussed in the relation to independence for elderly people

Suggestion for technical support

The suggested services for the GiraffPlus system would be for instance: remote control to turn on the light when dark; sensor system alarming when routine differs from the normal, infrared light, alarms sent to a caregivers if the monitored person does not return to bed, the light turns on automatically when the persons raise from bed; fall detection and consequent alarm sent to a caregiver; alarm sent to a caregiver if the monitored person does not get up after a given amount of minutes.

3. Psychological and social factors

Both professionals and the elderly themselves identified the fear of being alone and the need for contact with relatives and professionals. *Expressions of isolation and anxiety* were identified by professionals as early signs of decline. This is supported by the literature review that describe how social relations and social support is important factors to preserve health and better quality of life of elderly people.

Suggestions for technical support

The Giraff platform could facilitate contact and communication with relatives, friends and caregivers. This form of communication should be seen as an important complement to visits in the home. In case of acute need for contact the Giraff robot offers an easy way for both the elderly person and for the caregiver to get in contact.

4. Environmental factors

Both primary and secondary users mention the need to prevent potential risks related to environmental factors. Factors suggested to monitor were for instance: *fire detection, taps opened, smoke detection, wet floor, temperature, and gas leaking*. Another aspect that was mentioned by the elderly was the fear of *intrusion in the home*.

Suggestion for technical support

The GiraffPlus system could include different sensors to detect smoke, fire, gas leaks and flooding or wet floor. Intrusion sensors and surveillance camera could prevent intrusion or warn the person in case of intrusion. A display that shows if the doors are closed could mean increased security in the home.

6.2.2.1 Additional findings

In addition to the main results reported above, we also obtained additional feedback that can be useful in view of the GiraffPlus development.

According to the participants, the technical solutions should be integrated in the home in cooperation with the elderly. Technical solutions *should not replace human contact*, rather they should be seen as a means to foster and promote human communication and support. Additionally it is important that the technical solutions support the individuals' autonomy and do not make them dependent on the technology itself.

In proposing the technical solution developers should ensure the integrity of the elderly person. Respect for the elderly opinions and feelings are to be taken into maximum consideration. This is something that for example should be considered also by continuously involving them in the evaluation loop to assess the produced technology and adjust dynamically the products. Continuity in the services and professional support should be guaranteed (e.g., same staff that visits the elderly person would ensure continuity).

From a professional point of view it is important to see the elderly person in his/her context and put everything together. Even small differences may be a sign of decline. Depression, psychiatric problems, alcohol abuse could make the situation more difficult as well as multi-sickness makes the situation complex.

Somehow people expressed ambivalent feelings about the GiraffPlus system, especially in Italy. On one hand, elder people recognize its potential usefulness and its necessity in some cases, but on the other hand, they pointed out concerns, in particular, with respect to the "monitoring issue". Indeed also the privacy issue has been raised. Concerns about continuous monitoring and access to the data were raised.

As we will see later in this document, some cross-cultural differences emerged: Italian elderly seem to place great reliance on his/her family in comparison to north European countries. In such cases, the GiraffPlus system is perceived as valuable to help families that have institutional caregivers as the only possible support.

The system could offer different types of information to informal caregivers (especially close relatives). It has been underscored the importance of **triggering alarms in case of dangerous situations** as well as to **issue reassuring messages to report that everything is going well** (e.g. at

the end of each day, a message from the system could be sent to the caregiver to inform him/her that everything in the house and with the person is fine).

Overall there is a generalized good perception of the Giraff robot potentialities within the system, especially with respect to the possibility to make emergency calls in case of need.

Overall there was a great concern with respect to the cost of the system. In Italy, people expressed their worries about the fact they could not afford such expenses and that maybe the National Service should provide it. The requirement has been, however, that the cost should be kept low.

A final consideration, related mainly to the focus group with health professionals, was an expressed need to focus on a specific typology of assisted person in order to provide their feedback. This entails that different people have different needs and in turn suggests a user requirement for the **system** to be **customizable** to different cases.

6.2.3 Questionnaires design and administration

Starting from the focus group analysis we then reasoned on how this feedback could be translated into user requirements for the system. The first step was to examine the main areas of interest for monitoring that emerged from the focus group results. Specifically, starting from the focus group results we identified the main areas according to which to organize the monitoring services.

The four categories emerged with the focus group analysis are the following:

1. Body functions and physiological parameters
2. Changes in daily activities and routines
3. Psychological and social factors
4. Environmental factors

Figure 2 shows how the focus group classification has been analyzed and reasoned upon. Specifically the first area of monitoring can be seen as mainly related to the **Person** monitoring while the fourth is related to the monitoring of the **Home** environment.

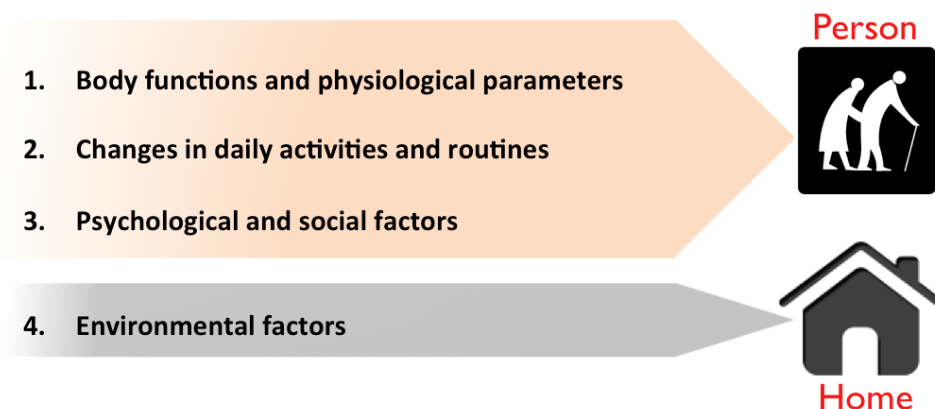


Figure 2 Areas of monitoring for the GiraffPlus system: a twofold perspective

In the first case, the services are devoted to monitor parameters, activities or routines of the primary users, while the second case corresponds to services devoted to monitor environmental factors.

The **Person monitoring services** are in turn subdivided into three main subareas (see Figure 3):

- a) **Physiology Monitoring**: that is all the services devoted to assess the body function and physiological parameters and vital sign monitoring
- b) **Social Interaction Monitoring**: that is all the services that can contribute to facilitate the social interaction of the elderly users or in more specifically the communication between primary and secondary users
- c) **Activity Monitoring**: that is all the services that can be used to monitor changes in the daily routine of the person and in general facts or events that relate to the primary users

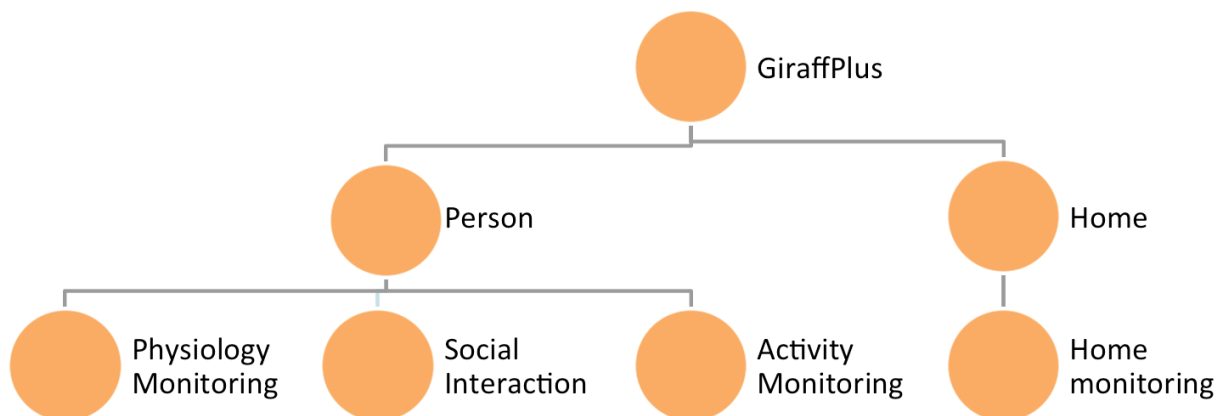


Figure 3 GiraffPlus areas of monitoring: identification of subareas

The **Home services** are mainly related to the **Home monitoring**.

Based on this classification we then translated the detailed results of the focus groups described in the appendixes into a list of services that could be implemented in the GiraffPlus system and a set of parameters to be monitored. Some parameters were infeasible from a technical point of view and for this reason are excluded from the list of possible services. The remaining parameters have been grouped according to the categorization described above. The list of services were translated into items of a questionnaire that was intended as a means to validate the user requirement list. Indeed, the main objective of this second step in the user requirement elicitation stems from the need to validate the services emerged during the focus group and to assign a level of priority to them.

The questionnaire has been based on a 5-point Likert scale where perceived *usefulness* of the service was the main measure to assess with:

1= strongly useless
2= useless
3= neither useless nor useful
4= useful
5= strongly useful

A similar scale was adopted to access the *acceptability* issue. Indeed, examining the focus groups results we realized that elderly sometimes tend to distinguish between usefulness and acceptability. In other words, what the elderly found useful for their independence, was not necessarily considered acceptable for their person. In this light items were repeated in the questionnaires and participants were asked to rate also on *acceptability* according to the following scale:

1= strongly unacceptable
2= unacceptable
3= neither unacceptable nor acceptable
4= acceptable
5= strongly acceptable

The overall questionnaire consisted then of 45 items for *usefulness* and 45 items for *acceptability*.

Considering that questionnaires should be administered to three different kinds of users, different variants were developed in order to find the most suitable version to the users' language and understanding. Specifically, the same questions were formulated in different ways depending on the user. For Primary users (elderly) the questions were developed in a more popular manner using less technical terms. Moreover, items for elderly were formulated referring to themselves (i.e. Determining if you fall to the ground), while items for secondary users were formulated referring to the elderly they take care of (i.e. Determining if the person fall to the ground). The application and response to the questionnaire was individual.

Specifically, a 45-item questionnaire was developed in English and then translated into Italian, Spanish and Swedish to be administrated to the users in the three countries. The English version of the questionnaire is available in Appendix 12.9.

6.2.3.1 Participants

We recruited **200 persons** for this validation phase; specifically, 104 from Italy, 50 from Sweden and 39 from Spain. In each Country, questionnaires were administered to both primary and secondary users. The primary users were the Elderly People (EP), while secondary users were both informal caregivers (CG) such as elderly's relatives or friends, and health professional caregivers (HP) such as physicians, home care assistants, psychologists, nurses, physical therapists, and receiver of emergency call. In total, there were 82 (41%) EP, 52 (26%) CG and 66 (33%) HP (see Table 2).

		N	%	age	
				M	SD
ITALY	EP	43	41,3	79,67	7,33
	CG	33	31,7	49,3	8,30
	HP	28	27	45,93	10,71
Subtot		104	52	60,95	18.02
SWEDEN	EP	27	47,4	79,52	7,7
	CG	7	12,4	*	*
	HP	23	40,2	42,7	12,26
Subtot		57	28,5	62,58	21,09
SPAIN	EP	12	30,8	73,58	5,40
	CG	12	30,8	55,25	8,34
	HP	15	38,4	48,47	5,75
Subtot		39	19,5	58,28	12,47
TOT		200	100	60,83	17,8

Table 2 Number and mean age of questionnaires' respondents from each Country
***not available**

6.2.3.2 Data collection

In Italy, elderly people were recruited mainly into day care centers (Associazione Arca di Noe' and Virtus Italia). Care Givers were recruited with the help of the above mentioned organizations and Health Professionals into ASL.

In Sweden the elderly persons that have answered the questionnaires are all visiting a day care center one or more times a week as a result of a need for rehabilitation support. The group still manage to live at home alone or with a spouse. For the professionals, some of the respondents were recruited from the emergency call center of Tunstall Company working in Sweden. All of them, except one administrative personnel, work as receiver of emergency calls from elderly persons. Other professionals were recruited from primary health care centers.

In Spain elderly people and informal caregiver were recruited in several ways: a) opportunistic as they were attending the clinics (doctor, nurse); b) when nurses attended home visits; c) through a "Caregivers register", choosing randomly some of them and asking for their participation. Health Professionals were recruited among the Servicio Andaluz de Salud staff.

6.2.3.3 Method of analysis

Statistical analyses were conducted in order to assess different levels of priority for each parameter or event. Priority was evaluated in terms of mean scores for each variable, and in terms of differences among both countries and subjects. This means that the higher is the usefulness score of a parameter or event to monitor, the higher the priority is considered. At the same time, the more common is the usefulness judgment among countries and subjects, the higher the priority is considered.

Statistical analysis consisted in the analysis of variance with two factors (*Country* – Sweden, Italy, Spain; *Subjects* – EP, CG, HP).

First, subscales were considered, in order to investigate differences in general areas among Countries and Subjects. Specifically, this is intended to investigate if there are some monitoring areas considered as more important of others in order to support elderly independent living. Then, within every subscale, each item was taken into account, in order to investigate different degrees of priority of single parameters and events (items) among Countries and subjects. This is in order to investigate if within every single area there are some aspects more useful than others to take in account in supporting elderly autonomy.

In order to assess if *usefulness* was *associated* to acceptability, correlation analyses were performed. Correlations among four usefulness subscales and acceptability subscales were calculated.

6.2.4 Questionnaires Results

The whole sample seems to perceive the overall system as a useful support to independent living. Specifically, participants rated the GiraffPlus usefulness of facilitating social interaction as 3,76 mean score (SD= 0,52), usefulness of physiological monitoring as 4 mean score (SD= 0,68), usefulness of person's activities monitoring as 3,84 mean score (SD= 0,58) and usefulness of home monitoring as 4,23 mean score (SD= 0,62).

Nonetheless, significant differences among Countries were found when considering means scores for each subscale rating. Post-hoc results showed significant differences among Country rating (see figure 4). More specifically, Spanish participant always rated the services as more useful than other participants. This group received a mean score significantly higher for the social interaction facilitation ($F_{(2,197)}=13,62$, $p=.000$), physiological monitoring evaluation ($F_{(2,197)}=9,37$, $p=.000$), and activities monitoring ($F_{(2,197)}=19,4$, $p=.000$). Finally, as regard home monitoring, all three Countries' scores were significantly different ($F_{(2,197)}=16,85$, $p=.000$). In fact Spanish respondents, who considered such kind of detection as strongly useful, obtained higher scores.

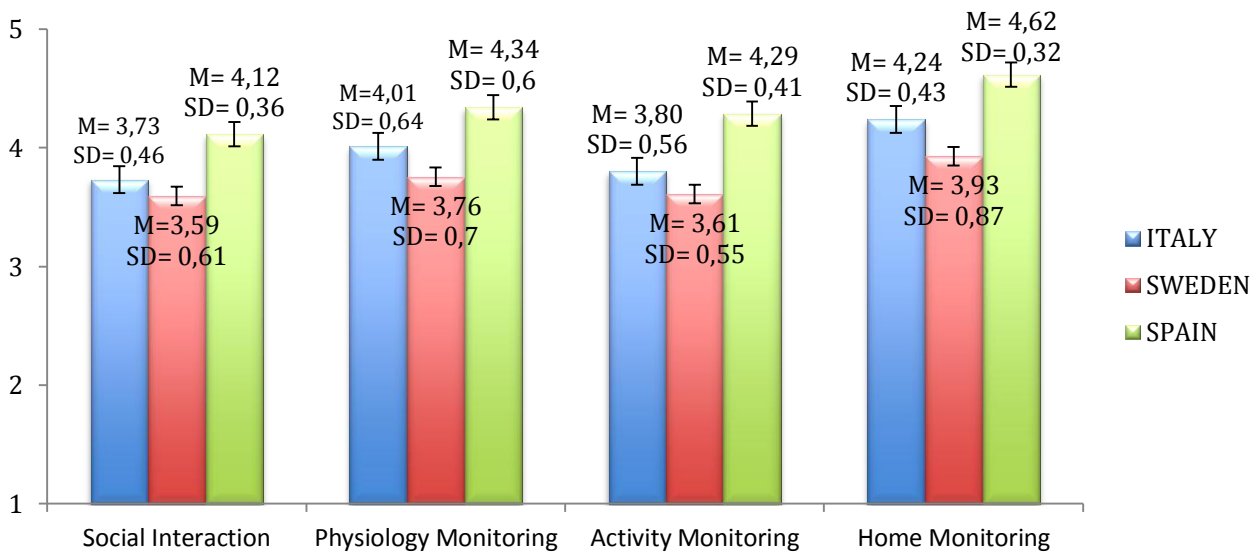


Figure 4 Subscales average scores for each Country

As regarding differences among subjects, significant results were found for all subscales, except for the physiological and home monitoring. In particular, EP assessed slightly less useful the facilitating social interaction capability ($F_{(2,197)}=3,103$, $p=.047$), and person's activities monitoring ($F_{(2,197)}=4,52$, $p=.012$) than CG. All average scores and standard deviation for each subject group are shown on Figure 5.

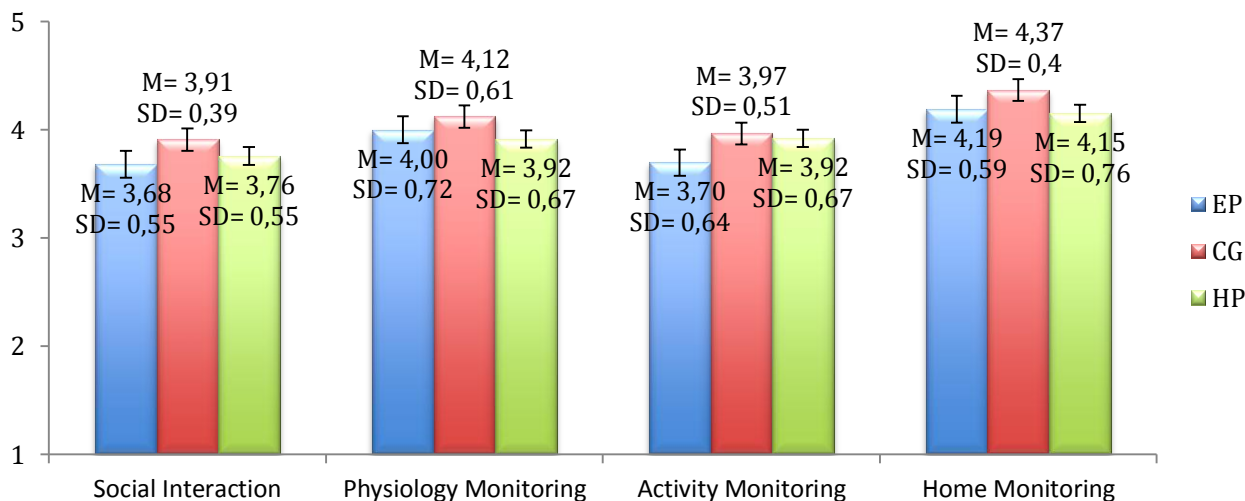


Figure 5 Subscales average scores for each subject group.

In the next subsections we present the results of evaluations of each subscale among Countries and Subjects. More detailed data (detailed means and standard deviations of each subscale items) are depicted in appendix 11.11.

6.2.4.1 Social interaction

As regard facilitating social interaction usefulness, an analysis on each single service was performed, in order to find differences among both Country and Subjects. Means and Standard Deviations are depicted in figure 6.

Facilitating social interaction between elderly and physician (item 12) was significantly different with respect to the Country variable. Specifically, Spain ($M= 4,74$, $SD= 0,49$) rated it as strongly useful, while Italy ($M= 4,29$, $SD= 0,85$) and Sweden ($M= 4,11$, $SD= 0,99$) judged it as useful (significantly different result $F_{(2,191)}= 4,77$; $p= .001$).

Reminding functions of system, such as reminder in performing medications or taking medicine (item 15) was judged more useful in Spain ($M= 4,72$, $SD= 0,51$; $F_{(2,191)}= 4,77$; $p= .001$) than in other Countries (Sweden: $M= 4,14$, $SD= 0,89$; Italy: $M= 4,33$, $SD= 0,71$). Additionally, caregivers ($M= 4,6$, $SD= 0,53$) considered it significantly more useful than the elderly did ($M= 4,13$, $SD= 0,81$; $F_{(2,191)}= 3,69$; $p= .027$).

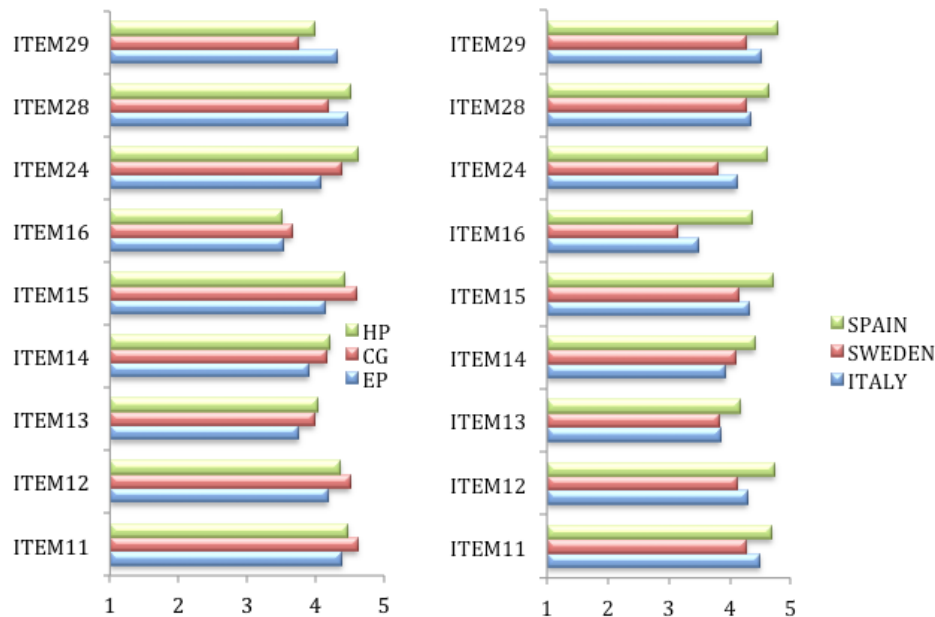
As regard to give a *direct notice to a relative* if there are lights on during the night (item 16), significant differences emerged among Countries ($F_{(2,191)}= 18,82$; $p= .000$). In Spain it was considered more useful ($M= 4,36$, $SD= 0,66$), than in Italy ($M= 3,48$, $SD= 0,89$) and Sweden ($M= 3,14$, $SD= 1,09$) where participants rated it as indifferent.

Facilitating communication between elderly and relative who takes care about him/her (item 24) presented significantly different rating on Countries ($F_{(2,191)}= 10,44$; $p= .000$). Again Spain rated it as strongly useful ($M= 4,62$, $SD= 0,59$), while Italy ($M= 4,11$, $SD= 0,75$), and Sweden ($M= 3,81$, $SD= 0,99$) judged it as useful.

Warning to relatives in case of danger to elderly (item 29) obtained significantly different scores highlighting a subject effect ($F_{(2,191)}= 3,28$; $p= .040$). Caregivers considered this services as strongly useful ($M= 4,73$, $SD= 0,56$), significantly different with respect to health professional ($M= 4,36$, $SD= 0,98$), and elderly people ($M= 4,48$, $SD= 0,69$) who rated it as useful.

Others services and parameters did not highlight significant differences neither in Country nor Subject perspective. Support in monitoring of physiological parameters after hospitalization or for any illness (item 11) was considered strongly useful by every participant.

The possibility of giving a report of the elderly person day to a relative or to a trustworthy person (item 13), and finally, the facilitating function in communication between the elderly person and the home care assistant (item 14) were judged as useful by everybody.



SOCIAL INTERACTION MONITORING

ITEM11_Monitoring of physiological parameters: e.g., ECG, Blood Pressure etc. (after hospitalization or for any illness);
ITEM12_Facilitation of contact between the person and the doctor;
ITEM13_Report of the day to a care giver (e.g., to a family member);
ITEM14_Facilitating contact between the person and the home care assistance;
ITEM15_Support the person in remembering to take medicine or perform medication;
ITEM16_Direct notice to the care giver (e.g. family member) if there are still lights on in the house during the night;
ITEM24_Facilitating contact between the person and his/her family member;
ITEM28_Forced entry by you or someone you trust in case of emergency;
ITEM29_Warning of danger to a caregiver or others (e.g., relatives) in case of possible danger of the person.

Figure 6 Average scores for “Social interaction” item per subject (left) and per country (right)

6.2.4.2 Physiology monitoring

As regard the physiological monitoring usefulness, an analysis on each single service was performed, in order to find differences among both Country and subjects as depicted in figure 7. No significant differences among subjects were found. This means that elderly people, caregivers, and health professional gave a similar average score in usefulness degree. Specifically, they all considered every service or parameter monitoring as useful.

Talking about the Country effect, detecting the presence of body fluids (sweat, urine, blood) on sofas or beds (item 19) presented significant differences ($F_{(2,191)} = 10,37$; $p = .000$). In Spain it was judged as useful ($M = 4,38$, $SD = 0,63$), slightly less useful in Italy ($M = 3,69$, $SD = 0,95$), while in Sweden it was considered as neither useful nor useless ($M = 3,16$, $SD = 1,2$).

Monitoring of physiological parameters, such as blood pressure (item 35; $F_{(2,191)} = 3,70$; $p = .026$), glycaemia (item 36; $F_{(2,191)} = 3,39$; $p = .036$), oximetry (item 37; $F_{(2,191)} = 4,62$; $p = .011$), and body

temperature (item 39; $F_{(2,191)} = 5,99$; $p = .003$) seem to be important to detect, even if with differences between Countries. Specifically, Spanish people judged blood pressure and glycaemia monitoring as strongly useful, significantly different than Swedish, even if they judged such monitoring as useful.

Oximetry and body temperature monitoring scores indicate that they are both considered as useful, but significantly more for Spanish than for Swedish.

Determining whether the person suffers of overnight episodes of incontinence (item 41; $F_{(2,191)} = 4,75$; $p = .010$) seems significantly more useful in Spain ($M = 4,15$, $SD = 0,63$), compared with Sweden ($M = 3,56$, $SD = 1,15$) and Italy ($M = 3,64$, $SD = 0,84$). As regard weight monitoring (item 43; $F_{(2,191)} = 3,42$; $p = .035$), significant differences emerged between Spain ($M = 3,79$, $SD = 0,89$) and Sweden ($M = 3,16$, $SD = 1,09$), where it seems neither useful or useless.

No significant differences were found among Countries as regarding monitoring of vital signs, such heart rate, breathing etc. during the night (item 17), judged as useful by every subject.

Predictably, the same trend was shown for monitoring the person's sleep (e.g. if he/she moves a lot during the night this could be a sign of a disturbed sleep). Item 44 was judged, in fact useful by everyone.



PHYSIOLOGY MONITORING

ITEM17_ Monitoring of vital signs during the night (e.g., heart rate, breathing etc.);

ITEM19_ Detecting the presence of body fluids (sweat, urine, blood) on sofas, beds, etc.;

ITEM34_ Monitoring heart functions;

ITEM35_ Monitoring body temperature;

ITEM36_ Monitoring blood glucose levels in blood (glycemia);

ITEM37_ Monitoring blood oxygen levels (oximetry);

ITEM39_ Monitoring body temperature;

ITEM41_ Determining whether the person suffers from episodes of incontinence (e.g., overnight);

ITEM43_ Monitoring the person body weight;

ITEM44_ Monitoring the person's sleep (e.g. if he/she moves a lot during the night could be a sign of a disturbed sleep).

Figure 7 Average scores for each item of "Physiology Monitoring" subscale per subject and country

6.2.4.3 Activities monitoring

Through this series of services, the intent is to monitor some activities of daily living that are indicative of well-being and autonomy in the elderly.

An effect of Country was found with regard to many items. Generally, Spain rated services more useful than other Countries, followed by Italy, and by Sweden.

In particular, detecting the position of the person inside the house (item 1; $F_{(2,191)} = 5,76$; $p = .004$), and monitoring both the movement (item 2; $F_{(2,191)} = 7,53$; $p = .001$) and the absence of movement (item 3; $F_{(2,191)} = 3,79$; $p = .024$) of the person inside the house were rated on average strongly useful by Spanish respondents, and useful by others. Temporal monitoring of a person's position (item 4; $F_{(2,191)} = 4,19$; $p = .006$) was found useful just by Spanish, while both Italian and Swedish rated it as neither useful or useless.

As regard monitoring of a person during night (e.g. how many times he/she gets out of bed to go to a place and how much time he/she stay there), item 7, significant differences were found among three Countries ($F_{(2,191)} = 6,09$; $p = .003$). Again in Spain the higher score was obtained, judging it as strongly useful, in Italy it was considered useful and in Sweden neither useful nor useless.

Monitoring a person's ability to prepare lunch alone (item 8; $F_{(2,191)} = 9,68$; $p = .000$), monitoring the frequency with which the refrigerator is opened by the person (item 18; $F_{(2,191)} = 13,86$; $p = .000$), and monitoring the time taken to prepare for lunch (item 9; $F_{(2,191)} = 10,04$; $p = .000$), were considered in Spain they as useful the first one and strongly useful the second two; while they all were considered neither useful nor useless in Italy and Sweden. Monitoring of the use of the stove during time (item 27; $F_{(2,191)} = 5,67$; $p = .004$) was considered useful everywhere, but significantly more useful in Spain.

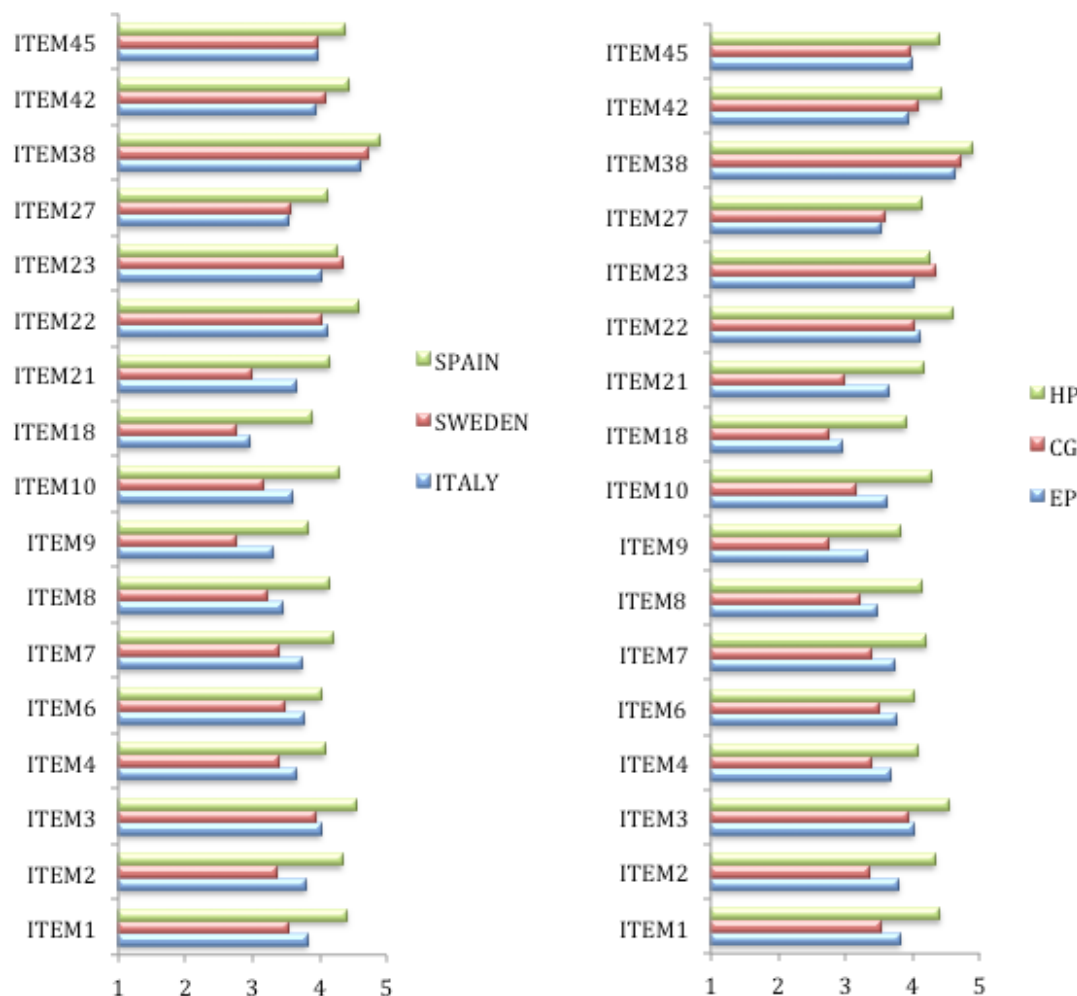
Spanish and Italian respondents considered monitoring of time spent by the person in the shower or bath (item 10; $F_{(2,191)} = 11,09$; $p = .000$) as useful, Swedish ones considered it indifferent.

Monitoring the frequency of social interactions of the person (item 21; $F_{(2,191)} = 13,43$; $p = .000$) represented a strongly useful service in Spain, useful in Italy, and indifferent in Sweden.

Detecting a decline in the mobility of the person (e.g. difficulty walking, difficulty maintaining balance), item 22, $F_{(2,191)} = 4,55$; $p = .012$) was considered as strongly useful by Swedish, and useful by Italians and Spanish.

Considering others services, detection of changes of person's habit in the daily activities inside the house (item 6), detection of absence from home by the person at unusual hours (item 23), monitoring if the person keeps staying in bed (item 42), and monitoring the person's ability to maintain balance (item 45) seemed useful in every Country. Determining if the person falls to the ground (item 38) was considered as strongly useful with no differences among Countries.

Considering differences among subjects, significant difference were found as regard some services, where elderly people rated them as less useful than other participants. Item 1 ($F_{(2,191)} = 8,67$; $p = .000$); item 2 ($F_{(2,191)} = 4,46$; $p = .013$); item 3 ($F_{(2,191)} = 11,35$; $p = .000$); item 4 ($F_{(2,191)} = 3,30$; $p = .039$); item 7 ($F_{(2,191)} = 3,28$; $p = .039$);. (see figure 8 for means and standard deviations).



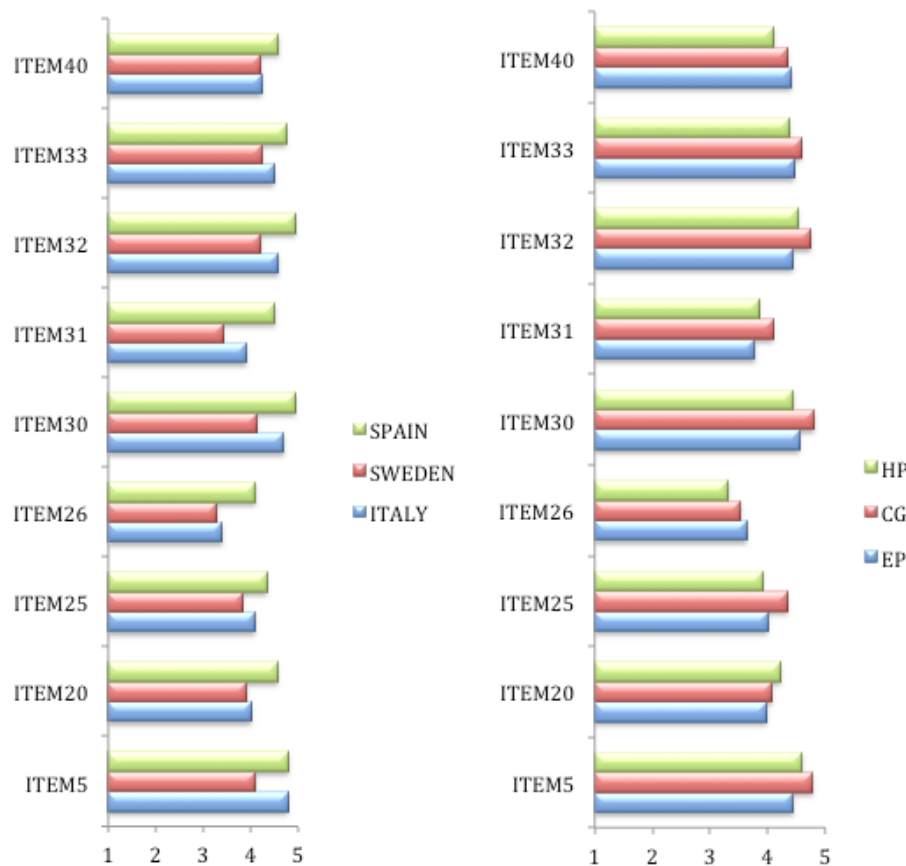
ACTIVITY MONITORING

- ITEM1** Detecting the position of the person inside the house;
ITEM2 Monitoring the movement of the person inside the house;
ITEM3 Detection of the absence of movement inside the house;
ITEM4 Temporal monitoring of a person's position (e.g. how much time he spends in the bed, kitchen, sitting, etc.);
ITEM6 Detection of changes of person's habit in the daily activities inside the house;
ITEM7 Monitoring of a person during night (e.g. how many times he/she gets out of bed to go to a place);
ITEM8 Monitoring a person's ability to prepare lunch alone;
ITEM9 Monitoring the time taken to prepare for lunch;
ITEM10 Monitoring of time spent by the person in the shower or bath;
ITEM18 Monitoring the frequency with which the refrigerator is opened by the person;
ITEM21 Monitoring the frequency of social interactions of the person;
ITEM22 Detecting a decline in the mobility of the person (e.g. difficulty walking, difficulty maintaining balance);
ITEM23 Detection of absence from home by you the person at unusual hours (e.g., overnight);
ITEM27 Monitoring of the use of the stove in time (e.g., does the person cook?);
ITEM38 Determining if the person fall to the ground;
ITEM42 Monitoring the person keeps staying in bed (e.g. if in the morning she/he does not get up);
ITEM45 Monitoring the person's ability to maintain balance (e.g., standing).

Figure 8 Average scores for each item of "Activity Monitoring" subscale per subject and country

6.2.4.4 Home monitoring

Significant Country effects were found as regard services about home monitoring (detailed results in figure 9). Italy and Spain assessed detection of potentially dangerous environmental situations (item 5; $F_{(2,191)} = 7,91$; $p = .000$), in particular gas leaks detection (item 30; $F_{(2,191)} = 9,71$; $p = .000$) and detection for presence of risky situations for the development of fire (item 32; $F_{(2,191)} = 6,54$; $p = .002$) as strongly useful, differently from Sweden where they were rated as useful.



HOME MONITORING

- ITEM5_** Detection of potentially dangerous environmental situations (ie gas leaks, risk of fire);
ITEM20_ Detection of misplaced objects in the environment that could cause risk of falls;
ITEM25_ Detection of open doors in the home;
ITEM26_ Detection of lights on in the home;
ITEM30_ Detecting the presence of gas leaks;
ITEM31_ Monitoring extreme temperatures (e.g., too hot or too cold);
ITEM32_ Detecting the presence of risky situations for the development of fire (e.g. smoke in the environment);
ITEM33_ Detecting if there are any water leaks that may cause flooding (with risk of falls);
ITEM40_ Detecting the presence of taps left open to avoid the risk of spills of water in the floor

Figure 9 Average scores for each item of “Home monitoring” subscale per subject and country.

Spanish people considered it strongly useful the detection of misplaced objects in the environment that could cause risk of falls (item 20; $F_{(2,191)} = 6$; $p = .003$), whereas in Italy and Sweden it was judged as useful. As regard monitoring extreme temperatures (item 31; $F_{(2,191)} = 14,77$; $p = .000$) significant differences result among three Countries. In Sweden it was rated as neither useful nor useless, in Italy as useful, while in Spain as strongly useful.

Detection of lights on in the home (item 26; $F_{(2,191)} = 9,99$; $p = .000$) seemed a neither useful or useless service both in Italy and Sweden, while it was judge as useful in Spain.

Detection of open doors in the home (item 25), Detection of the presence of taps left open (item 40), and detection of water leaks (item 33) were considered useful without significant differences among countries.

As regard differences among subjects, no significant findings were found.

ITALY								
	1	2	3	4	5	6	7	8
(1) U_SOCIAL	1							
(2)U_PHYSIOLOGIC	,608*	1						
(3)U_ACTIVITY	,658*	,726*	1					
(4)U_HOME	,634*	,555*	,593*	1				
(5)A_SOCIAL	,748*	,442*	,560*	,564*	1			
(6)A_PHYSIOLOGICAL	,523*	,736*	,696*	,462*	,617*	1		
(7)A_ACTIVITY	,575*	,629*	,836*	,513*	,658*	,793*	1	
(8)A_HOME	,543*	,433*	,455*	,716*	,708*	,496*	,552*	1

SWEDEN								
	1	2	3	4	5	6	7	8
(1) U_SOCIAL	1							
(2)U_PHYSIOLOGIC	,743*	1						
(3)U_ACTIVITY	,763*	,670*	1					
(4)U_HOME	,710*	,609*	,761*	1				
(5)A_SOCIAL	,810*	,769*	,755*	,738*	1			
(6)A_PHYSIOLOGICAL	,583*	,816*	,649*	,621*	,740*	1		
(7)A_ACTIVITY	,725*	,751*	,828*	,698*	,879*	,803*	1	
(8)A_HOME	,629*	,744*	,735*	,717*	,741*	,725*	,783*	1

SPAIN								
	1	2	3	4	5	6	7	8
(1) U_SOCIAL	1							
(2)U_PHYSIOLOGIC	,805*	1						
(3)U_ACTIVITY	,670*	,624*	1					
(4)U_HOME	,779*	,624*	,689*	1				
(5)A_SOCIAL	,890*	,624*	,695*	,726*	1			
(6)A_PHYSIOLOGICAL	,756*	,624*	,691*	,713*	,812*	1		
(7)A_ACTIVITY	,736*	,624*	,894*	,740*	,772*	,779*	1	
(8)A_HOME	,672*	,624*	,709*	,839*	,737*	,625*	,705*	1

Figure 10 Correlation among usefulness subscales and acceptability subscales.

6.2.4.5 Usefulness and Acceptability

As depicted in figure 10, results show significant positive correlations between usefulness (U) and acceptability (A) in every subscale. We may infer that participants perceived as acceptable what they consider useful in respect of every area supported by the system.

6.2.5 Discussion

Taking into account the global theoretical framework of International Classification of Functioning, Disability and Health (ICF) developed by the World Health Organization, also mentioned in the literature review, an attempt has been made in order to understand if there are some parameters, events, or situations particularly important to detect or monitor. The idea was to investigate, which are the aspects more useful to monitor or to support within each area.

Overall opinion on technology and GiraffPlus services

A first encouraging impression is that both primary and secondary users showed a positive attitude toward the use of this kind of technology to support and promote independent living. Considering the overall sample, negative opinions on the system and the services did not clearly emerged. At the same time, investigating the relation between system's usefulness and acceptability, interesting results emerged. People seem to be confident in what they consider useful. A positive association between these two dimensions might mean that people are not so distrustful of this kind of support. That is, perceived benefits that GiraffPlus could lead to elderly, seems to mitigate the negative effect of other issues like privacy concern or mistrust.

A comprehensive view of results suggests that people is more interested on **environmental monitoring** with respect to other types of monitoring. This result is also in line with previous studies (Cesta et al 2007) where the monitoring of the home environment has been assessed as extremely useful. It seems that monitoring the house is considered the most useful service both among Countries and typology of users.

More specifically, caregivers, more often than relatives, consider that detecting environmental changes can be a strongly useful service in order to support independent living of elderly people. As one might expect, elderly people do not consider as useful the monitoring of their own activities during the day. This service is perceived more as a control rather than a support.

Social Interaction monitoring: results show that social interaction is perceived as a means to contribute to good quality of life and better health for the elderly. Maintaining relationships, especially with family and friends is considered very important. Loss of relations might on the contrary lead to poorer health including sleep problems. In this respect, Further, the results showed that several visits of different professionals during the week at different times could limit the elders' life [27-33]. In line with this consideration, results of our study show that facilitating communication between the elderly and relatives is a useful service both for primary and secondary users thus suggesting that this could be a relevant service that GiraffPlus might provide. At the same time also communication with doctors, or home care assistants might be a relevant

issue that could be useful to improve through the system. Moreover, it seems that Spanish people judges it as particularly useful compared to the other countries.

More in detail specific functions are considered as useful. For example, all users from each Country recognize the usefulness of the possibility to receive every day a sort of report on the elderly day, in order to reassure that nothing went wrong during the day. This service has been considered as important as the possibility to get a warning alarm from the system in case of dangerous situations detected by sensors, and especially caregivers judge this service as particularly useful.

Another way to exploit this function of the system is to use the communication ability provided by the system to facilitate doctors' work after hospitalization. Overall, it clearly emerge that after this hospitalization period, patients usually feel abandoned and manifest the need to maintain a contact with their care givers. As we will explain later in this document the GiraffPlus system can be seen as a means to continue the monitoring period from home thus allowing a continuous monitoring of both physiological parameters and physiological conditions. Indeed, all users participating at the survey considered it as a strongly useful service that GiraffPlus might provide.

In spite of a well-documented importance of social relationships, discordant opinions emerged among Countries. Namely, asking for usefulness in monitoring the frequency of social interactions with the purpose of determining if persons see and talk to someone or spend their days in solitude, only Italians and Spanish considered it as useful service in supporting independent living, while Swedish could not give a clear judgment.

Activity monitoring: as mentioned in literature it is widely known that functional limitations are common in elderly people and affect mobility. To be mobile is highly valued by the elderly and may identify individuals at risk of deterioration. Decreased walking abilities as well as decreased balance abilities are associated with an increased risk of falling, and are predictors of decline in capacity to perform activities in the daily living [6, 8, 10-17]. To confirm the importance of detecting these aspects, a pervasive positive opinion about monitoring mobility and balance decline has been highlighted. The whole sample rated these services as useful. A further confirmation of this result is that also participants unanimously rated the "detection of the person position", "person motion", and "motion absence" within the house, as a useful service.

In this line it should be important to detect changes of body position in order to predict disability. Nevertheless, only Spanish people recognizes monitoring motion and position during time as useful, while Italian and Swedish could not give a clear judgment in term of usefulness, rating it as neither useful or useless service of the system.

In considering how different users categories evaluate these system functions, elderly people found them less useful than others. This finding can be interpreted such an "invasive monitoring" perceived by the elderly. The idea to be monitored in term of movement inside their house does not seem to be particularly appreciated.

Some household tasks that contribute to maintain independence were also investigated. Specifically, the ability to prepare food has been taken into account since it can be considered as predictor of physical decline, survival, and quality of life. Specifically, cognitive impairment is an important factor related to poorer nutritional status and increased need for assistance and care [5, 26], and good nutritional status is important to preserve independent living [11, 43]. In this

respect, three kinds of detections were considered: the ability to prepare food, the time taken to do it, and the frequency with which the person opens the refrigerator. Only in Spain monitoring of these three tasks are considered as useful. In Italy and Sweden it seems that people cannot give a judgment so they declare themselves as indifferent, meaning that this detection is neither useful nor useless.

Self-caring also was found to be a predictor of ADL-independence by previous studies. Difficulty in having a bath, for example, increases the risk of falls. In order to detect this capability, GiraffPlus could help in monitoring time taken to have a shower or to have a bath in order to send an alarm in case of anomalies. Asking about this to the people, just Swedish persons could not recognize usefulness in this function. Actually, they neither assess it as useless, but again they expressed themselves as indifferent.

Another important aspect of self-care concerns medication. For example, improper intake of medication was found to be a risk factor for falling [14, 17, 24-26]. In this respect, a function of GiraffPlus can be reminding medications. The whole sample judged this function as useful with no differences among countries. Informal caregivers, more than others, recognized the importance of this reminding service.

Maintaining a routine in daily activities can be also important. Detection of changes of person's habit in the daily activities inside the house, e. g., the person wakes up too late with respect to usual standard, or absence from home during unusual hours, e. g overnight, can be to understand early signs of decline. Confirming these findings the whole sample rated this type of service as useful recognizing its value in supporting prompt interventions in case of anomalies.

Moreover, it is important to highlight that the main concern observed among elderly regards **falls** and **fear of falling**. In fact, the highest score was obtained when asking for useful in detection of person's falls. The whole sample rated it in a unanimous way as strongly useful for their life.

Physiology monitoring: concerning body functions, literature evidences showed that several different functions might be risk factors of increased dependency. This means that detecting specifics changes in body functions could help both in preventive actions and in risk situations. Also disturbed sleep is associated with decreased ADL capacity, risk of falls and poor quality of life [38, 39]. In this line, monitoring the person's sleep, both in terms of motion (e.g. if he/she moves a lot during the night this could be a sign of a disturbed sleep), and in terms of vital signs (e.g., heart rate, breathing etc.), was considered by the whole sample as a useful function for the GiraffPlus system.

As regard physiological monitoring, people was asked to answer about usefulness in monitoring specific parameters like blood pressure, glycaemia, oximetry, and body temperature. Everyone rated all parameters as useful, with except of blood pressure, and glycaemia that was assessed as strongly useful in Spain. These results are important because they are in line with evidences in literature. For example, decreased functions of the cardiovascular systems are risk factors of decline in ADL and recurrent falls [40-42], and these kinds of detections may help in evaluating early signs of dysfunction.

Overall findings about useful in detection of incontinence situations are also in line with evidences that problems of urinary function are associated with increased dependency in ADL and risk of falling [16, 38]. Similar trend with monitoring of the presence of body fluids such as urine, blood,

or sweat on sofas or beds, considered as useful function in system by everyone but in Sweden, where an indifferent rate was given.

Home monitoring: finally, concerning environmental factors, it has been demonstrated that they are predictors of independent living functioning among elderly people, and such monitoring might improve both social functioning and a feeling of safety. This means that people valued the home highly and living in their own flat contributed to good quality of life [32, 45-47]. In this direction, when asking to people about usefulness of dangerous environmental situation detection, all participants recognize it as useful, especially in Spain and Italy. Same findings were found when they were asked to give a judgment about gas leaks, and risky situations for the development of fire detection. In Spain people considers as strongly useful also detection of misplaced objects in the environment that could cause risk of falls, more than in Sweden and Italy.

There is variability among Countries regarding importance of detecting extreme temperature. Swedish people seem indifferent about it, while Italian, and even more Spanish consider it as useful in order to enhance safety feeling in elderly people.

Other aspects important to monitor for every person regardless of user type or place of origin are detection of open doors in the home, and detection of the presence of taps left open and water leaks.

Overall these findings confirmed results in the literature as well as provided some useful indications to identify a set of relevant user requirements (UR) with an associated level of priority. In this regard, in section 8, a detailed list of user requirements for the GiraffPlus system are defined according to the above discussion and organized according the classification introduced in Section 6.2.3.

6.2.6 Assigning Priority to User Requirements

The priority of each UR has been assessed according to a quantitative analysis performed on the results gathered through the questionnaires. In particular, both trans-cultural aspects and usefulness average values have been used (usefulness values are related to the 5-point Likert scale introduced in Section 6.2.3). The reader may find the means of the assessed values in Appendix 12.10. Specifically, three different priority levels have been considered: **KEY**, **DESIRABLE** and **OPTIONAL**. A requirement is assigned a **KEY** level of priority when at least one end user type estimates the UR as useful in each country. For instance, within **Activity monitoring**, *1.c.1 Detecting the position* is a key requirement since in each country, at least one end user category indicate is as useful (point 4 in the scale), i.e., Italian healthcare professionals $M_{HP}=4.14$, Swedish caregivers $M_{CG}=4.71$ and all the Spanish categories $M_{EP}=4.25$ $M_{CG}=4.33$ $M_{HP}=4.6$. A requirement is **DESIRABLE** when at least one end user type evaluates the UR as useful in two countries. An example is *2.a.6 Monitoring temperature* in **Home Environment** category considered useful by Italian caregivers $M_{CG}=4.18$ and all Spanish end users $M_{EP}=4.5$ $M_{CG}=4.25$ $M_{HP}=4.73$. Finally, a requirement is **OPTIONAL** when only in one country (or in none of the countries) the requirement is assessed as useful. A clear optional requirement is *1.a.8 Monitoring body weight* in **Physiological Monitoring**, since it is not considered useful by any of the end users in all the country.

6.3 A global cross cultural analysis of user needs

There is no doubt that GiraffPlus enters deeply into social and cultural aspects of Italy, Spain and Sweden. The objective of this paragraph is not only to provide an analysis of the data gathered across different European countries during these three months of user requirement elicitation, but also to stress and to promote the idea of the "independent living" concept. The whole GiraffPlus project aims to promote both physical and mental health trying to reduce social and health isolation.

Recent research on aging conducted in the United States, has brought to light a reality foreseen for the next future, which is quite worrying. Getting older can be considered a luxury, as the increase of the elderly population will weigh heavily on public expenses thus potentially lead to a collapse of the economic system. We must not forget that the aging of the population involves all those countries that have access to health resources and can consistently meet the health needs of the population. It is also worth remembering that various diseases and co-morbidities often accompany aging. In this light, the continuous monitoring of the elderly in their environment, still in good health, certainly can help to ensure a more prolonged stay in the home, also contributing to avoid accidents in the home, giving the possibility to intervene promptly, allowing to health professionals to access to home and obtain immediate feedback of certain essential parameters (such as ECG, blood glucose, O2 saturation, blood pressure etc.). This, in turn, can reduce improper access to the public emergency room or institutionalization that causes a financial burden on health system very high.

The GiraffPlus system could also help to contain health care costs, but the hope is that it can become a new reference point for health workers, caregivers and volunteers working in the field of aging.

The analysis of focus groups and workshops results together with a direct contribution of individual countries with their own impressions, provide useful feedback and information on their reaction to the system. As already mentioned, overall, a positive response to the GiraffPlus monitoring system has emerged although concerns exist about the privacy: <<who will acquire personal data? >>. Ultimately it is a common desire that this type of support should be provided directly by the National Health System.

The Focus groups, while have been led following a procedure shared by all groups, still have revealed some unusual considerations that are worth being reported. In presenting these additional results we subdivide them according to the type of users they refer to.

Health Professionals

The Health Professional recruited in the three countries can be considered a valuable and diverse sample: nurses, doctors, physiotherapists and so on. Collecting some considerations that were expressed at the edge of the focus groups we can list the following considerations across the countries: Both in Italy and in Spain the very first impression toward Giraff was of apprehension. Specifically, they were in a sense worried about the idea of something that was substituting their professional roles. This was specifically expressed by operators rather than by medical doctors.

In addition, in the same countries there were concerns about the feasibility of the support, the costs (Is not going to be too expensive for marketing?). Once the purpose of GiraffPlus was well

identified by Health Professional, then it was perceived as a possible good help for their work, especially to discriminate or prioritize when a person is ill.

Both in Italy and in Spain, primary health care perceived the GiraffPlus tool as a means to improve the communication between the elderly person and relatives.

Especially in Italy, HPs involved in the home care are favorable to remotely monitor elderly people with diseases, but not suffering of Cognitive Impairment. Indeed this type of patients seems not to be the most appropriate for the GiraffPlus system, or at least the professionals in this field are a bit skeptical with respect to this type of support. On the contrary, monitoring the daily living habits and the possible changes over time has been suggested as a means to monitor a possible mild cognitive impairment. This represents an additional feature that could be listed among the capabilities of GiraffPlus system.

In all three countries, many HP have judged the system as if they themselves were in the role of the primary users.

Overall Health Professionals, after some initial doubts show interest in GiraffPlus, looking at the whole project from a strictly professional point of view. It could be interesting to have study-cases to see how certain suggestions and procedures can be developed within the GiraffPlus system.

Elderly people

The response of the elderly to the system has been variegated, but highly coincident in several points: both in Spain and in Sweden, especially in rural areas, elderly perceived the GiraffPlus system as a “good safety net” when you live alone, and they liked the idea of being monitored, especially for the possibility of generating alarms when a problem occurs. Moreover, they were also interested in the social interaction function. In some sense, they see the Giraff platform as a window to the external world, and even more, as a kind of “partner”.

Both in Italy and in Sweden aging people in good health have difficulty to apprehend what support they would like if they were disabled and how this support should be delivered. In Italy it seems that they perceive GiraffPlus as useful and acceptable mostly for the others but not for themselves (“it can help my old neighbor” (same age)). In addition, again in Italy, a very strong ideology regarding the family supports the idea that their relatives will be in charge of their needs.

Another important question both in Italy and in Spain is the cost of the system: “who is going to pay for it?” “If I really need, is it easy to get these tools?” The choice to have in the house a system like GiraffPlus and to operate environmental adjustment is strictly depending on the will of the caregiver (especially if this is a son).

For Sweden “it seems like elderly who really experience decreased health and need support, they appreciate monitoring more”. Italian elderly people although interested in the system, do not see the immediate need to be monitored because they perceive their family as very close. What is possible to interpret from the data is: aging people living in rural area or far from the town are more interested in GiraffPlus because in this way they avoid solitude having a direct contact with caregivers or operators, with a consequent possible positive effect on aspect like depression, alcohol abuse, psychiatric syndrome (especially in Sweden) and they are more satisfied of the health services. In short the entire system is well accepted by elderly both for current contingencies and for health situations that may occur in the future.

Elderly also proposed some more special uses to help them at home, like the robotic arm or the possibility of using the robot as a home computer, a source of information, etc. (Spain); while

others would like that the robot was directly equipped with sensors to monitor vital parameters (Italy).

The **station receiving data seems to assume a significant** role. Some doubts are expressed about the possibility that national health systems will provide this type of support without economic additional.

In Italy, regarding the choice to be or not to be monitored, we have different answers that may be directly proportional to the bond that elderly have with their son: the stronger is the bond the more they tend to rely on sons for taking decisions.

Caregivers

Caregivers' position can be considered homogeneous, perhaps because they are more comfortable with new technologies. They play an important role in the elderly management and they understand the real possibilities of GiraffPlus. In particular they appreciate to avoid the sense of guilt for not being all the time with their relatives, for leaving them "alone" or abandoning them.

The same caregivers suggest and expect the GiraffPlus has to have more functions "to help them at home, (e.g. Adding a robotic arm or the possibility of using the robot as a home computer, a source of information, etc.).

On the other hand, caregivers are also interested in monitoring tools of the health of the relatives, if some acute or chronic disease is present.

Another point of view comes from aging couples involved with disabled children: they think the system can give them more security and freedom of movement.

Part II – GiraffPlus environment design principles

In addition to the user requirements related to the system functionalities we investigated aspects connected to users' preferences with respect to *system design* and *physical appearance*. Specifically, we focused on three alternative models for the Giraff robot to be assessed by elderly users. Overall this part of the work has been useful to gather additional user requirements related to the design and configuration of the environment from a physical point of view.

7 Environment design principles

The objective was to provide three alternative models of the GiraffPlus product and system with an industrial design approach to be commented on by the elderly users involved. The models are expected to provide suggestions for product design with comments on aspects that concern the GiraffPlus system including the home environment with sensors and a mobile tele-presence robot. For the elderly, the system should offer ambient support and comfort, well integrated into everyday life. Elderly and patients at home may have specific requirements and different expectations that are driven by what is meaningful, acceptable and supportive for them and their specific situation. Most often professionals, both health care providers, caregivers and engineers, have a more generalized perspective. This aspect is of course crucial to deliver personalized services and flexible solutions.

The result shows what product design users prefer and are willing to accept as solutions in relation to their home environment and lifestyle; this influences what they find attractive and useful. This is important to determine if the robot and the sensors are experienced as intrusive or not. In this way the result will affect ethical considerations related to Task 6.1. The result from the workshop will be handed over to Task 1.4 in the form of drawings and sketches with written comments. The result will be used in three ways:

- Together with user requirements in Task 1.1 for defining functional specifications.
- If manageable and simple enough, inspire the design of the product in a short-term perspective.
- Inspire the project in a long-term perspective to enrich and deepen the understanding of what is meaningful, acceptable and useful.

7.1 Industrial design approach, models/mock-ups

Industrial design focuses on aspects of experiencing products from personal, social and cultural perspectives. At the individual level, research concerns the understanding of consumer experience of products, emotionally and culturally, but also how trends evolve and influence consumer behavior, user-friendliness and sustainable development (Olander 2011, Ralf 2007). The purpose is for people to achieve better opportunities through more useworthy technology, new design concepts and new individual forms of learning and searching. The work begins and ends with the person, while both the process and results are often genuinely technical in nature (Jönsson 2006).

Elderly's potential of being proactive is often underestimated as they have been understood as laggards (Rogers 1995). The interest in elderly users appears to be limited as test persons in the later part of the design process (Chen & Chan, 2011; Chitturi, 2009; Dahlin-Ivanoff et al., 2010). Recent publications point to the fact they are proactive rather than reactive i.e. their thinking covers their whole context (Essén & Östlund 2011, Östlund 2011). This is why elderly users, with a life time experience of technological change and technological development fulfils the main criteria for being involved in innovation processes (Porter 1998).

In a broad sense, this recalls the discussion in design research on whether design should be carried out with or by users (Eason, 1995). However, there is a growing body of literature on human-centered design and user innovation that provides important insights regarding the potential of involving users in earlier phases of the design process (e.g., Bechenau & Fulton Suri, 2000; Davila, Epstein, & Shelton, 2006; Keikonen, Jääskö, & Mattelmäki, 2008; Yoon, 2008). Workshops to develop ideas and models embodied in the form of mock-ups or sketches are common methods to capture user requirements in industrial design but not that common with elderly involved (Zajicek 2005, Östlund 2008, Wu, Fassert et al. 2011). Here the design work started with the basic hardware that was developed into three different sketches that was elaborated in workshops with elderly in Malaga Spain, Lund Sweden and Rome Italy.

Studies on the experience of robot appearance among elderly shows contradicting results related to variations in context and purpose (Wu et al 2012, Walter et al 2008, Broekens et al. 2009). Assistive robots have been shown to be helpful to compensate and carry out difficult tasks (Beer, Smarr et al. 2012). It seems that the elderly needs are in focus (Ulrich and Eppinger 2011) but also that robot should not take up too much space in their home (Wu, Fassert et al. 2011). These experiences have led the work on developing models. When individuals experience new technological opportunities such as the GiraffPlus system, their experiences are activated with reference to technology they already have in their home as well as ideas and needs for which they require technological. However, the focus in performing the workshops in this project is on the Giraff robot and not on the overall system or the entire life situation of the elderly participants. Even though the system also encompasses sensors and a social organisation outside the home we concentrate on the robot being the most visible and noticeable part of the system.

7.2 Development of design sketches

Starting with the basic hardware the development of sketches for the workshops was carried out in three steps.

7.2.1 Development of a design brief

The first step was to present a design brief with a description of the Giraff concept for the industrial designer involved. A design brief is focused on the desired results of design, and in this case, from an elderly point of view:

The Giraff is a product that will provide support for elderly people (+65 years) to live at home longer. Together with a sensor system the GiraffPlus system can measure health changes and provide communication between health care professionals, patients and families. The Giraff helps elderly people to keep track of their health and wellbeing. It reminds them of everyday actions and routines so that for example medication, diet and medical consultations are supported in a satisfying way. The patients are expected to be active persons in the sense that they want to decide about their own lives. The product helps them to keep things in control and are proposed and inspired with activities. The user and the product like doing things together but they also have time and space to do things separately. The product monitors its users and attracts their attention when there is an expressed need. However, it is the user who decides what, when and how the product is allowed to interfere in his or her life. The product is part of a system that is limited to an individual patient's home. The GiraffPlus system can be compared with a communication center that gathers information from various sensors in the patient's home. The sensors have different functions and different data to support the patient's daily life. The sensors should not be noticeable, only that which appears in the patient's home is the Giraff, whose main part is a display device where the user can see the person he or she talks to.

7.2.2 Playfulness as a basic concept

The second step was to elaborate on “playfulness” as a concept for the development of sketches. At a seminar at the Department of Design Sciences at Lund University “playfulness” was defined and developed related to the degree of what is desirable and what is realistic according to project limitations. A mood board was produced with attributes and pictures associated with playfulness and characteristics of the Giraff associated with playfulness was mapped out. Playfulness is a concept that has been used not only to meet the needs of children but also to break new path and increase creativity in business (Jacobs, C. and Heracleous, L., 2007). In this process it is used both as a childish association and as a way to trigger the creativity of the users participating in the workshops. This lead the development of three models that took up some extremes related to the Giraff hardware. For example, considering the hardware in terms of playfulness, it has a chin that could become a mouth, it has mounts on the screen that can be ears, it has a top that can become the eyes and antennas. The three models turned out to emphasise a variety in taste and life style with the purpose to trigger the users:

- Playfulness
- Functionality
- Minimalism

7.2.3 Design Sketches

Three design sketches were produced and distributed to be evaluated in Malaga, Rome and Lund. The first model has a bearing on minimalism. It is simple in its form, almost a skeleton which offers the possibility to grab it and hang things on it. An image of a seated person shows the size of the robot.

Minimalistic with alternatives

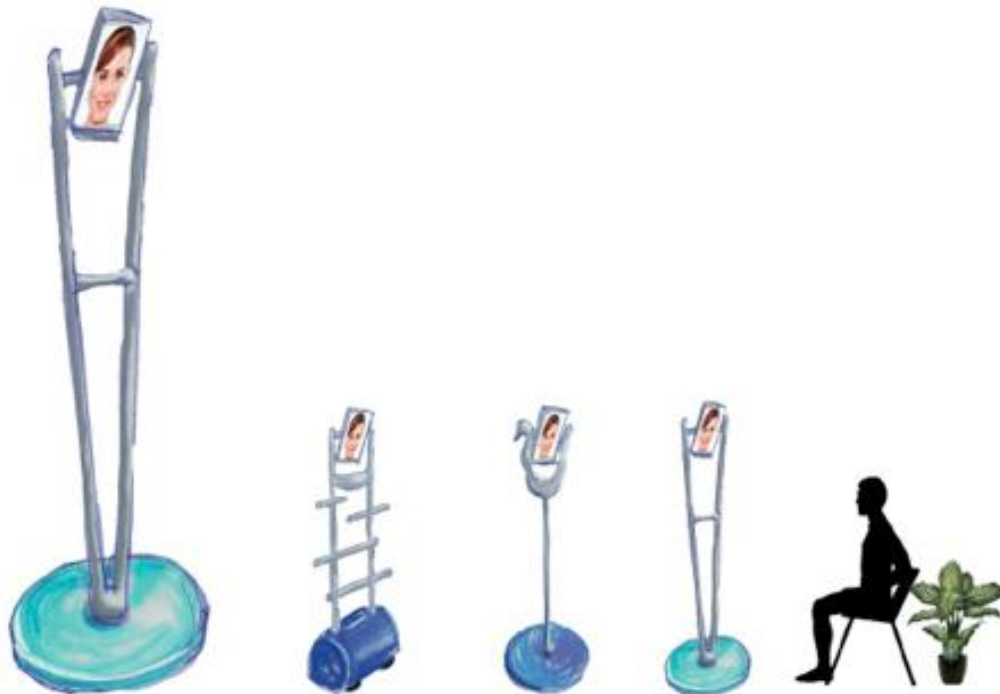


Figure 9 Minimalistic option with alternatives

Furniture-like with flower pot and alternatives

The second model resembles a piece of furniture, almost camouflaged with a possible flowerpot, a table, a scale or similar functions that may trigger the imagination.



Figure 10 Furniture-like option with flowerpot and alternatives

Dragon animal-like with alternative playful design

The third model is colorful and maybe playful in its true sense. It is childish, animal like, signals happiness and might attract both children and elderly. The seated person shows the size of this appearance.



Figure 11 Dragon animal-like option with alternative playful design

7.3 Workshops with users

The design sketches were evaluated in three different countries. The joint workshop guide describes workshop as a way to be creative in a structured manner and with a clear objective and where the participants is the most important resource. In these workshops performed in Malaga, Rome and Lund, in total 27 people, aged 65 and older, were participating. All of them were living as singles in their own home.

The main objective for the workshop to evaluate the models in order to understand which of them the participants prefer and why, and what the participants find acceptable, meaningful and supportive for them and their specific situation.

The preparations of the workshop encompasses previous experiences of involving elderly users, a similar structure to be used in all the three countries, guidance for workshop leaders and a tool for the analysis of the result. See Appendix 12.11.

7.3.1 Involving elderly

The workshops were planned for five hours, lunch included. Elderly are not a heterogeneous group, and there are certain aspects should be considered in relation to their age. Previous experiences show that the *length* of the meetings and the *hours* are important (Östlund 2008, Zajicek 2005). Five hours is the maximum time possible. For the same reason the workshop should not start too early in the morning, though this may differentiate between northern and southern Europe. Also the *number* of participants in the group is important. Their concentration and attention to others dramatically fell when there were more than three in a smaller group and fifteen in total. The relevance of the *content* is also important for the concentration. Since the participants have been invited and have accepted the invitation the content is hopefully attractive to them.

One aspect of being invited to a workshop about the use of robots in the home is that it will raise emotions associated with earlier impressions of what robots are. This is being considered in the beginning of the workshop where the participants will be given the opportunity to express what initially comes to their mind.

Overall **27 elderly users** have been involved (7 men and 20 women) with an age ranging from 65 to 90 years ($M = 79.32$, $SD = 6.67$). Figure 12 describes in more details the composition of the samples with respect to the age.

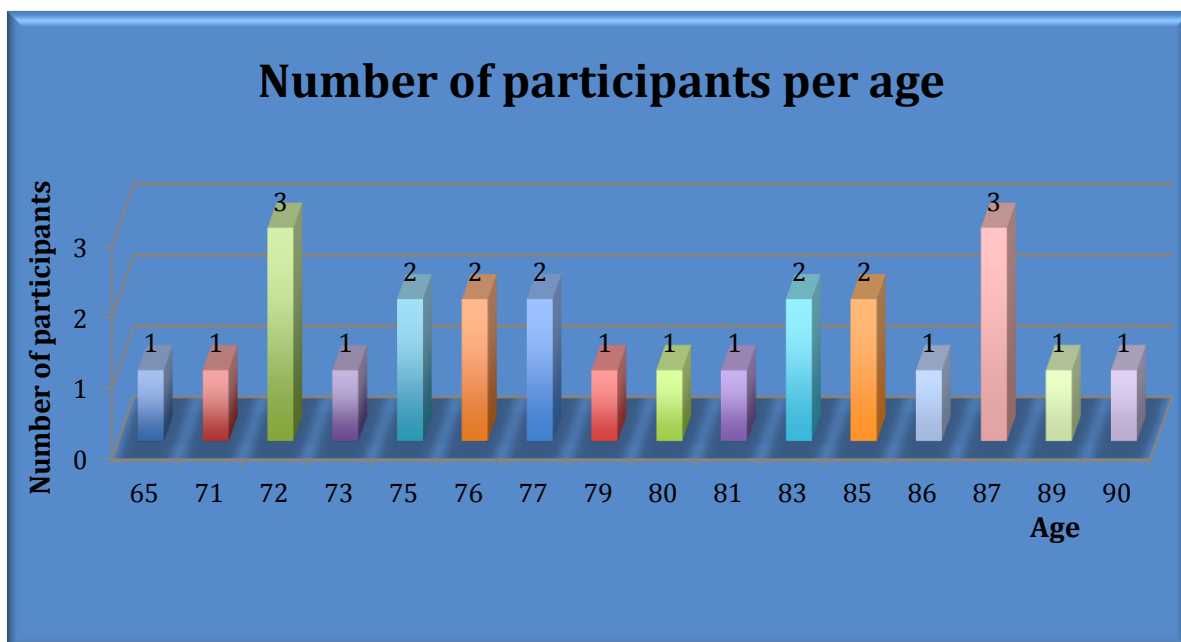


Figure 12 Sample of the workshop: number of participants per age

Some pictures from the workshop sessions are depicted in the following Figure 13 and Figure 14.



Figure 13 Workshop at “Associazione Arca di Noè” in Italy

(Picture reproduced with participants’ written permission)



Figure 14 Workshop at “Associazione Arca di Noè” in Italy

(Picture reproduced with participants’ written permission)



Figure 15 Workshop in Sweden

(Picture reproduced with participants' permission)



Figure 16 Workshop in Sweden

(Picture reproduced with participants' permission)

7.3.2 The structure of the workshop

The structure of the workshop is based on experiences of designing robotics for elderly and participatory design within the ageing and design program in Lund (Wu, Fassert & Riguard 2012, Östlund 2008).

1. The aim of the first step is:
 - To make it clear for the participants what is the goal of the workshop, what will happen with the results and who is going to process the results. See the guide below.
 - To make a short presentation of the participants
 - To present the schedule for the day.
 - To tell them how and when they will get feedback and information of what happened with their contributions.
2. The aim of the second step is to get the participants to express their feelings and ideas about robots, and to focus on the models that will be presented. Pictures of different robots, fictive and real, are displayed on a screen. The participants are asked to make free comments on what they see and what they feel. This can be done in the big group but preferably in smaller groups of two to three persons.
3. The third step is a lunch that the participants and the leaders are eating together.
4. The fourth step is to introduce the Giraff concept to the participants. Show them a picture of the Giraff robot itself and describe the system with sensors, that it is mobile and provide communication opportunities.
5. The fifth step is to get the participants comment on and develop the design sketches provided by Industrial design at Lund University. The participants will work in groups of 3-4 and be provided with a picture of each design sketch, blank papers and different kind of crayons and pencils in different colors. It is valuable if workshop leaders can act as facilitators in every group, not to run the discussion but to listen and to take notes.

They are asked to:

- Comment on the pictures and individually rank them on a piece of paper and motivate why they prefer certain models and not others. Encourage them to talk about themselves as "I" instead of discussing elderly in general. The rankings should be motivate a low or high rank in relation to special needs, expressed life style, the physical space/home environment, usefulness, to be used for what and other unpredictable comments.
- Ask them to write down their comments or make their own changes and drawings. The sketches have a few alternatives on the side that might encourage them to bring up new ideas. Elaborate further in drawing or writing, how to develop the design, the color, the function to fit into their home etc..
- Discuss the result in the large group.

6. The aim of the fifth step is to conclude the day. Let every group give any concluding remarks on the content of the day and their experience of being a part of this workshop. Remind them about when and how they will get feedback.

7.4 Results and Analysis

The results of the workshops have been presented in two tables with rankings and motivations according to the list of content below.

The first table shows the priorities of the three design models.

The second table shows requirements and requests that emerged from the workshop analysis.

7.4.1 Priorities of design models

The table shows the result of the priorities of the three design models with a brief description of the requirements delivered by the participants in Italy, Spain and Sweden. The third column is a short description of what motivated the different requirements. The table shows that the minimalistic model was in favor in Sweden but not in Italy and Spain who prefer the second design model with a more functional approach. No one selected the third model.

#	Description of requirements	Justification
Top ranking in Sweden: Minimalistic model	Nice appearance, more functionality More stability Discrete and stylish Possible to personalize and make their own changes.	This alternative: a) is possible to modify and decorate with flowers or lights b) take less place in the home c) easier to move in small apartments d) seems to be most resource-efficient and therefore environmentally friendly
Top ranking in Italy and Spain: Furniture like with flower pot	More functionality	Nicest one and it is also somehow less cumbersome in comparison to the other two models one.
Second ranking in Sweden: Furniture like with flower pot	Camouflage, but a bit clumsy and awkward	Disguise that makes it not so easily detected among other furniture, prevent stigmatization.

Second ranking in Italy and Spain		
Third ranking in Sweden, Italy, Spain: Dragon, animal-like	Playful but a bit too much As a first priority: more functional	Attractive to the grand children when they visit. More functional Practical, handy and useworthy

7.5 Analysis

The workshop results have been critically analyzed. A summary of the main results is presented in this section, while the next section reports the list of user requirements that have been derived. In Appendix 12.11 the detailed list of row user requirements is also available.

Personalization and adaptation: the result of the workshop indicates the prerequisites to design and develop new technology for elderly people today, including the need for personalization and adaptation to a variety of environments where people live at home. To carry out this type of design workshops with a relatively broad approach in three countries stress the heterogeneity of the elderly population further. In that situation the three alternative models helped, due to their extreme or exaggerated design, to clarify some of the user experience of ambient support and comfort and the conditions under which they would be willing to incorporate the GiraffPlus system in their daily lives. In Italy and Spain the workshop participants preferred the model with the table with a flowerpot given that it had more useful features and perceived as less cumbersome to have at home. In Sweden the workshop participants preferred the minimalistic model given that it was discrete and offered possibilities to personalize with different kind of decorations. None of the workshops suggested the third model based on the playfulness concept.

Beyond different priorities concerning the three alternative models the cross cultural differences were few. This seems to make the GiraffPlus system possible to apply on a European scale. Italy focused more on the sensors and Spain and Sweden focused more on the utility. The differences are most likely due to the fact that the discussions at the workshops went in different directions.

Integration in the home environment: the desire to get the GiraffPlus system to fit in at home is also seen in requirements and requests. Some general conclusions can be drawn. The location of the robot, the sensors and the charging station depends on the organization of the home. They have to be adapted to where there is room and where the users spend most of their time. However, there may be clear limits for when the robot can become too intrusive. Participants complained that the bathroom and the bedroom are perceived as private, and where they were hesitant or resistant to whether the robot should have access. The variety of homes also includes space problems. When elderly people change home they most often move into a smaller space than they had before. To select what furniture they want to keep and not keep is also a time consuming process, which can result in that the home despite of a smaller area is over furnished (Marcoux 2001). In addition a general statement is that the robot needs to be less bulky and lower

but still stable. One suggestion is no taller than 1.50 meters which might be a measure that need to be adapted to individual length. Other aspects that were regarded as mandatory to allow the robot into the home are the look and the feel of the material and the colour.

Sounds and voice: sound is another general aspect that workshop participants express. According to participants, the robot should not produce unwanted noise. Machine sounds are not associated with domesticity. The sound aspect also includes the voice of the people that the users communicate with through the screen. There are reasons based on these results of further testing of how trustworthy voices sound and the way communication via the screen should be implemented. When discussing the face of the robot the Spanish participants preferred a female look. Previous experiences of design in Lund tell us that this is also frequent when it comes to sound. The gender of the voice and the face also has a bearing on male and female requirements that should be discussed further in the project.

Robot appearance: the appearance of the robot and whether or not to see the person you are talking to on the screen was discussed related to acceptance. To make the robot more humanlike was considered as an alternative to the screen. Another consideration was to keep the screen and develop a face and choose what fits the situation or the moment. The dominant view among the workshop participants was that a human appearance, at least the face, makes it more familiar. How human a robot should look is a question that there are reasons to follow up on during the project since it is the subject of a wide debate today in connection with the development of different types of robots, where traditional steel figure and less machinelike robots such as vacuum cleaners occur in parallel with animal like robots and human-like forms (Wu et al 2012).

System Usefulness: the result proves that to be worth taking on, the GiraffPlus system need to have something more that the primary user can benefit from; what's in it for me? Monitoring, reminders to take medication and alarm functions were mentioned as mandatory, desirable or optional utilities depending on the need. However, to let a new object such as the Giraff into the home it needs to bring more of a possibility of use to the user. This is a window of opportunity for this system to open up the home to a range of social contacts and services. The workshop participants mentioned possibilities to order services, e.g., get information from Internet and use it as a book reader. Advanced requests were also mentioned such as rehabilitation training programs, massage and help to grasp devices, both functions requiring a mechanical hand and an adjustable arm. Other functions beyond using the GiraffPlus system as media was to use it as a support when arise from a chair. This was one of the arguments for increased stability when making priorities in between the three models.

Hardware modifications to the robot: some hardware modifications were pointed out to increase affordance. These where a round grip bar since a square bars can signal "do not touch". Modifications also suggested a night vision camera and the adjustment of the screen and voice control. In this respect the primary users were considering the secondary users and the possibility to keep up a dialogue also at night.

Finally, the participants also raised questions about who will pay for the use of the GiraffPlus system and the battery life.

To conclude, the workshop participants preferred a GiraffPlus system that could provide an alarm system and reminders of medications and also maintain social contacts and offer possibilities to receive information. Moreover it should be placed where there is space and with respect for privacy, with a limited number of sensors that are camouflaged. The robot should be stable, lower and silent, with nice material and colour and with a grip bar, a vertically adjustable screen and voice control.

Overall these findings provided useful indications to identify a set of relevant user requirements (UR) with an associated level of priority. In this regard, in section 9, the GiraffPlus UR list is enriched with an additional detailed list of user requirements defined according to the above discussion.

7.5.1 Assigning Priority to User Requirements

The priority of each UR has been assessed according to a qualitative analysis performed on the results gathered through the workshops (see Appendix 12.11.4). More specifically, the URs that were somehow related to system functionalities have been considered as more relevant than the ones related to the sole system appearance and shape, unless the participants strongly rated it differently. Moreover, coherently with the results collected on the usefulness/acceptability (see Part I), the environmental/physiological monitoring capabilities have been assigned a higher level of priority with respect to the other system capabilities. Finally, a remarkable set of URs has been derived from some additional services that the tele-presence robot may provide to primary users. As in section 6.2.6, the same priority levels have been considered: **KEY**, **DESIRABLE** and **OPTIONAL**.

Part III Detailed List of User Requirements for the GiraffPlus system

The third step of the user needs elicitation entailed a critical analysis of the indications obtained by the end users and a subsequent synthesis of the detailed list of user requirements. To this purpose we carefully analyzed the results of focus groups, questionnaires and workshops and produced two lists of detailed user requirements. Specifically, the next two sections describe in detail the user requirements which emerged from both the first and second part of the work, corresponding to Task T1.1 and Task T1.2.

In addition, this part contains requirements related to the *Data Privacy and Security* issue emerged both during the focus group and the workshop phases.

In this respect, the GiraffPlus consortium is fully committed to comply with the Directive 95/46/EC of 24th of October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data, which has been implemented in all the participant countries. In addition, the European Commission has recently proposed (25th January 2012) a comprehensive reform of the EU's 1995 data protection rules to strengthen online privacy rights and boost Europe's digital economy. In this regulation, concepts like biometric data and data concerning health are clearly defined. Therefore, a key requirement of the project is to ensure the protection of this kind of data sharing and collecting.

In this regard, some measures shall be taken to suitably address security issues to:

- Ensure that personal data can be accessed only by authorized personnel for legally authorized purposes;
- Protect personal data stored or transmitted against accidental or unlawful destruction, accidental loss or alteration, and unauthorized or unlawful storage, processing, access or disclosure;
- Ensure the implementation of a security policy with respect to the processing of personal data;
- Provide any person with the right of access to data which has been collected concerning them.

Considering the nature of the GiraffPlus project, some additional regulations (and their local implementation in the involved Countries) must be considered: Directive 2009/136/EC amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data, the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws, and Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity).

In Section 9, we define a set of User Requirements aiming at defining a list of requirements needed to address the above mentioned data security and protection issues. Then, in the *D1.3 System Reference Architecture* document (due date M6), data security and protection issues will be fully addressed considering suitable modules in the GiraffPlus system architecture as well as defining a set of dedicated functional specifications of the overall system.

8 Requirements from Part I

The results of the work already discussed in Section 6.2.2 and Section 6.2.4 have been further critically analysed resulting in the following list of detailed User Requirements. For the definition of the level of priority for each requirement, the reader can refer to Section 6.2.6.

For each requirement the following information is provided:

Serial/Ref: an identifier of the User Requirement

Capability Descriptor: a brief textual description of the User Requirement

Requirement Statement: a more detailed description of the User Requirement

Justification References: A short reference to the motivations for the User Requirement and specifically the source that inspired it.

In particular, the origin of each UR is specified through the specific phase (Literature Review, Focus Groups and/or Workshops), the country (Italy, Spain and/or Sweden) and the end user category (EP = Elderly People, HP = Healthcare Professionals, CG = Caregivers) from which the UR has been addressed.

Validation criteria: a statement suggesting how the User Requirement could be checked

Priority: the level of importance of the User Requirement in the range of **Key**, **Desirable**, **Optional**

Serial/ Ref	Capability Descriptor	Requirement Statement	Justification References	Validation Criteria	Priority
1. Person					
1.a. Physiology Monitoring					
1.a.1	Monitoring of vital signs	GiraffPlus shall monitor vital signs over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain EP, CG, HP	GiraffPlus provides the capability to measure over time some of the vital signs of the elderly: e.g., heart rate and/or breathing during day and/or night for a certain number of days or weeks	K
1.a.2	Detecting the presence of body fluids	GiraffPlus shall detect the presence of body fluids in different places at home	Literature Review Focus Groups Spain HP	GiraffPlus provides the capability to detect the presence of sweat and/or urine and/or blood on sofas and/or beds	D
1.a.3	Monitoring blood pressure	GiraffPlus shall monitor blood pressure over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the capability to monitor the elderly person blood pressure during day and/or night for a certain number of days or weeks (time and frequency of the measurement can be defined)	K

1.a.4	Monitoring blood glucose levels	GiraffPlus shall monitor blood glucose levels (glycemia) over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the capability to monitor the elderly person blood glucose levels (glycemia) during day and/or night for a certain number of days or weeks	K
1.a.5	Monitoring blood oxygen saturation	GiraffPlus shall monitor blood oxygen saturation (oximetry) over different day periods for a variable amount of days	Literature Review Focus Groups Italy, Spain EP, HP	GiraffPlus provides the capability to monitor the elderly person blood oxygen saturation (oximetry) during day and/or night for a certain number of days/weeks/months	K
1.a.6	Monitoring body temperature	GiraffPlus shall monitor body temperature over different day periods for a variable amount of time	Literature Review Focus Groups Spain HP	GiraffPlus provides the capability to monitor the elderly person body temperature during day and/or night for a certain number of days/weeks/months	O
1.a.7	Determining whether the person suffers from incontinence	GiraffPlus shall help in understanding whether the elderly person suffers from incontinence over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, HP	GiraffPlus supports the caregiver in understanding whether the elderly person suffers from episodes of incontinence during day and/or night for a certain number of days or weeks	D

1.a.8	Monitoring body weight	GiraffPlus shall monitor body weight over a (variable) period of time	Literature Review Focus Groups Sweden, HP	GiraffPlus provides the capability to monitor the elderly person body weight during day for a certain number of days/weeks/months (time and frequency of the measurement can be defined)	K
1.a.9	Monitoring Heart function	GiraffPlus shall monitor Heart function over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the capability to monitor the elderly person Heart rate during day and/or night for a certain number of days or weeks	K
1.a.10	Monitoring sleep activity	GiraffPlus shall monitor sleep activities over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Spain EP, HP	GiraffPlus provides the capability to monitor whether the elderly person is moving a lot while sleeping during day and/or night for a certain number of days or weeks	O
1.b. Social Interaction Monitoring					

1.b.1	<i>Facilitating contact between the person and healthcare professionals</i>	<i>GiraffPlus shall facilitate the communications between the elderly person and authorized healthcare professionals in different day periods</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides an additional and easy way of communication between the elderly person and healthcare professionals responsible of his/her health status. Communications may occur at different times during the day. The person (or more than one) to communicate with should be authorized and can change.</i>	K
1.b.2	<i>Periodic reporting to secondary users</i>	<i>GiraffPlus shall provide both formal and/or informal secondary users with a periodic report on ADL/IADL</i>	<i>Focus Groups</i> <i>Italy</i> <i>EP,</i>	<i>GiraffPlus provides the capability to send relevant information on the elderly person daily activities to a secondary user (e.g., a close relative and/or a doctor).</i>	K
1.b.3	<i>Facilitating contact between the person and home care assistance</i>	<i>GiraffPlus shall facilitate the communications between the elderly person and authorized home care assistant(s) in different day periods</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides an additional and easy way of communication between the elderly person and the home care assistant(s) responsible of his/her health status. Communications may occur at different times during the day</i>	K

1.b.4	Reminding medications	<i>GiraffPlus shall remind important medication events with some time regularity for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides the capability to send reminders to the elderly person on the medicine assumption or medications in particular hours of the day and/or night for period of time whose length can be defined</i>	K
1.b.5	Notifying the house presents an unusual setting to caregivers	<i>GiraffPlus shall provide caregivers with direct notice if the house presents an unusual setting (first potenzial evidence of a personal disorder)</i>	<i>Focus Groups</i> <i>Italy</i> <i>EP</i>	<i>GiraffPlus provides the capability to inform caregivers if the lights are still on and/or if doors are open during the night</i>	O
1.b.6	Facilitating contact between the person and family members	<i>GiraffPlus shall facilitate the communications between the elderly person and family member(s) in different day periods</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Italy, Spain</i> <i>EP</i>	<i>GiraffPlus provides an additional and easy way of communication between the elderly person and family member(s). Communications may occur at different times during the day</i>	D
1.b.7	Allowing emergency call	<i>GiraffPlus shall enable authorised secondary users to make an emergency call through the tele-presence robot</i>	<i>Focus Groups</i> <i>Italy</i> <i>EP</i>	<i>GiraffPlus should allow authorized caregivers to perform an emergency call through the tele-presence robot in order to monitor the status of the elderly person in the house.</i>	K

1.b.8	Warning notice to secondary users	GiraffPlus shall provide both formal and informal caregivers with warning notice in case of possible danger of the elderly person	Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the capability to send to authorized home care assistant and/or close relatives warning notice in case of possible danger of the elderly person	K
1.c. Activity Monitoring					
1.c.1.	Detecting the position	GiraffPlus shall detect the position of the elderly person inside the house over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the capability to detect the position of the elderly person inside the house in particular hours of the day and/or night for a certain number of days or weeks	K
1.c.2	Monitoring the movement	GiraffPlus shall monitor the movement inside the house over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the capability to monitor the movement of the elderly person in particular hours of the day and/or night for a certain number of days or months	K
1.c.3	Detecting the absence of movement	GiraffPlus shall detect the absence of movement of inside the house over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the capability to detect the absence of movement of the elderly person inside the house for a period of time which can be defined.	K

1.c.4	<i>Temporal monitoring of the position</i>	<i>GiraffPlus shall temporally monitor the elderly person's position inside the house</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides the capability to detect how much time the elderly person spends in the bed/kitchen/sitting/etc. for a certain number of days or weeks</i>	O
1.c.5	<i>Detecting changes of habit</i>	<i>GiraffPlus shall provides evidence that helps to detect changes in elderly person's habit in ADL/IADL inside the house for long-term monitoring</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides the capability to monitor changes of habits for long-term monitoring, e.g., the elderly person wakes up too late with respect to usual standard and/or he/she spends more time than usual in personal cleaning</i>	O
1.c.6	<i>Monitoring of night activities</i>	<i>GiraffPlus shall monitor the night activities of the elderly person inside the house over different day periods for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides the capability to detect how many times the elderly person gets out of bed to go to a particular place and/or how much time he/she stays there (monitoring for a certain number of days or weeks)</i>	D

1.c.7	Monitoring cooking ability	GiraffPlus shall monitor the cooking activities of the elderly person inside the house for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain HP	GiraffPlus provides the capability to gather information that help to monitor the ability of the elderly person to prepare for lunch and/or dinner over a certain number of days or weeks	O
1.c.8	Monitoring the time spent for preparing lunch	GiraffPlus shall monitor the time spent by the elderly person for preparing lunch for a variable amount of time	Literature Review Focus Groups Sweden, Italy, Spain HP	GiraffPlus provides the capability to help understanding the time spent by the elderly person to prepare for lunch for a certain number of days/weeks/months	O
1.c.9	Monitoring the time spent in different home places	GiraffPlus shall monitor the time spent by the elderly person in different places inside the home for a variable amount of time	Literature Review Focus Groups Italy HP	GiraffPlus provides the capability to understand the time spent by the elderly person in the shower and/or bath for a certain number of days or weeks	O
1.c.10	Monitoring the use of refrigerator at home	GiraffPlus shall monitor the frequency with which the refrigerator is opened by the elderly person over different day periods for a variable amount of time	Literature Review Focus Groups Sweden, Spain EP, HP	GiraffPlus provides the capability to detect the frequency with which the refrigerator is opened by the person for a certain number of days or weeks	O

1.c.11	<i>Monitoring the social interactions activity</i>	<i>GiraffPlus shall monitor the frequency of the social interactions of the elderly person over different day periods for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Spain</i> <i>HP</i>	<i>GiraffPlus provides the capability to detect prolonged periods of time spent by the elderly in complete solitude in the house without contacts with the external world.</i>	O
1.c.12	<i>Detecting decline in mobility</i>	<i>GiraffPlus shall help monitoring a decline in the mobility of the elderly person for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides the capability to help understanding whether the elderly person presents difficulty walking and/or difficulty maintaining balance for a certain number of days or weeks</i>	K
1.c.13	<i>Detecting absence of the elderly person</i>	<i>GiraffPlus shall detect the absence of the elderly person in the house during unusual period for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden,</i> <i>EP, HP</i>	<i>GiraffPlus provides the capability to detect the absence of the elderly person overnight for a certain number of days or weeks</i>	K
1.c.14	<i>Monitoring the use of home appliances</i>	<i>GiraffPlus shall monitor the use of home appliances by the elderly person over different day periods for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>HP</i>	<i>GiraffPlus provides the capability to monitor over time the use of the stoves or other appliances by the elderly person in particular hours of the day and/or night for a certain number of days or weeks</i>	D

1.c.15	<i>Detecting Falls</i>	<i>GiraffPlus shall detect whether the elderly person falls inside the house for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides the capability to determine whether the person falls to the ground and remains there unable to get up</i>	K
1.c.16	<i>Monitoring the time spent in bed</i>	<i>GiraffPlus shall be able to monitor how much time the elderly person spends in bed over different day periods for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>HP</i>	<i>GiraffPlus provides the capability to monitor whether in the morning the elderly person keeps staying in bed and/or whether she/he does not get up</i>	K
1.c.17	<i>Monitoring person balance</i>	<i>GiraffPlus shall help monitoring the elderly person's ability to maintain balance for a variable amount of time</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides the capability to help monitoring the person's ability to maintain a stable standing position for a certain amount of days or weeks</i>	K
2. Environment					
2.a. Home environment					

2.a.1	<i>Detecting dangerous environmental situations</i>	<i>GiraffPlus shall detect potentially dangerous environmental situations</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Italy, Spain</i> <i>EP, HP</i>	<i>GiraffPlus provides the ability to monitor selected home environment factors like: gas leaks and/or risk of fire inside the house</i>	K
2.a.2	<i>Detecting misplaced objects inside the house</i>	<i>GiraffPlus shall detect the presence of misplaced objects inside the house</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Spain</i> <i>HP</i>	<i>GiraffPlus provides the ability to detect the presence of misplaced objects in the environment that could cause risk of falls</i>	K
2.a.3	<i>Detecting open doors</i>	<i>GiraffPlus shall detect for open doors in the house</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, ItalyEP,</i>	<i>GiraffPlus provides the ability to detect whether selected doors inside the house are open (or remain open)</i>	K
2.a.4	<i>Detecting lights status</i>	<i>GiraffPlus shall detect the status of lights inside the house</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Spain</i> <i>HP</i>	<i>GiraffPlus provides the ability to detect the presence of lights on inside the house during unusual day period (e.g., overnight)</i>	O

2.a.5	Detecting gas leaks	GiraffPlus shall detect the presence of gas leaks inside the house	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the ability to detect the presence of gas leaks inside the house	K
2.a.6	Monitoring temperature	GiraffPlus shall monitor the temperature inside the house	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the ability to monitor the presence of extreme temperatures (e.g., too hot or too cold) inside the house (too hot and too cold should be defined over time)	D
2.a.7	Detecting risky situations	GiraffPlus shall detect the presence of risky situations inside the house	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the ability to detect the presence of smoke in the environment potentially risky for the development of fire inside the house or for the elderly health	K
2.a.8	Detecting water leaks	GiraffPlus shall detect the presence of water leaks inside the house	Literature Review Focus Groups Sweden, Italy, Spain EP, HP	GiraffPlus provides the ability to detect water leaks inside the house that may cause flooding and risk of falls	K

2.a.9	<i>Detecting taps status</i>	<i>GiraffPlus shall detect the status of taps inside the house</i>	<i>Literature Review</i> <i>Focus Groups</i> <i>Sweden, Spain</i> <i>HP</i>	<i>GiraffPlus provides the ability to detect whether taps have been left open inside the house to avoid the risk of spills of water in the floor and, consequently of falls</i>	K
-------	------------------------------	--	--	---	----------

9 Requirements from Part II

This section describes the detailed list of User Requirements emerged from the critical analysis of the workshops results already discussed in Section 7.4. These requirements are complementary with respect to the ones presented in the previous sections and are mainly related the GiraffPlus physical aspects and appearance.

For each requirement the following information is provided:

Serial/Ref: an identifier of the User Requirement

Capability Descriptor: a brief textual description of the User Requirement

Requirement Statement: a more detailed description of the User Requirement

Justification References: A short reference to the motivations for the User Requirement and specifically the source that inspired it.

In particular, the origin of each UR is specified through the specific phase (Literature Review, Focus Groups and/or Workshops), the country (Italy, Spain and/or Sweden) and the end user category (EP = Elderly People, HP = Healthcare Professionals, CG = Caregivers) from which the UR has been addressed.

Validation criteria: a statement suggesting how the User Requirement could be checked

Priority: the level of importance of the User Requirement in the range of **Key**, **Desirable**, **Optional**

<i>Serial/ Ref</i>	<i>Capability Descriptor</i>	<i>Requirement Statement</i>	<i>Justification References</i>	<i>Validation Criteria</i>	<i>Priority</i>
3. Robot					
3.a. Appearance					
3.a.1.	Shapes	<i>GiraffPlus shall deploy a tele-presence robot with graceful aspect in the home environment</i>	<i>Workshop Italy Spain Sweden EP</i>	<i>GiraffPlus shall include a tele-presence robot with a nice-to-see aspect</i>	D
3.a.2.	Dimensions	<i>GiraffPlus shall deploy a tele-presence robot with suitable size</i>	<i>Workshop Italy Spain EP</i>	<i>GiraffPlus shall integrate a tele-presence robot with dimension suitable to be placed in the home environment of the elderly person and to safely navigate within it</i>	K
3.a.3.	Materials	<i>GiraffPlus shall include a tele-presence robot made of a suitable material</i>	<i>Workshop Italy Sweden EP</i>	<i>The material of the Giraff robot is positively assessed by the elderly</i>	D
3.a.4.	Colors	<i>GiraffPlus shall deploy a tele-presence robot with customizable colors</i>	<i>Workshop Italy Sweden EP</i>	<i>The colors of the Giraff robot can be adapted to the house furniture style</i>	D

3.a.5.	Screen positions	<i>GiraffPlus shall deploy a tele-presence robot with adjustable screen position according to the elderly person position</i>	Workshop Sweden EP	<i>GiraffPlus integrates a tele-presence robot capable of adapting the screen at the standing/sitting/lying position of the elderly person</i>	K
3.b. Sounds and Voice					
3.b.1.	Avoid noises	<i>GiraffPlus shall deploy a tele-presence robot producing no noise in the home environment of the elderly person</i>	Workshop Spain EP	<i>GiraffPlus must deploy a tele-presence robot with no noisy engine and/or unpleasant sounds</i>	K
3.b.2.	Adjustable sound settings	<i>GiraffPlus shall deploy a tele-presence robot with adjustable sounds settings</i>	Workshop Italy Spain Sweden EP	<i>The voice and sounds setting of the tele-presence robot can be easily adjusted</i>	O
3.b.3	Voice Controls	<i>GiraffPlus shall deploy a tele-presence robot capable of executing voice commands (after receiving voice commands by the elderly person)</i>	Workshop Spain Sweden EP	<i>GiraffPlus integrates a tele-presence robot capable of reaching the charging station or to move to some positions after voice commands by the elderly person</i>	O
3.c. Hardware Configuration					

3.c.1	<i>Adjustable dimensions</i>	<i>GiraffPlus shall deploy a tele-presence robot capable of being physically reconfigured in terms of the height</i>	Workshop Italy Spain EP	<i>GiraffPlus includes a tele-presence robot that can be adjusted according to the height of the elderly person.</i>	K
3.c.2	<i>Night Vision</i>	<i>GiraffPlus shall deploy a tele-presence robot endowed with a night vision camera</i>	Workshop Spain EP	<i>GiraffPlus must deploy a tele-presence robot that can be operated also with reduced light conditions in the home environment</i>	K
3.c.3	<i>Adjustable Screen</i>	<i>GiraffPlus shall deploy a tele-presence robot allowing the physical reconfiguration of the screen in terms of the height</i>	Workshop Sweden EP	<i>GiraffPlus must deploy a tele-presence robot capable of adapting the screen at the standing/sitting/lying position of the elderly person</i>	K
3.c.4	<i>Open to sensors installation</i>	<i>GiraffPlus shall deploy a tele-presence robot open to sensors installation</i>	Workshop Italy EP	<i>GiraffPlus must deploy a tele-presence robot on which some sensors (e.g., a blood pressure assessment device) could be installed</i>	O
3.c.5	<i>Open to object allocation</i>	<i>GiraffPlus shall deploy a tele-presence robot open to object allocation</i>	Workshop Sweden EP	<i>GiraffPlus must deploy a tele-presence robot on which some objects (e.g., a glass or medicine) could be placed</i>	D

3.d Position in the home environment					
3.d.1	Positions	<i>GiraffPlus shall deploy a tele-presence robot suitable to be placed in different rooms in the home environment according to the elderly person preferences</i>	Workshop Italy EP	<i>The GiraffPlus tele-presence robot can be placed in the room where the elderly person spends the major amount of time during the day</i>	K
3.d.2	Limitations to mobility	<i>The GiraffPlus tele-presence robot shall be allowed to access the rooms in the home environment according to the elderly person preferences</i>	Workshop Italy EP	<i>The GiraffPlus tele-presence robot must access only the rooms in the home environment in which the elderly person allows its access (e.g., the living room, the kitchen, etc.)</i>	K
3.d.3	Charging station position	<i>The charging station of the GiraffPlus tele-presence robot shall be placed in different place in the home environment according to the elderly person preferences</i>	Workshop Sweden EP	<i>The charging station of the GiraffPlus tele-presence robot can be placed in every place of the house according to the elderly person's preference</i>	K
4. Sensors					
4.a. Appearance					

4.a.1	Shapes	<i>GiraffPlus shall provide sensors with graceful aspect</i>	Workshop Italy EP	<i>GiraffPlus must include sensors with a nice-to-see aspect (e.g., that appear as ornaments)</i>	D
4.a.2	Dimensions	<i>GiraffPlus shall deploy sensors with reduced dimensions</i>	Workshop Italy EP	<i>GiraffPlus must deploy sensors with dimensions suitable to be placed in the home environment of the elderly person</i>	D
4.a.3	Materials	<i>GiraffPlus shall deploy sensors with suitable materials</i>	Workshop Italy EP	<i>GiraffPlus integrates sensors the material of which is positively assessed by elderly people.</i>	D
4.a.4	Colors	<i>GiraffPlus shall deploy sensors with different colors</i>	Workshop Italy EP	<i>GiraffPlus integrates sensors with colors that can be well integrated with the house furniture style</i>	D
4.b. Integration in the home environment					
4.b.1	Aspects	<i>GiraffPlus shall provide sensors to be gracefully integrated within the home environment of the elderly person</i>	Workshop Italy EP	<i>GiraffPlus must provide sensors that elderly judge nice to see and with nice colors</i>	K

4.b.2	<i>Positions</i>	<i>GiraffPlus shall provide sensors suitable for installation in different home environment positions according to the elderly person preferences</i>	<i>Workshop</i> <i>Italy</i> <i>EP</i>	<i>GiraffPlus must provide sensors that can be installed in different home environment positions, e.g., avoiding some rooms for privacy reasons</i>	D
4.b.3	<i>Limited numbers</i>	<i>GiraffPlus shall provide a limited number of sensors to be installed in the home environment according to the elderly person preferences</i>	<i>Workshop</i> <i>Italy</i> <i>EP</i>	<i>GiraffPlus can be installed with a minimum number of sensors which is decided by the users in accordance with the specific monitoring needs (ability of customization)</i>	K
4.b.4	<i>Sensors camouflage</i>	<i>GiraffPlus shall provide the possibility to camouflage sensors according to the elderly person preferences</i>	<i>Workshop</i> <i>Italy</i> <i>EP</i>	<i>GiraffPlus must provide the possibility to camouflage sensors as part of the ornament in the home environment</i>	K
4.b.5	<i>Attached to the robot</i>	<i>GiraffPlus shall provide the possibility to attach sensors to the robot</i>	<i>Workshop</i> <i>Italy</i> <i>EP</i>	<i>GiraffPlus must provide sensors that could be attached to the robot, e.g., blood pressure assessment device</i>	O
5. Overall system					
5.a. Primary user services					

5.a.1	Reminder	<i>GiraffPlus shall provide reminders to the elderly person through the tele-presence robot</i>	Workshop Spain Sweden EP	<i>GiraffPlus provides the capability to send reminders the elderly person to perform medications, assume medicines, and/or special events (e.g., a birthday)</i>	K
5.a.2	Alarm	<i>GiraffPlus shall provide alarms to the elderly person in case of emergency through the tele-presence robot</i>	Workshop Sweden EP	<i>GiraffPlus must provide the elderly person with alarms in case of gas leaks and/or risk of fire</i>	K
5.a.3	Memorandum	<i>GiraffPlus shall provide a memorandum repository access through the tele-presence robot</i>	Workshop Sweden EP	<i>GiraffPlus should be able to associate pictures and/or tunes to the act of reminding the elderly person of relevant information</i>	O
5.a.4	Recording function	<i>GiraffPlus shall record and store audio/video/picture memorandum through the tele-presence robot</i>	Workshop Sweden EP	<i>GiraffPlus provides the possibility to record and store audio and/or video and/or picture to store relevant info through the tele-presence robot</i>	O
5.a.5	Internet access	<i>GiraffPlus shall enable internet access through the tele-presence robot</i>	Workshop Spain Sweden EP	<i>GiraffPlus provides the possibility to access the internet using the tele-presence robot</i>	D

5.a.6	Book reader	<i>GiraffPlus shall provide book reader service through the tele-presence robot</i>	Workshop Spain EP	<i>GiraffPlus provides the capability of reading a book through the tele-presence robot</i>	D
5.a.7	Language selection	<i>GiraffPlus shall be able to customize its interface according to the nationality of the elderly person</i>	Workshop Spain EP	<i>GiraffPlus integrates a robot the language of which can be selected according to the elderly people nationality</i>	D
5.a.8	Medical support	<i>GiraffPlus shall support rehabilitation activities</i>	Workshop Sweden EP	<i>GiraffPlus provides the capability to allow the elderly person to receive support during rehabilitation and/or post-hospitalization periods</i>	K
5.a.9	Obstacle detection	<i>GiraffPlus shall deploy a tele-presence robot capable of detecting obstacle in the home environment of the elderly person</i>	Workshop Spain EP	<i>GiraffPlus must integrate a tele-presence robot capable of navigating the home environment of the elderly person automatically detecting and avoiding obstacle</i>	K
5.b Costs					

5.b.1	Low cost	<i>GiraffPlus shall be a low-cost system</i>	Workshop Italy EP	<i>GiraffPlus should maintain an affordable cost (to be defined with a specific project activity)</i>	K
5.b.2	Public healthcare service support	<i>GiraffPlus shall be paid by public healthcare service</i>	Workshop Italy EP	<i>GiraffPlus must be provided to elderly person with the economic support of public healthcare service</i>	K
5.c Privacy and data protection					
5.c.1	Authorized data access	<i>GiraffPlus shall allow access to personal data only by authorized personnel only for legally authorized purposes.</i>	Focus Groups and Workshops Italy, Sweden, Spain HP, EP, CG	<i>GiraffPlus should adhere to the currently existing EU data protection directive and should be tested with respect to agreed security protocols that will be defined as system requirements in D1.3.</i>	K
5.c.2	Data Protection	<i>GiraffPlus shall protect stored data against accidental and/or unlawful destruction/loss/alteration as well as unauthorized or unlawful storage, processing, access or disclosure.</i>	Focus Groups and Workshops Italy, Sweden, Spain HP, EP, CG	<i>GiraffPlus should adhere to the currently existing EU data protection directive and should be tested with respect to agreed security protocols that will be defined as system requirements in D1.3.</i>	K

5.c.3	<i>Data security policy</i>	<i>GiraffPlus shall implement a suitable data security policy with respect to the processing of personal data.</i>	<i>Focus Groups and Workshops</i> <i>Italy, Sweden, Spain</i> <i>HP, EP, CG</i>	<i>GiraffPlus should adhere to the currently existing EU data protection directive and should be tested with respect to agreed security protocols that will be defined as system requirements in D1.3.</i>	K
-------	-----------------------------	--	---	--	----------

Part IV – Final Considerations

10 Additional suggestions for the GiraffPlus development

In addition to the detailed list of user requirements presented in this document these three months of work also allowed us to obtain indications for possible *scenarios* for the GiraffPlus system. Specifically, GiraffPlus has been initially conceived as a general and customizable system that can support different types of users in different ways.

The idea to pursue in the subsequent months of work could be to focus on *usage scenarios* that could be fully implemented and tested by the evaluation plan.

10.1 GiraffPlus scenarios of usage

In this section we provide a sketch of three possible scenarios that were recurrent in the focus group analysis, and that could deeply inspire the use case definition that will be one of the objectives of Task T1.4. For each of the three scenarios, we will provide a brief description, the type of users involved, the possible role of GiraffPlus, the sensors and the main parameters to be monitored and relevant to the case study and, finally, the more relevant involved UR.

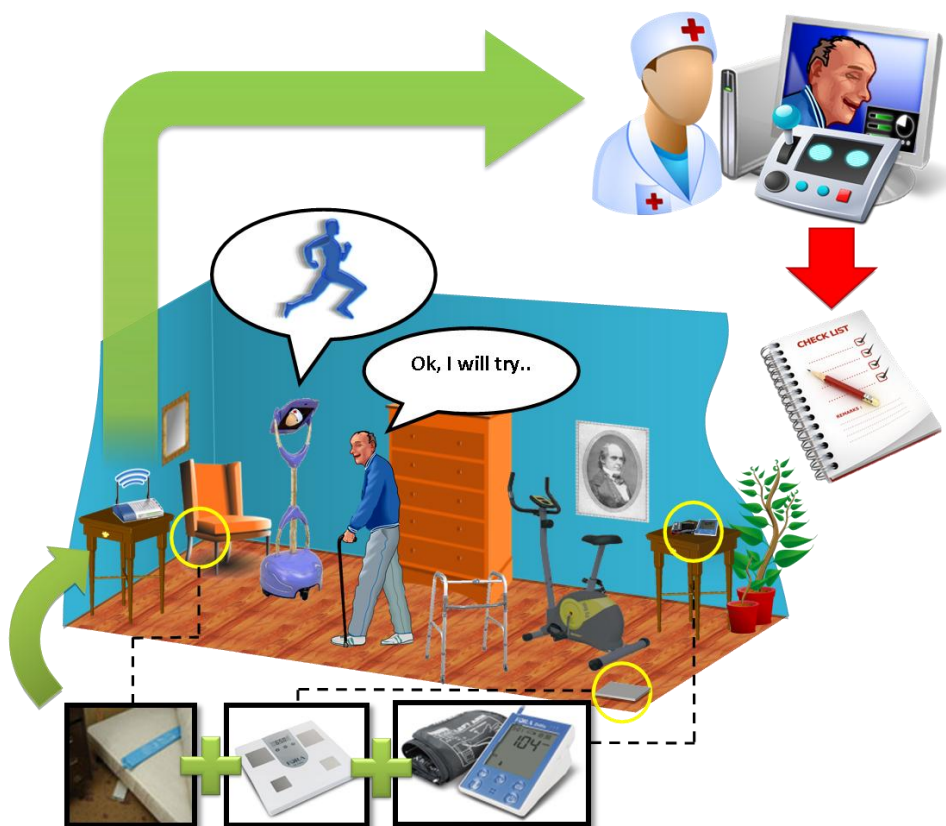


Figure 17 Scenario N. 1: monitoring a physiotherapy protocol

10.1.1 Scenario N. 1: monitoring a physiotherapy protocol

The first usage scenario covers the case of an elderly user who is following a protocol of physiotherapy rehabilitation. In Figure 17, a schematic idea of the scenario is given: GiraffPlus could be a means to continue such a support.

The following table summarizes the main actors involved and a possible role of the GiraffPlus system:

Primary Users	<i>An elder person at home following a physiotherapy treatment protocol</i>
Secondary User	<i>A physiotherapist who monitors the elderly during rehabilitation</i>
Role of GiraffPlus	<i>In a rehabilitation protocol, the physical therapist tries to restore the ability to move in a patient. In this perspective, the physical therapist assigns to the elderly a rehabilitation protocol strictly related to his/her physical activity. GiraffPlus could register relevant information such as for example: how long the patient spends in total in bed, sitting, standing and moving. The information may be submitted periodically to the physiotherapist at the level of detail or as a cumulative data. In this way the therapist could have an objective measure of the physical activity of the patient and possibly correct the protocol itself. In fact, the time spent in certain activities is "normal" only within certain limits. Providing historical data would also enable the therapist to do some statistics. Another important service could be to create a "Rehabilitation Forum", through which, thanks to robots Giraff, the physiotherapist can make rehabilitation session.</i>
Sensors and relevant parameters	<i>Mainly environmental parameters and the Giraff robot</i>
Main involved URs	<i>UR 1.b.1 Facilitating contact between the person and healthcare professionals</i> <i>UR 1.c.3 Temporal monitoring of position</i> <i>UR 1.b.2 Periodic reporting to secondary users</i> <i>UR 1.c.5 Detecting changes of habit</i> <i>UR 5.a.8 Medical support</i>

10.1.2 Scenario N. 2: monitoring after the de-hospitalization

One of the recurring problems among the elderly is also the case of de-hospitalization: elderly people who are discharged to return home and do not receive regular and continuous support by the medical staff. In such cases, the problem is the inability/difficulty to maintain a constant and frequent contact between the staff and the elderly person, maybe also worsened by the fact that many elderly people also have a few relatives at home. The Figure 18 gives a schematic idea of the scenario: GiraffPlus could be a means to continue such a support.

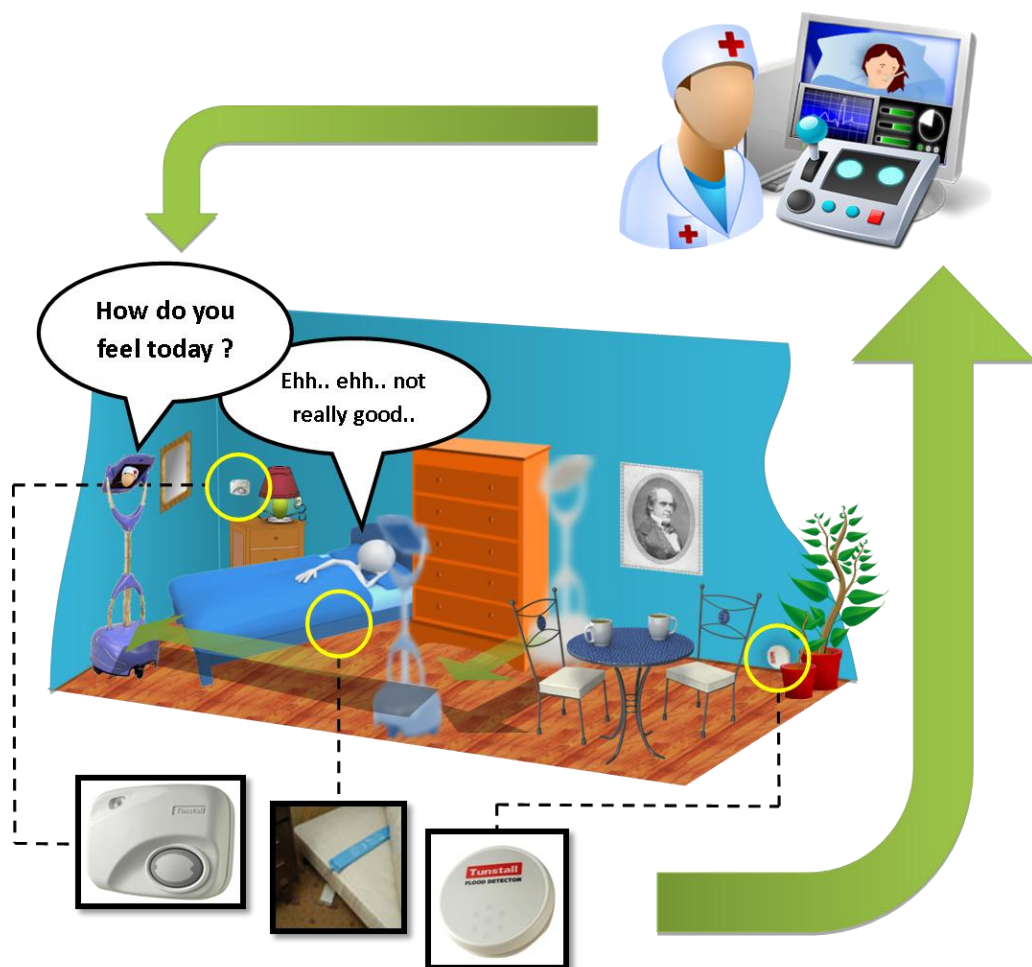


Figure 18 Scenario N 2: monitoring after de-hospitalization

The following table summarizes the main actors involved and a possible role of the GiraffPlus system:

Primary Users	An elder at home after a period in hospital;
Secondary User	Medical staff monitoring physiological parameters Psychologists or social operators
Role of GiraffPlus	GiraffPlus may support in two directions: 2.a Psychological monitoring: In general the Giraff presence can contribute to maintain a continuum with the care and support received in the hospital, also ensuring that the monitoring service is more frequent. Obviously the monitoring service could be a combination of remote (through the tele-presence robot Giraff) and physical assistance (through a real visit). 2.b Health monitoring: In this case GiraffPlus would allow monitoring the vital parameters after de-hospitalization,

Sensors and relevant parameters Main Involved URs	<i>eventually those specifically connected to a given pathology.</i> <i>Moreover, in this case, ensuring a continuous and frequent contact, a doctor could also better assess the need to change and customize the therapy protocol. The aim is to check if a certain therapy or just the post-hospital period proceeds properly and, if necessary, to support a doctor with evidence to change the treatment and or to personally visit the elderly.</i> <i>Mainly physiological sensors/parameters and the Giraff robot</i> <i>UR 1.b.1 Facilitating contact between the person and healthcare professionals</i> <i>UR 5.a.8 Medical support</i> <i>UR 1.a.1 Monitoring of vital signs</i> <i>UR 1.a.4 Monitoring blood glucose levels</i> <i>UR 1.a.9 Monitoring heart function</i>
--	--

10.1.3 Scenario N. 3: daily activity monitoring by an informal caregiver

The third scenario would be to use GiraffPlus for a daily monitoring of the elderly person by an informal caregiver (e.g. a son or a close relative). Figure 19 gives a schematic idea of the scenario: GiraffPlus could be a means to detect risky situations as well as provide warning to secondary users.



Figure 19 Scenario N 3: Daily activity monitoring by an informal caregiver

The following table summarizes the main actors involved and a possible role of the GiraffPlus system:

Primary Users	<i>An elder at home after living alone and assisted by an informal caregiver;</i>
Secondary User	<i>A son or a close relative of the elderly people who takes care of him/her</i>
Role of GiraffPlus	<i>In this scenario, a possible role of the GiraffPlus system could be to “detect” a risky situation such as falls. According to pre-defined emergency protocols, GiraffPlus is to provide the related secondary users (e.g., a close relative) with a warning message.</i> <i>Other useful services could be for instance monitoring some environmental events and overall understand the activities of the person inside the house, e.g., monitoring of usual activities in the different rooms.</i> <i>All this info could be presented to the informal caregiver as an objective evidence of particular situations.</i>
Sensors and relevant parameters	<i>Mainly physiological sensors and parameters and the Giraff robot</i>
Main involved URs	<i>UR 2.a.7 Detecting risky situation</i> <i>UR 1.c.15 Detecting Falls</i> <i>UR 1.b.8 Warning notice to secondary users</i> <i>UR 1.c.9 Monitoring the time spent in different home places</i> <i>UR 1.b.2 Periodic reporting to secondary users</i>

The three scenarios are mainly examples of the possible usage of the GiraffPlus system. They can be further elaborated and reinforced by means of additional dedicated interviews and workshops with the involved users and become the use cases of the GiraffPlus system.

10.2 Preventing role of GiraffPlus

We cannot neglect an important result that came out of the focus group and that is related to the fact that the system could monitor some aspects both related to the home environment and to the cognitive status of the patient that would allow a pre-alarm in case of Mild Cognitive Impairment.

In light of current data issued by the WHO, which considers Alzheimer and dementias as a global priority, reports confirm that around the world every 4 seconds a new case of dementia occurs: a growth rate defined as “awesome”, equal to 7,7 million of new cases each year. Faced with this situation, and the fact that two out of five people over 85 are at risk of dementia, the WHO's member countries that have a national plan on dementia in place are only eight of a total of 194. “Some countries, like India, have national strategies, but - says the director of the Department of Mental Health and Substance Abuse of WHO, Shekhar Saxena, developed by civil organizations: our hope is that other countries will follow the good example, using the report as a starting point for planning and implementation of national official plans. Since we know that these diseases will explode in this century, as we all live longer - the risk of dementia is already 1 to 8 for those over

65 and 1 to 2.5 for those over 85 - its impact will be increasing with the passage of decades" (News HEALTHCARE Rome, 12 April)

It is important to underscore that the elderly is the protagonist of this emergency, and certainly GiraffPlus should be considered in this perspective.

Marc Wortmann, Executive Director of Adi, states that the dementias are not only a public health problem, but also a social nightmare, fiscal and economic: our current health care systems cannot cope with the explosion of the crisis of dementia, as we all live longer.

The WHO Director General Margaret Chan urged all stakeholders to "make health care and social systems well informed, sensitive and responsive to this looming threat" ([http://www.alz.co.uk / WHO-dementia-report](http://www.alz.co.uk/WHO-dementia-report)).

In this framework GiraffPlus can be seen as a system that has a potentiality to monitor aspects that are a sign of cognitive decline, allowing the family and the medical institutions to take countermeasures preventively.

11 Conclusions

In this deliverable we presented the results achieved within these three months of work through the active involvement of potential users of the GiraffPlus system.

The report describes the methodology used for the collection and analysis of user needs, the qualitative and quantitative analysis performed, a literature review and the results obtained.

The requirements were collected in relation to *system services*, *physical appearance* and its *integration within the home environment*.

The study of these aspects allowed the definition of the user requirements that have also been assigned a *level of importance*. In conclusion, some scenarios of use have been defined that can serve as inspiration for the definition of use cases foreseen in Task T1.4.

12 Appendixes

12.1 References

This list contains the references that are inserted in the text to support the results described above.

1. Dahlin-Ivanoff, S., et al., *The multiple meaning of home as experienced by very old Swedish people*. Scand J Occup Ther, 2007. **14**(1): p. 25-32.
2. World Health Organization, *International classification of functioning, disability and health (ICF)2001*, Geneva: World Health Organization.
3. Haak, M., et al., *Home as a signification of independence and autonomy: experiences among very old Swedish people*. Scand J Occup Ther, 2007. **14**(1): p. 16-24.
4. Bravell, M.E., S. Berg, and B. Malmberg, *Health, functional capacity, formal care, and survival in the oldest old: a longitudinal study*. Arch Gerontol Geriatr, 2008. **46**(1): p. 1-14.
5. Kelley-Moore, J.A., et al., *When do older adults become "disabled"? Social and health antecedents of perceived disability in a panel study of the oldest old*. J Health Soc Behav, 2006. **47**(2): p. 126-41.
6. Barry, L.C., T.E. Murphy, and T.M. Gill, *Depression and functional recovery after a disabling hospitalization in older persons*. J Am Geriatr Soc, 2011. **59**(7): p. 1320-5.
7. von Heideken Wagert, P., Y. Gustafson, and L. Lundin-Olsson, *Large variations in walking, standing up from a chair, and balance in women and men over 85 years: an observational study*. Aust J Physiother, 2009. **55**(1): p. 39-45.
8. Young, Y., et al., *Does Self-Reported Function Correspond to Objective Measures of Functional Impairment?* Journal of the American Medical Directors Association, 2010. **11**(9): p. 645-653.
9. Aoyama, M., et al., *Physical and functional factors in activities of daily living that predict falls in community-dwelling older women*. Geriatrics & Gerontology International, 2011. **11**(3): p. 348-357.
10. Rossat, A., et al., *Risk factors for falling in community-dwelling older adults: which of them are associated with the recurrence of falls?* J Nutr Health Aging, 2010. **14**(9): p. 787-91.
11. Fox, K.R., et al., *Neighbourhood deprivation and physical activity in UK older adults*. Health Place, 2011. **17**(2): p. 633-40.
12. Wennie Huang, W.N., et al., *Performance measures predict onset of activity of daily living difficulty in community-dwelling older adults*. J Am Geriatr Soc, 2010. **58**(5): p. 844-52.
13. Merritt, B.K., *Utilizing AMPS ability measures to predict level of community dependence*. Scand J Occup Ther, 2010. **17**(1): p. 70-6.
14. Wilson, R.T., et al., *Hip fracture risk among community-dwelling elderly people in the United States: a prospective study of physical, cognitive, and socioeconomic indicators*. Am J Public Health, 2006. **96**(7): p. 1210-8.
15. Seidel, D., C. Brayne, and C. Jagger, *Limitations in physical functioning among older people as a predictor of subsequent disability in instrumental activities of daily living*. Age & Ageing, 2011. **40**(4): p. 463-469.

16. Yamashita, T., et al., *Fall risk factors in community-dwelling elderly who receive Medicaid-supported home- and community-based care services*. Journal of Aging and Health, 2011. **23**(4): p. 682-703.
17. Covinsky, K.E., et al., *Development and validation of an index to predict activity of daily living dependence in community-dwelling elders*. Medical Care, 2006. **44**(2): p. 149-157.
18. Faxen-Irving, G., et al., *Nutrition education for care staff and possible effects on nutritional status in residents of sheltered accommodation*. Eur J Clin Nutr, 2005. **59**(8): p. 947-54.
19. Woo, J., et al., *Development of a simple scoring tool in the primary care setting for prediction of recurrent falls in men and women aged 65 years and over living in the community*. Journal of Clinical Nursing, 2009. **18**(7): p. 1038-1048.
20. Chen, H., et al., *A hierarchical categorisation of tasks in mobility disability*. Disability & Rehabilitation, 2010. **32**(19): p. 1586-1593.
21. Yuen, H.K., et al., *Actions and personal attributes of community-dwelling older adults to maintain independence*. Physical & Occupational Therapy in Geriatrics, 2007. **25**(3): p. 35-53.
22. Fausset, C.B., et al., *Challenges to Aging in Place: Understanding Home Maintenance Difficulties*. Journal of Housing for the Elderly, 2011. **25**(2): p. 125-141.
23. Hays, J.C., H.H. Keller, and T. Ostbye, *The effects of nutrition-related factors on four-year mortality among a biracial sample of community-dwelling elders in the North Carolina Piedmont*. Journal of Nutrition for the Elderly, 2005. **25**(2): p. 41-67.
24. Chou, K. and J.C.B. Leung, *Disability trends in Hong Kong community-dwelling Chinese older adults: 1996, 2000, and 2004*. Journal of Aging & Health, 2008. **20**(4): p. 385-404.
25. Hein, A., et al., *Monitoring systems for the support of home care*. Inform Health Soc Care, 2010. **35**(3-4): p. 157-76.
26. Naik, A.D., et al., *Assessing safe and independent living in vulnerable older adults: perspectives of professionals who conduct home assessments*. J Am Board Fam Med, 2010. **23**(5): p. 614-21.
27. Wood, J.P., D.M. Connelly, and M.R. Maly, *'Getting back to real living': A qualitative study of the process of community reintegration after stroke*. Clin Rehabil, 2010. **24**(11): p. 1045-56.
28. Rozario, P.A., M. Kidahashi, and D.R. DeRienzi, *Selection, optimization, and compensation: strategies to maintain, maximize, and generate resources in later life in the face of chronic illnesses*. J Gerontol Soc Work, 2011. **54**(2): p. 224-39.
29. Adams, K.B. and S. Sanders, *Measurement of developmental change in late life: a validation study of the Change in Activities and Interests Index*. Clinical Gerontologist, 2010. **33**(2): p. 92-108.
30. Chen, K.-M., et al., *Development of the model of health for older adults*. Journal of Advanced Nursing, 2011. **67**(9): p. 2015-2025.
31. Eloranta, S., P. Routasalo, and S. Arve, *Personal resources supporting living at home as described by older home care clients*. International Journal of Nursing Practice, 2008. **14**(4): p. 308-314.
32. Bergland, A. and I. Narum, *Quality of Life demands comprehension and further exploration*. Journal of Aging & Health, 2007. **19**(1): p. 39-61.

33. Vaz Fragoso, C.A. and T.M. Gill, *Sleep complaints in community-living older persons: a multifactorial geriatric syndrome*. Journal of the American Geriatrics Society, 2007. **55**(11): p. 1853-1866.
34. Fujiwara, Y., et al., *Intellectual activity and likelihood of subsequently improving or maintaining instrumental activities of daily living functioning in community-dwelling older Japanese: a longitudinal study*. International Journal of Geriatric Psychiatry, 2009. **24**(6): p. 547-555.
35. Murphy, K., E. O'Shea, and A. Cooney, *Nurse managers' perceptions of quality of life of older adults living in long-stay care in Ireland: is it time for a bill of rights?* Journal of Gerontological Nursing, 2008. **34**(3): p. 47-55.
36. Fusco, D., et al., *Predictors of rehabilitation outcome among frail elderly patients living in the community*. Journal of the American Medical Directors Association, 2009. **10**(5): p. 335-341.
37. Sanders, S., et al., *Homebound older individuals living in the community: a pilot study*. Physical & Occupational Therapy in Geriatrics, 2005. **23**(2/3): p. 145-160.
38. Yamanaka, T., et al., *Daily living functions of the elderly requiring home visits: a study at a comprehensive assessment clinic for the elderly*. Geriatrics & Gerontology International, 2007. **7**(4): p. 388-392.
39. Martin, J.L., et al., *Sleep quality in residents of assisted living facilities: effect on quality of life, functional status, and depression*. Journal of the American Geriatrics Society, 2010. **58**(5): p. 829-836.
40. Griffith, L., et al., *Population attributable risk for functional disability associated with chronic conditions in Canadian older adults*. Age Ageing, 2010. **39**(6): p. 738-45.
41. Gray-Miceli, D.L., et al., *Psychometric properties of the Post-Fall Index*. Clin Nurs Res, 2006. **15**(3): p. 157-76.
42. Lee, T.W., I.S. Ko, and K.J. Lee, *Health promotion behaviors and quality of life among community-dwelling elderly in Korea: a cross-sectional survey*. International Journal of Nursing Studies, 2006. **43**(3): p. 293-300.
43. Odlund Olin, A., et al., *Nutritional status, well-being and functional ability in frail elderly service flat residents*. Eur J Clin Nutr, 2005. **59**(2): p. 263-70.
44. Topinková, E., *Aging, disability and frailty*. Annals Of Nutrition & Metabolism, 2008. **52 Suppl 1**: p. 6-11.
45. Keysor, J.J., et al., *Association of environmental factors with levels of home and community participation in an adult rehabilitation cohort*. Arch Phys Med Rehabil, 2006. **87**(12): p. 1566-75.
46. Brownsell, S., S. Blackburn, and M.S. Hawley, *An evaluation of second and third generation telecare services in older people's housing*. J Telemed Telecare, 2008. **14**(1): p. 8-12.
47. Fitzpatrick, T.R., S. Alemán, and T. Van Tran, *Factors that contribute to levels of independent activity functioning among a group of Navajo elders*. Research on Aging, 2008. **30**(3): p. 318-333.
48. Ayalon, L., *Subjective cognitive functioning as a predictor of all cause mortality in an Israeli national sample of community dwelling older adults*. International Journal of Geriatric Psychiatry, 2008. **23**(8): p. 830-836.
49. Kamper, A.M., et al., *Predictors of functional decline in elderly people with vascular risk factors or disease*. Age & Ageing, 2005. **34**(5): p. 450-455.

50. Sands, L.P., et al., *Predicting change in functional status over quarterly intervals for older adults enrolled in the PACE community-based long-term care program*. Aging Clinical & Experimental Research, 2008. **20**(5): p. 419-427.
51. Jung, Y., et al., *Multicultural aging. Health status and fall-related factors among older Korean women: implications for nurses*. Journal of Gerontological Nursing, 2007. **33**(10): p. 12-20.
52. Stobaeus, N., *[Consider drug treatment as a cause of deterioration. A day at a small health care center in Gotland]*. Lakartidningen, 2010. **107**(40): p. 2406-7.
53. Kadam, U.T., *Potential health impacts of multiple drug prescribing for older people: a case-control study*. Br J Gen Pract, 2011. **61**(583): p. 128-30.
54. Martin, S., et al., *Smart home technologies for health and social care support*. Cochrane Database Syst Rev, 2008(4): p. CD006412.
55. Brandt, A., et al., *Activity and participation, quality of life and user satisfaction outcomes of environmental control systems and smart home technology: a systematic review*. Disabil Rehabil Assist Technol, 2011. **6**(3): p. 189-206.
56. Eriksson, B G (2010) *Studying ageing: experiences, description, variation, prediction and explanation*. University of Gothenburg: Gothenburg Studies in Sociology no.41.
57. Marcoux, J-S (2001) The Caisser Maison Ritual. *Journal of Material Culture*. Vol 6 (2) 213-235.
58. Wu Y-H, Fassert, C & Riguid, A-S (2012) Designing robots for the elderly: Appearance issue and beyond. *Archives of Gerontology and Geriatrics*, 54: 121-126, 2012.
59. Östlund, B (2011) Silver Age Innovators. In Kohlbacher F. & Herstatt C (eds) *The Silver Market Phenomenon. Marketing and Innovation in the Aging Society*. Berlin: Springer Verlag, 2nd edition.

12.2 Additional references from the literature Review

Acevedo, A. and D. A. Loewenstein (2007). "Nonpharmacological cognitive interventions in aging and dementia." *Journal Of Geriatric Psychiatry And Neurology* 20(4): 239-249.

Adams, K. B. and S. Sanders (2010). "Measurement of developmental change in late life: a validation study of the Change in Activities and Interests Index." *Clinical Gerontologist* 33(2): 92-108.

Andel, R., K. Hyer, et al. (2007). "Risk factors for nursing home placement in older adults with and without dementia." *Journal of Aging & Health* 19(2): 213-228.

Aoyama, M., Y. Suzuki, et al. (2011). "Physical and functional factors in activities of daily living that predict falls in community-dwelling older women." *Geriatrics & Gerontology International* 11(3): 348-357.

Atkinson, H. H., M. Cesari, et al. (2005). "Predictors of combined cognitive and physical decline." *Journal of the American Geriatrics Society* 53(7): 1197-1202.

Ayalon, L. (2008). "Subjective cognitive functioning as a predictor of all cause mortality in an Israeli national sample of community dwelling older adults." *International Journal of Geriatric Psychiatry* 23(8): 830-836.

Baker, M. W. (2005). "Creation of a model of independence for community-dwelling elders in the United States." *Nursing Research* 54(5): 288-295.

Balzi, D., F. Lauretani, et al. (2010). "Risk factors for disability in older persons over 3-year follow-up." *Age & Ageing* 39(1): 92-98.

Barry, L. C., T. E. Murphy, et al. (2011). "Depression and functional recovery after a disabling hospitalization in older persons." *J Am Geriatr Soc* 59(7): 1320-1325.

Bergland, A. and I. Narum (2007). "Quality of Life demands comprehension and further exploration." *Journal of Aging & Health* 19(1): 39-61.

Birkeland, A. and G. K. Natvig (2009). "Coping with ageing and failing health: a qualitative study among elderly living alone." *International Journal of Nursing Practice* 15(4): 257-264.

Boyle, P. A., A. S. Buchman, et al. (2007). "Physical activity is associated with incident disability in community-based older persons." *Journal of the American Geriatrics Society* 55(2): 195-201.

Bravell, M. E., S. Berg, et al. (2008). "Health, functional capacity, formal care, and survival in the oldest old: a longitudinal study." *Arch Gerontol Geriatr* 46(1): 1-14.

Braubach M, Power A. (2011). "Housing Conditions and Risk: Reporting on a European Study of Housing Quality and Risk of Accidents for Older People." *Journal of Housing for the Elderly* 25(3):288-305.

Brown MJ, Jacobs DE. (2011). "Residential Light and Risk for Depression and Falls: Results from the LARES Study of Eight European Cities." *Public Health Reports* 126:131-40.

Brownsell, S., S. Blackburn, et al. (2008). "An evaluation of second and third generation telecare services in older people's housing." *J Telemed Telecare* 14(1): 8-12.

Burnett, J., J. A. Cully, et al. (2011). "Assessing Self-Efficacy for Safe and Independent Living: A Cross-Sectional Study in Vulnerable Older Adults." *Journal of Applied Gerontology* 30(3): 390-402.

Callen, B. L. and T. J. Wells (2005). "Screening for nutritional risk in community-dwelling old-old." *Public Health Nursing* 22(2): 138-146.

Cesta A., Cortellessa G., Giuliani M. V., Pecora F., Scopelliti M., T., L. *Psychological implications of domestic assistive technology for the elderly*. In: *PsychNology Journal*, vol. 5 pp. 229 - 252. 2007.

Chen, C. C. (2005). "A framework for studying the nutritional health of community-dwelling elders." *Nurs Res* 54(1): 13-21.

- Chen, H., C. Wang, et al. (2010). "A hierarchical categorisation of tasks in mobility disability." *Disability & Rehabilitation* 32(19): 1586-1593.
- Chen, K.-M., H.-M. Hung, et al. (2011). "Development of the model of health for older adults." *Journal of Advanced Nursing* 67(9): 2015-2025.
- Chou, K. and J. C. B. Leung (2008). "Disability trends in Hong Kong community-dwelling Chinese older adults: 1996, 2000, and 2004." *Journal of Aging & Health* 20(4): 385-404.
- Coelho, C., M. Steers, et al. (2005). "Indoor air pollution in old people's homes related to some health problems: a survey study." *Indoor Air* 15(4): 267-274.
- Cohen-Mansfield, J. and B. Jensen (2007). "Self-maintenance Habits and Preferences in Elderly (SHAPE): reliability of reports of self-care preferences in older persons." *Aging Clinical & Experimental Research* 19(1): 61-68.
- Cohen-Mansfield, J., A. Parpura-Gill, et al. (2005). "Elderly persons' preferences for topics of discussion and shared interest groups." *Journal of Gerontological Social Work* 44(3/4): 39-57.
- Covinsky, K. E., J. Hilton, et al. (2006). "Development and validation of an index to predict activity of daily living dependence in community-dwelling elders." *Medical Care* 44(2): 149-157.
- Cummings, S. M. and K. M. Cassie (2008). "Perceptions of biopsychosocial services needs among older adults with severe mental illness: met and unmet needs." *Health & Social Work* 33(2): 133-143.
- Dahlin-Ivanoff, S., M. Haak, et al. (2007). "The multiple meaning of home as experienced by very old Swedish people." *Scandinavian Journal of Occupational Therapy* 14(1): 25-32.
- Daniels, R., E. van Rossum, et al. (2008). "Interventions to prevent disability in frail community-dwelling elderly: a systematic review." *BMC Health Services Research* 8: 278-278.
- Dye, C. J., D. F. Willoughby, et al. (2011). "Advice from rural elders: What it takes to age in place." *Educational Gerontology* 37(1): 74-93.
- Eloranta, S., P. Routasalo, et al. (2008). "Personal resources supporting living at home as described by older home care clients." *International Journal of Nursing Practice* 14(4): 308-314.
- Ensberg, M. and C. Gerstenlauer (2005). "Incremental geriatric assessment." *Primary Care* 32(3): 619-643.
- Erkal S. (2010). "Home safety, safe behaviors of elderly people, and fall accidents at home." *Educational Gerontology* 36(12):1051-64.

Fagerström, C., R. Palmqvist, et al. (2011). "Malnutrition and cognitive impairment among people 60 years of age and above living in regular housing and in special housing in Sweden: A population-based cohort study." *International Journal of Nursing Studies* 48(7): 863-871.

Fange, A. and S. D. Ivanoff (2009). "The home is the hub of health in very old age: Findings from the ENABLE-AGE Project." *Arch Gerontol Geriatr* 48(3): 340-345.

Fange, A. and S. Iwarsson (2005). "Changes in accessibility and usability in housing: an exploration of the housing adaptation process." *Occup Ther Int* 12(1): 44-59.

Fausset, C. B., A. J. Kelly, et al. (2011). "Challenges to Aging in Place: Understanding Home Maintenance Difficulties." *Journal of Housing for the Elderly* 25(2): 125-141.

Faxen-Irving, G., B. Andren-Olsson, et al. (2005). "Nutrition education for care staff and possible effects on nutritional status in residents of sheltered accommodation." *Eur J Clin Nutr* 59(8): 947-954.

Ferdous, T., T. Cederholm, et al. (2009). "Nutritional status and self-reported and performance-based evaluation of physical function of elderly persons in rural Bangladesh." *Scandinavian Journal of Public Health* 37(5): 518-524.

Fitzpatrick, T. R., S. Alemán, et al. (2008). "Factors that contribute to levels of independent activity functioning among a group of Navajo elders." *Research on Aging* 30(3): 318-333.

Fox, K. R., M. Hillsdon, et al. (2011). "Neighbourhood deprivation and physical activity in UK older adults." *Health Place* 17(2): 633-640.

Freiheit, E. A., D. B. Hogan, et al. (2010). "Development of a frailty index for patients with coronary artery disease." *J Am Geriatr Soc* 58(8): 1526-1531.

Friedman, S. M., D. M. Steinwachs, et al. (2006). "Informal caregivers and the risk of nursing home admission among individuals enrolled in the program of all-inclusive care for the elderly." *Gerontologist* 46(4): 456-463.

Fujiwara, Y., P. H. M. Chaves, et al. (2009). "Intellectual activity and likelihood of subsequently improving or maintaining instrumental activities of daily living functioning in community-dwelling older Japanese: a longitudinal study." *International Journal of Geriatric Psychiatry* 24(6): 547-555.

Fusco, D., G. B. Boichichio, et al. (2009). "Predictors of rehabilitation outcome among frail elderly patients living in the community." *Journal of the American Medical Directors Association* 10(5): 335-341.

Gill, T. M., L. Han, et al. (2007). "Predisposing factors and precipitants for bathing disability in older persons." *Journal of the American Geriatrics Society* 55(4): 534-540.

Gray-Miceli, D. L., N. E. Strumpf, et al. (2006). "Psychometric properties of the Post-Fall Index." *Clin Nurs Res* 15(3): 157-176.

Gustafson Y, Lundin-Olsson L. (2009). "Large variations in walking, standing up from a chair, and balance in women and men over 85 years: an observational study." *Australian Journal of Physiotherapy* 55(1):39-45.

Haak, M., A. Fänge, et al. (2007). "Home as a signification of independence and autonomy: experiences among very old Swedish people." *Scandinavian Journal of Occupational Therapy* 14(1): 16-24.

Hardy, S. E., S. Perera, et al. (2007). "Improvement in usual gait speed predicts better survival in older adults." *Journal of the American Geriatrics Society* 55(11): 1727-1734.

Hart, R. P. and M. K. Bean (2011). "Executive function, intellectual decline and daily living skills." *Neuropsychol Dev Cogn B Aging Neuropsychol Cogn* 18(1): 64-85.

Hays, J. C., H. H. Keller, et al. (2005). "The effects of nutrition-related factors on four-year mortality among a biracial sample of community-dwelling elders in the North Carolina Piedmont." *Journal of Nutrition for the Elderly* 25(2): 41-67.

Hein, A., S. Winkelbach, et al. (2010). "Monitoring systems for the support of home care." *Inform Health Soc Care* 35(3-4): 157-176.

Hoogerduijn, J. G., M. J. Schuurmans, et al. (2007). "A systematic review of predictors and screening instruments to identify older hospitalized patients at risk for functional decline." *Journal Of Clinical Nursing* 16(1): 46-57.

Horowitz, B. P. and E. Vanner (2010). "Relationships among active engagement in life activities and quality of life for assisted-living residents." *Journal of Housing for the Elderly* 24(2): 130-150.

Ishizaki, T., H. Yoshida, et al. (2006). "Effects of cognitive function on functional decline among community-dwelling non-disabled older Japanese." *Archives of Gerontology & Geriatrics* 42(1): 47-58.

Iwarsson, S., V. Horstmann, et al. (2007). "Housing matters in very old age - yet differently due to ADL dependence level differences." *Scand J Occup Ther* 14(1): 3-15.

Iwarsson, S., V. Horstmann, et al. (2009). "Impact of sociocultural care and service context on instrumental activities of daily living dependence among very old European women." *Topics in Geriatric Rehabilitation* 25(3): 251-264.

Izawa, S., H. Enoki, et al. (2010). "The longitudinal change in anthropometric measurements and the association with physical function decline in Japanese community-dwelling frail elderly." *Br J Nutr* 103(2): 289-294.

- Jacobs, J. M., A. Cohen, et al. (2008). "Going outdoors daily predicts long-term functional and health benefits among ambulatory older people." *Journal of Aging & Health* 20(3): 259-272.
- Jansen, D. A. (2005). "Perceived barriers to participation in mentally restorative activities by community-dwelling elders." *Activities, Adaptation & Aging* 29(2): 35-53.
- Jansen, D. A. (2008). "Mentally restorative activities and daily functioning among community-dwelling elders." *Activities, Adaptation & Aging* 32(3-4): 181-197.
- Jensen, G. L. (2005). "Obesity and functional decline: epidemiology and geriatric consequences." *Clinics In Geriatric Medicine* 21(4): 677.
- Jensen, G. L. and P. Y. Hsiao (2010). "Obesity in older adults: relationship to functional limitation." *Current Opinion In Clinical Nutrition And Metabolic Care* 13(1): 46-51.
- Jerome, D., P. Dehail, et al. (2009). "Stroke in under-75-year-olds: expectations, concerns and needs." *Ann Phys Rehabil Med* 52(7-8): 525-537.
- Jung, Y., D. Shin, et al. (2007). "Multicultural aging. Health status and fall-related factors among older Korean women: implications for nurses." *Journal of Gerontological Nursing* 33(10): 12-20.
- Kamper, A. M., D. J. Stott, et al. (2005). "Predictors of functional decline in elderly people with vascular risk factors or disease." *Age & Ageing* 34(5): 450-455.
- Keller, H. H. (2005). "Reliance on others for food-related activities of daily living." *Journal of Nutrition for the Elderly* 25(1): 43-59.
- Kelley-Moore, J. A., J. G. Schumacher, et al. (2006). "When do older adults become "disabled"? Social and health antecedents of perceived disability in a panel study of the oldest old." *J Health Soc Behav* 47(2): 126-141.
- Keysor, J. J., A. M. Jette, et al. (2006). "Association of environmental factors with levels of home and community participation in an adult rehabilitation cohort." *Arch Phys Med Rehabil* 87(12): 1566-1575.
- Kloseck, M., S. Hobson, et al. (2007). "The influence of personality on falling and engagement in daily activities by community-dwelling older adults." *Physical & Occupational Therapy in Geriatrics* 26(1): 1-17.
- Kobayashi, K. M., D. Cloutier-Fisher, et al. (2009). "Making meaningful connections: A profile of social isolation and health among older adults in small town and small city, British Columbia." *Journal of Aging and Health* 21(2): 374-397.

Lai, J. M. and J. Karlawish (2007). "Assessing the capacity to make everyday decisions: a guide for clinicians and an agenda for future research." *The American Journal Of Geriatric Psychiatry: Official Journal Of The American Association For Geriatric Psychiatry* 15(2): 101-111.

Lan, T. Y., S. C. Wu, et al. (2009). "Home environmental problems and physical function in Taiwanese older adults." *Arch Gerontol Geriatr* 49(3): 335-338.

Lange, B. S., P. Requejo, et al. (2010). "The potential of virtual reality and gaming to assist successful aging with disability." *Physical Medicine And Rehabilitation Clinics Of North America* 21(2): 339-356.

Larsson, A., L. Haglund, et al. (2009). "Doing everyday life--experiences of the oldest old." *Scandinavian Journal of Occupational Therapy* 16(2): 99-109.

Lee, T. W., I. S. Ko, et al. (2006). "Health promotion behaviors and quality of life among community-dwelling elderly in Korea: a cross-sectional survey." *International Journal of Nursing Studies* 43(3): 293-300.

Leung, G. T. Y., A. W. T. Fung, et al. (2011). "Examining the association between late-life leisure activity participation and global cognitive decline in community-dwelling elderly Chinese in Hong Kong." *International Journal of Geriatric Psychiatry* 26(1): 39-47.

Li, L. W. (2005). "Predictors of ADL disability trajectories among low-income frail elders in the community." *Research on Aging* 27(6): 615-642.

Li, L. W. and Y. Conwell (2009). "Effects of changes in depressive symptoms and cognitive functioning on physical disability in home care elders." *Journals of Gerontology Series A: Biological Sciences & Medical Sciences* 64A(2): 230-236.

Littbrand, H., M. Stenvall, et al. (2011). "Applicability and effects of physical exercise on physical and cognitive functions and activities of daily living among people with dementia: a systematic review." *American Journal Of Physical Medicine & Rehabilitation / Association Of Academic Physiatrists* 90(6): 495-518.

Mann WC, Belchior P, Tomita MR, Kemp BJ. (2007). "Older adults' perception and use of PDAs, home automation system, and home health monitoring system." *Topics in Geriatric Rehabilitation* 23(1):35-46.

Markland, A. D., P. S. Goode, et al. (2008). "Correlates of urinary, fecal, and dual incontinence in older African-American and white men and women." *Journal of the American Geriatrics Society* 56(2): 285-290.

Martin, J. L., L. Fiorentino, et al. (2010). "Sleep quality in residents of assisted living facilities: effect on quality of life, functional status, and depression." *Journal of the American Geriatrics Society* 58(5): 829-836.

McKenna, K., J. Liddle, et al. (2009). "Comparison of time use, role participation and life satisfaction of older people after stroke with a sample without stroke." *Australian Occupational Therapy Journal* 56(3): 177-188.

Meaney, A. M., M. Croke, et al. (2005). "Needs assessment in dementia." *International Journal of Geriatric Psychiatry* 20(4): 322-329.

Merritt, B. K. (2010). "Utilizing AMPS ability measures to predict level of community dependence." *Scand J Occup Ther* 17(1): 70-76.

Moss, M. S., C. J. Hoffman, et al. (2007). "Changes over 4 years in health, quality of life, mental health, and valuation of life." *Journal of Aging & Health* 19(6): 1025-1044.

Murata, C., T. Kondo, et al. (2006). "Factors associated with life space among community-living rural elders in Japan." *Public Health Nursing* 23(4): 324-331.

Murphy, K., E. O'Shea, et al. (2008). "Nurse managers' perceptions of quality of life of older adults living in long-stay care in Ireland: is it time for a bill of rights?" *Journal of Gerontological Nursing* 34(3): 47-55.

Naik, A. D., M. E. Kunik, et al. (2010). "Assessing safe and independent living in vulnerable older adults: perspectives of professionals who conduct home assessments." *J Am Board Fam Med* 23(5): 614-621.

Nehmer, J., M. Becker, et al. (2010). "Electronic emergency safeguards: Sensor-based detection and prevention of critical health conditions." *GeroPsych: The Journal of Gerontopsychology and Geriatric Psychiatry* 23(2): 91-98.

Odlund Olin, A., A. Koochek, et al. (2005). "Nutritional status, well-being and functional ability in frail elderly service flat residents." *Eur J Clin Nutr* 59(2): 263-270.

Olazarán, J., B. Reisberg, et al. (2010). "Nonpharmacological therapies in Alzheimer's disease: a systematic review of efficacy." *Dementia And Geriatric Cognitive Disorders* 30(2): 161-178.

Parisi, J. M. (2010). "Engagement in adulthood: perceptions and participation in daily activities." *Activities, Adaptation & Aging* 34(1): 1-16.

Pierini, D. M. and D. L. Volker (2009). "Living alone in community and over 85 years old: a case study." *Southern Online Journal of Nursing Research* 9(1): 7p.

Poujaud, J., N. Noury, et al. (2008). "Identification of inactivity behavior in smart home." *Conf Proc IEEE Eng Med Biol Soc* 2008: 2075-2078.

Richard, L., L. Gauvin, et al. (2009). "Staying connected: neighbourhood correlates of social participation among older adults living in an urban environment in Montreal, Quebec." *Health Promotion International* 24(1): 46-57.

- Riche, Y. and W. Mackay (2010). "PeerCare: Supporting awareness of rhythms and routines for better aging in place." *Computer Supported Cooperative Work (CSCW)* 19(1): 73-104.
- Rioux, L. and C. Werner (2011). "Residential satisfaction among aging people living in place." *Journal of Environmental Psychology* 31(2): 158-169.
- Robison, J., J. J. Schensul, et al. (2009). "Mental health in senior housing: racial/ethnic patterns and correlates of major depressive disorder." *Aging & Mental Health* 13(5): 659-673.
- Rozario, P. A., M. Kidahashi, et al. (2011). "Selection, optimization, and compensation: strategies to maintain, maximize, and generate resources in later life in the face of chronic illnesses." *J Gerontol Soc Work* 54(2): 224-239.
- Ryburn, B., Y. Wells, et al. (2009). "Enabling independence: restorative approaches to home care provision for frail older adults." *Health & Social Care In The Community* 17(3): 225-234.
- Saito, E., Y. Sagawa, et al. (2005). "Social support as a predictor of health status among older adults living alone in Japan." *Nursing & Health Sciences* 7(1): 29-36.
- Sanders, S., J. M. Polgar, et al. (2005). "Homebound older individuals living in the community: a pilot study." *Physical & Occupational Therapy in Geriatrics* 23(2/3): 145-160.
- Sands, L. P., H. Xu, et al. (2008). "Predicting change in functional status over quarterly intervals for older adults enrolled in the PACE community-based long-term care program." *Aging Clinical & Experimental Research* 20(5): 419-427.
- Sarma, S., G. Hawley, et al. (2009). "Transitions in living arrangements of Canadian seniors: Findings from the NPHS longitudinal data." *Social Science & Medicine* 68(6): 1106-1113.
- Schein, C., A. J. Gagnon, et al. (2005). "The association between specific nurse case management interventions and elder health." *Journal of the American Geriatrics Society* 53(4): 597-602.
- Schultz-Larsen, K. and K. Avlund (2007). "Tiredness in daily activities: a subjective measure for the identification of frailty among non-disabled community-living older adults." *Archives of Gerontology & Geriatrics* 44(1): 83-93.
- Seidel, D., C. Brayne, et al. (2011). "Limitations in physical functioning among older people as a predictor of subsequent disability in instrumental activities of daily living." *Age & Ageing* 40(4): 463-469.
- Seidel, D., K. Richardson, et al. (2010). "Design for independent living: Activity demands and capabilities of older people." *Ageing & Society* 30(7): 1239-1255.
- Sergeant, J. F., D. J. Ekerdt, et al. (2010). "Older adults' expectations to move: do they predict actual community-based or nursing facility moves within 2 years?" *Journal of Aging & Health* 22(7): 1029-1053.

Sahlen KG, Löfgren C, Mari Hellner B, Lindholm L, Preventive home visits to older people are cost-effective, *Scandinavian Journal Of Public Health*, 2008 May; Vol. 36 (3), pp. 265-71.

Stewart, David W., Shamdasani, Prem N. & Rook, Dennis W. (2007). *Focus groups: theory and practice*. 2. uppl. Thousand Oaks, Calif.: Sage Publications

Topinková, E. (2008). "Aging, disability and frailty." *Annals Of Nutrition & Metabolism* 52 Suppl 1: 6-11.

Wagert, P. V., Y. Gustafson, et al. (2009). "Falls in very old people: The population-based Umea 85+Study in Sweden." *Archives of Gerontology and Geriatrics* 49(3): 390-396.

Wahl, H. W., A. Fange, et al. (2009). "The home environment and disability-related outcomes in aging individuals: what is the empirical evidence?" *Gerontologist* 49(3): 355-367.

Wahl, H., M. Schmitt, et al. (2010). "Is the emergence of functional ability decline in early old age related to change in speed of cognitive processing and also to change in personality?" *Journal of Aging & Health* 22(6): 691-712.

Wang, J., R. L. Kane, et al. (2009). "The effects of resident and nursing home characteristics on activities of daily living." *Journals of Gerontology Series A: Biological Sciences & Medical Sciences* 64A(4): 473-480.

Vaz Fragoso, C. A. and T. M. Gill (2007). "Sleep complaints in community-living older persons: a multifactorial geriatric syndrome." *Journal of the American Geriatrics Society* 55(11): 1853-1866.

Wennie Huang, W. N., S. Perera, et al. (2010). "Performance measures predict onset of activity of daily living difficulty in community-dwelling older adults." *J Am Geriatr Soc* 58(5): 844-852.

Werngren-Elgström, M., G. Carlsson, et al. (2008). "Changes in person-environmental fit and ADL dependence among older Swedish adults. A 10-year follow-up." *Aging Clinical & Experimental Research* 20(5): 469-478.

Whitson, H. E., S. W. Cousins, et al. (2007). "The combined effect of visual impairment and cognitive impairment on disability in older people." *Journal of the American Geriatrics Society* 55(6): 885-891.

Wilson, R. T., G. A. Chase, et al. (2006). "Hip fracture risk among community-dwelling elderly people in the United States: a prospective study of physical, cognitive, and socioeconomic indicators." *Am J Public Health* 96(7): 1210-1218.

Woo, J., J. Leung, et al. (2009). "Development of a simple scoring tool in the primary care setting for prediction of recurrent falls in men and women aged 65 years and over living in the community." *Journal of Clinical Nursing* 18(7): 1038-1048.

Wood, J. P., D. M. Connelly, et al. (2010). "'Getting back to real living': A qualitative study of the process of community reintegration after stroke." *Clin Rehabil* 24(11): 1045-1056.

Vrkljan, B. H., V. Leuty, et al. (2011). "Aging-in-place: Exploring the transactional relationship between habits and participation in a community context." *OTJR: Occupation, Participation and Health* 31(3): 151-159.

Yamanaka, T., E. Takasugi, et al. (2007). "Daily living functions of the elderly requiring home visits: a study at a comprehensive assessment clinic for the elderly." *Geriatrics & Gerontology International* 7(4): 388-392.

Yamashita, T., H. Jeon, et al. (2011). "Fall risk factors in community-dwelling elderly who receive Medicaid-supported home- and community-based care services." *Journal of Aging and Health* 23(4): 682-703.

Yeung, F. K. C., K. Chou, et al. (2006). "New and emerging professionals. Characteristics associated with fear of falling in Hong Kong Chinese elderly residing in care and attention homes." *Clinical Gerontologist* 29(3): 83-98.

Yoshino, H., T. Sakurai, et al. (2011). "Causes of decreased activity of daily life in elderly patients who need daily living care." *Geriatrics & Gerontology International* 11(3): 297-303.

Young, Y., C. M. Boyd, et al. (2010). "Does Self-Reported Function Correspond to Objective Measures of Functional Impairment?" *Journal of the American Medical Directors Association* 11(9): 645-653.

Yuen, H. K., R. W. Gibson, et al. (2007). "Actions and personal attributes of community-dwelling older adults to maintain independence." *Physical & Occupational Therapy in Geriatrics* 25(3): 35-53.

Öhman, A. and L. Nygård (2005). "Meanings and motives for engagement in self-chosen daily life occupations among individuals with Alzheimer's disease." *OTJR: Occupation, Participation & Health* 25(3): 89-97.

12.3 References for the Industrial design approach

Bechenau, M., & Fulton Suri, J. (2000). Experience prototyping. *Proceedings of the Conference on Designing Interactive Systems* (pp. 424-433).

Beer, J. M., C. A. Smarr, et al. (2012). *The domesticated robot: design guidelines for assisting older adults to age in place*, ACM.

Broekens, J., Heerink, M. and Rosendal, H. Assistive social robotics in elderly care: a review. *Gerontechnology* 8(2): 94-103, 2009

- Chen, K., & Chan, A. (2011). A review of technology acceptance by older adults. *Gerontechnology*, 10(1), 1-12.
- Chitturi, R. (2009). Emotions by design: A consumer perspective. *International Journal of Design*, 3(2), 7-17.
- Dahlin-Ivanoff, S., Gosman-Hedström, G., Edberg, A-K., Wilhelmson, K., Eklund, K., Duner. Ziden, L., Welmer, A-K., & Landahl, S. (2010). Elderly persons in the risk zone. Design of a multidimensional, health-promoting, randomised three-armed controlled trial for “prefrail” people of 80+ years living at home. *BMC Geriatrics*, 10(1), 1471-2318.
- Davila, T., Epstein M. J., & Shelton, R. (2006). *Making innovation work. How to manage it, measure it, and profit from it*. Upper Saddle River, NJ: Wharton School Publishing.
- Eason, K. D. (1995). User centered design: For users or by users? *Ergonomics*, 38(8), 1667-1673.
- Essén A & Östlund B. *Laggards as Innovators? Old Users as Designers of New Services & Service Systems*. International Journal of Design Vol.5 (3) December 2011.
- Jacobs, C. Heracleous, L. (2007) “Strategizing through playful design”, *Journal of Business Strategy*, Vol. 28 Iss: 4, pp.75 – 80.
- Jönsson Bodil (ed) *Design side by side*. Lund: Studentlitteratur 2006.
- Porter, Michael E (1998) *The Competitive Advantage of Nations*. Free Press USA.
- Keikonen, T. K., Jääskö, V., & Mattelmäki, T. M. (2008). Three-in-one user study for focused collaboration. *International Journal of Design*, 2(1), 1-10.
- Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.
- Ralf M (2007) *Design research now: essays and selected projects*. Basel: Birkhauser.
- Ulrich, K. T. and S. D. Eppinger (2011). Product design and development, McGraw-Hill.
- Walters, M. Syrdal, D. Dautenhahn, K. · Boekhorst, R., Koay, K. Avoiding the uncanny valley: Robot appearance, personality and consistency of behaviour in an attention-seeking home scenario for a robot companion. *Auton Robot* 24: 159-178. 2008
- Wu, Y-H, Fassert, C. and Riguid, A-S. Designing robots for the elderly: Appearance issue and beyond. *Archives of Gerontology and Geriatrics*, 54: 121-126, 2012.
- Wu, Y. H., C. Fassert, et al. (2011). "Designing robots for the elderly: Appearance issue and beyond." Archives of gerontology and geriatrics.

Yoon, C. Y. (2008). Design of a measurement tool for end-user e-business competency and its applications. *12th International Conference on Computer Supported Cooperative Work in Design*. IEEE. doi: [10.1109/CSCWD.2008.4537116](https://doi.org/10.1109/CSCWD.2008.4537116)

Östlund, B. 2011. *Silver Age Innovators*. In Kohlbacher F. & Herstatt C (eds) *The Silver Market Phenomenon. Marketing and Innovation in the Aging Society*. Berlin: Springer Verlag, 2nd edition.

Östlund, B. *The Revival of Research Circles: to meet the needs of modern ageing and the third age*. Educational Gerontology 2008, Vol. 34, No. 4.

12.4 Discussion guide, health care professionals

Start with a short description of the project

1. **Opening question** (to get the participants to know each other and to see what they have in common):

Let's find out some more about each other by going around the room one at a time. Tell us your name, professional role and where you work.

2. You all work with older persons in different ways. What are usual and important signs that something is not quite all right with the older persons you meet?
3. What problems/data are important for you to observe in order to identify the risk of impaired ability to manage independent living and/or deterioration of health? It could be, on activity level, functional level, physiological/psychological signs, social aspects or other events or behaviors.
 - In what way are the factors mentioned a risk? What can be the consequences if not attended to?
 - How can the identified data be used to prevent the risk? What support might the older persons need to prevent further deterioration of health and to prolong independent active living?
 - What information constitutes an explicit risk and should result in an alarm or alert?
4. Sometimes one symptom/sign alone is not an acute risk but together with other factors it becomes a risk. What interaction between the factors you have mentioned is especially important to be aware of, interaction that can be either positive or negative in relation to older persons' health and ability to manage independent living?
5. What are usual questions and worries among the older person themselves concerning managing daily life? What do they mention or ask about when you meet them in your professional work? What events, symptoms or loss of activities do they express worries about?
6. Closing question. The moderator gives a short summary of the discussion and let each participant express what they think has been the most important issues and if there is something more to add.

12.5 Discussion guide for focus group with older persons

Start s with a short description of the project

1. Opening questions (to get the participants to know each other and to see what they have in common):

Let's find out some more about each other by going around the room one at a time. Tell us your name and why you chose to participate in this discussion.

2. What are your feelings about yourself or your relatives becoming older and regarding possible future deterioration of health such as loss of capacity to handle activities of daily living? What are your main worries and concerns?
3. If you or an older relative was living at home experiencing some deterioration of health or functional limitations, what assistive support, service or help do you think is most important in order to live an independent active life and feel secure at home?
4. If you or an older relative was living at home having some health problems or functional limitations, and was offered the possibility of having sensors in your home in order to detect risks for deterioration of health or need for help (for example that your doctor at the health care center can follow your heart function over time, or an alarm is sent to the home help services if you have not left bed for some days). How would you feel about this possibility?
5. If you had the possibility of having sensors in your home what factors would you consider important for the sensors to observe (for example noticing if you have not been eating, have been falling or measuring your blood pressure) in order to support independent living?
 - Why, in your opinion, are the factors mentioned important to monitor? What do you think can be the consequences if not attended to?
 - How should the information be used (for follow up over time, for sending alarm if necessary, to give you or your relative a reminder...)?
6. Closing questions:

The moderator gives a short summary of the discussion and let each participant express what they think has been the most important issues and if there is something more to add.

12.6 Detailed focus group results in Sweden

Source Prof=P, elderly=E Primary care=PC, home care rural=P rural, Home care urban= P urban	Suggested activities/events/data etc. that is relevant and important to pay attention to	Why is this data relevant and important. (i.e what can be the consequences if not attended to? How is the information to be used?)	Expressions of technical support needed to promote health and/or independent living	Interaction with this factor and other factors, that might, in a positive or negative way, influence the person's health and/or independent living
	Decreased body functions that may lead to activity decline			
PC, E	Vision decline	Risk of falls		
P rural	Pain	Decreased mobility and activity, lack of appetite		
P rural +urban	Dizziness	Risk for falls, inactivity		
P Urban	Loss of hearing	Increased risk for anxiety due to misunderstanding		
P PC, P-rural, P-urban	General health deteriorates	Early sign of activity decline, Risk of hospital care, risk for wounds	assistive devices	
P Urban	Fatigue	Early sign of decline , increased dependency		
P rural, PC, P urban	Urinary incontinence/ urinary infection	Sign of decline, Decreased social interaction, anxiety, risk of cognitive decline, hospital visits		
P Urban	Bowel problems			
P PC	Muscle weakness	Risk of falls, activity decline		
P PC, rural, urban	cognitive decline	could be sign of infection and/or of dementia		
	General activity decline			
P PC	Loss of routines	Increasing awareness among professionals that something is wrong, Early sign of activity decline	Technical solutions	

P Urban, PC, E	Can not manage the daily activities	Early sign of decline , increased dependency	home adaptation, assistive devices	
P Urban	Spends more time in bed	Early sign of decline , increased dependency		
P PC, P-Urban	Mobility decline	Risk of fall, increased dependency, early sign of decline	assistive devices, home adaptation, sensor system noticing if you haven't moved around for XX hours, or haven't used the toilet	
P PC, E	Leaving home when you should not	Early sign of cognitive decline	Sensor system alarming when routine differs from the normal or GPS.	
	Falls			
P rural, PC, P-Urban	Fear of falling	Increasing awareness among the professionals that something is wrong, fear of increased dependency, insecurity, decreased body function and mobility, inactivity	home adaptation	
P rural, P-Urban, E, PC	Falls	Fear of moving and falling, increased anxiety and dependency, hospital visits, inactivity	home adaptation, remote control to turn on the light when dark, Sensor system alarming when routine differs from the normal, infrared light, sending alarm if you don't return to bed, the light turns on automatically when you	Dizziness, medication, poor eating, inactivity, Impaired balance and being in a hurry, shower

			raise from bed ,,	
P Urban, PC, E	Fear that no one will find you when you have fallen	Acute need for help, someone need to assist	fall detection, someone receiving the alarm, alarm if you haven't got up within XX minutes, chip connected to GPS	
	Decline in personal care			
P PC	Visit the toilet several times by night		Sensor system alarming when flushing routine differs from the normal	Sleeping pills and visiting toilet at night. Blood pressure and visiting toilet. Left the alarm by the bed.
P rural, PC, P-Urban	Eating and drinking deteriorates	Early sign of decline, Important to know that the person has eaten, otherwise increased risk of mobility decline, falls, dizziness, hospital visits	Alarm when fridge not has been opened. monitoring if and how the person have been eating, Information sent to the home help that the person has taken out food from refrigerator or food-box	Dryness in mouth
P rural, PC	Personal hygiene is poor	Increasing awareness among professionals that something is wrong, Early sign of activity decline, Risk of disease, wounds		
P rural	Can't handle diabetes	Symptoms of diabetes increases, wounds		

P rural, PC, E	Can not handle medication	Increasing awareness among professionals that something is wrong, Early sign of cognitive decline	reminder system that tells you to take your pills, use of smartphone to remind	
	Decline in home activities			
P PC	Difficulties in buying food	May be a sign that something is wrong		
P rural	Maintenance of the house/apartment deteriorates	Increasing awareness among professionals that something is wrong, Early sign of physical and/or activity decline		
P rural, PC, P-Urban	Can not cook food and make coffee	Early sign of activity decline, May be a sign that something is wrong, Increased dependency; loss of identity	Alarm when stove etc. not has been used.	
P PC, E	Forget to lock the door, turn off the light, the stove etc.		Display, alarm or reminder, remote control	
	Psychological and Social factors			
P Urban, E, PC	Fear of being alone	Frequent alarms, Increasing awareness among the professionals that something is wrong, insecurity, anxiety		
E	Insecurity		Being able to communicate: sensor system, telephone with preprogrammed phonenumbers or	

			pictures for being able to immediately get in contact with relatives or other person	
P PC, P-rural, P-urban	Do not want home care support.	May not get support in time, risk for other cosequences like fall. Difficult to work preventive, , fear of have to leave their own home, Once accepted help but now refusing could be early sign of cognitive decline, ashamed of not being able to take care of oneself, deny there is a problem		
P Urban	Fear of urinary leakage	More inactive and isolated		
P PC, P-Urban, P-rural	Isolation, loneliness	Feeling of insecurity, Early sign of decline	"Robot-cat"	
P PC, P-rural, P-urban	Disturbed sleep	Turns day into night, decreased perception of time, spends too much time in bed, activity decline	Sensor system may replace a visit by professional by night and may increase feeling of security for the older person and relative,	Inactivity, risk of falls
P rural, PC, P-Urban	Anxiety	Increasing awareness among the professionals/ the older person that something is wrong, fear of increased dependency, insecurity	safety alarm	
P rural, P-urban	Changed mood (suspicious, aggressive, low mood)	Increasing awareness among the professionals that something is wrong, insecurity, changed behaviour, Early sign of decline		

	Environmental factors			
E	fire detection		sprinkler system, fire alarm	
P PC, E	Poor medical adjustment by the physician	May cause cognitive impairment, risk for negative interaction between different medicines	Blood test, glucose test etc. alarm system when medication when risk for negative interaction	
E	running water		posibility to close the tap with a remote control, flood sensor	
E	refrigerator and freezer		alarm if the door is open	
E	Feeling secure in one's own home		safety/active alarm, remote control for the door lock, surveillance camera, automatic or manoeuvred by the perosn lining in the home, display control that doors are locked/open ,	
E, P-rural	Feeling secure outside		portable sensors/alarm, attack alarms	
	Vital signs monitoring		virtual contact and sensors that can monitor medical parameters, an alarm to the doctor if something is not okey	
P PC, E	Blood pressure		blood pressure gauge	

P PC, E	Blood sample		apparatus that takes a bloodtest , valued by health care professional	
P PC, E, P-urban	Blood sugar		sensors in clothes	
P PC, E, P-Urban	heart function	Sign of decline	Examination of heart and lungs by stethoscope, bloodpressure gauge, sensors in clothes, robotic dog nose	Sleep, activity and nutrition
P rural, P-urban	Swollen legs	Signs of heart failure		
P Urban	Hard to breathe	acute care		
P PC, P-urban	Weight loss	May be a sign that something is wrong, risk for fall		
P PC	Renal function	Kidney failure		

12.7 Detailed focus group results in Spain

Source Prof=P elderly=E	Suggested activities/events/data etc. that is relevant and important to pay attention to	Why is this data relevant and important. (i.e what can be the consequences if not attended to? How is the information to be used?)	Expressions of support needed to promote health and/or independent living	Interaction with this factor and other factors, that might, in a positive or negative way, influence the person's health and/or independent living	Other important aspects
P	Usual activities (routine)	The usual activities pattern is important to be analysed as loosing it can be a sign of memory or emotional deterioration.	Reiterated movement around the home	Lack of usual activities together with memory impairment can lead to malnutrition problems.	
P	Body temperature	A record of body temperature can help to detect a febrile illness or any other alteration of temperature regulation.	Sensor of body temperature	Body temperature problems together with memory loss can increase the risk of heatstroke or hypothermia	
P	Home temperature	Risk of heatstroke or hypothermia	Sensor of doors and windows opening. Thermometer		
P	Tap opened		Alarm for tap opened and water pouring. Reminder or timer on water tap.	Wet floor can increase risk of falls.	
P	Smoke, Carbon monoxide	Risk of fire and intoxication	Smoke and CO sensor		
P	Heart rhythm	Important in patients on risk of severe arrhythmia or cardiac conditions.	Heart rhythm monitor		

P	Breathing	Important in people with respiratory conditions, for early detection of exacerbations.	Breathing monitor. Pulse oxymeter		
P	Lights on overnight	Bedroom, bathroom or kitchen lights turned on overnight could mean the person has had a fall	Alarm when lights on for a certain length of time		
P	Bed movements	Important to detect convulsion in an epileptic person. Also to detect immobility for a long time	Epilepsy or pressure sensor under mattress		
P	Refrigerator	Refrigerator not opening could mean a bad nutrition	Sensor of refrigerator opening	Together with cooking can be a sign of a person not eating	
P	Body fluids	It is important to detect the presence of enuresis, sweating, bleeding, etc.	Sensor of body fluids in bed or sofa		
P	Objects out of usual place	It could cause falls			
P	Mobility	Important to be detect falls or immobility	Sensor of movements		
P	Social network	It is important to evaluate if the person is having visits or keeping contact with relatives or friends, in order to detect loneliness or isolation if they decrease	Devices identifying the homeowner voice (not recording) and detecting other people's voice.	Social contact absence together with mobility impairment could increase the risk of depression.	It could have a conflict with confidentiality.
P	Medication	A good compliance is important to properly	Electronic dossette with reminders to primary and		

		control chronic diseases	secondary users		
E	Walking	Walking difficulties or loss of balance can increase risk of falls	Devices to help moving things around. Fall detectors.		
E	Communication with healthcare professionals		Communication platform.		
E	Blood sugar	Important to monitor hyper or hypoglycaemia.	Blood sugar monitor.		
E	Vital signs monitoring	Important to detect a life threatening problem.	Sensors with a permanent monitoring, generating an alarm when needed		
E	Electricity breakdown		Alarm detecting electricity breakdown	Risk of falls and lack of communication	
E	Loss of strength	Risk of loosing autonomy.	Automatic doors, windows, curtains...		
E	Emergency situation		Panic button		
E	Loss of privacy	Ethical problem. Some people could feel observed	Possibility of voluntarily deactivate certain areas at home to keep some privacy		In case of emergency, the entire system could be activated automatically
E	Loss of memory	Important to maintain an independent life.	System able to detect memory impairment (i.e. regular test of memory)		
E	Loss of appetite	Nutrition problems	Access to different menu options		
E	Loneliness	It can cause sadness, anxiety, distress.	Communication with relatives, friends and other primary users via GIRAFF		

E	Home temperature	High temperature can increase risk of heatstroke	Temperature sensor	High temperatures in elderly people with chronic conditions could cause severe problems	
E	Cough	It can be a sign of respiratory acute conditions	Sensor to detect coughing		
E	Sleep apnoea		Alarm to detect apnoea		
P	Medication	Important in acute and chronic conditions	Medication dosette interacting with the system		
P	Eating	Keeping a good nutrition is very important to maintain a good health	Sensors detecting time of meals.		
P	Gas leaking	It can cause intoxication	Gas detector		

12.8 Detailed focus group results in Italy

Source Prof=P elderly=E	Suggested activities/events/data etc. that is relevant and important to pay attention to	Why is this data relevant and important. (i.e. what can be the consequences if not attended to? How is the information to be used?)	Expressions of support needed to promote health and/or independent living	Interaction with this factor and other factors, that might, in a positive or negative way, influence the person's health and/or independent living
E	Abnormal changes in environment	Some events may indicate a threat to individual health and safety	Environmental monitoring is important. In particular: fall and occupation sensors (especially detecting during the night for bed). But others interesting parameters to check are: presence of gas , flood, smoke and extreme temperatures. Also, intrusions and movements sensor.	Elderly people feels as highly important to feel protected. At the same time, they don't want to represent a burden to their close relatives who care about them.
E	falls	Fear of falling and none can help you.	sensor detecting falling	If the sensors detect some strange activity or event, the system provide an early alarm to the caregiver (relative or some other close)
E	occupation	especially during night if the person leave his/her bed and don't come back	pressure sensor under the mattress	
E	gas leaking	intoxication risk	gas detection	
E	wet floor	Wet floors, because of hydraulic failures or taps open, can increase risk of falling. Fear of falling.	sensors to detect flood	
E	fire	fear about intoxication	sensors for smoke detection	

E	lower/higher temperature	Extreme temperatures can represent a threat to the health, especially for people with cardiovascular problems	sensors to detect extreme temperatures	
E	intrusion	especially regarding people living alone, fear of intrusion	intrusion and movement sensors.	
E	Physiological monitoring	Important for those people with health problems. The system should be able to provide more accurate information, and a more efficient communication with doctors. At the same time, a general health monitoring during time could be useful in order to reduce worries and enhance a general safety feeling in elder people.	Tools for detecting physiological parameters, according to individual needs (i.e. Person with hearth problem may have some benefits from ECG device, less from glucometer)	Sensors installed on the Giraff platform may provide a prompt intervention in case of health threat.
E	heart functions		heart rate detection	Different physiological sensors are relevant according to individual post-hospitalization case. The Giraff robot can be an additional support for communication. Moreover the system could provide an early alarm if something is not ok.
E	blood pressure		blood pressure gauge	
E	blood sugar		glucometer	

E	breathing functions		oxymeter	
E	relation between patient and doctor		the robot Giraff	
E	medication reminder	In order to provide support in everyday managing activities	Strong interest for the medication dispenser that automatically provides medication and audio/visual alerts to the user each time medication should be taken	
P	User mobility within the environment	To check a physiotherapy rehabilitation	To monitor adherence to the rehabilitation protocol	
P	How much time the person spends in bed	If the persons spends too much time in bed, it cab be counterproductive for the rehab protocol	using a pressure sensor under the mattress	Detecting these parameters all together could give the physiotherapist the opportunity to correct or (if necessary) change the rehab. Protocol
P	How much time the person spends sitting	If the persons spends too much time sitting, it cab be counterproductive for the rehab protocol	using a pressure sensor under chairs or sofas	
P	How much time the person spends moving around the house	If the persons don't spend enough time moving, it could mean that he/she isn't following the rehab protocol	motion sensors in the house	

P	home security	To monitor people living alone, to avoid domestic accident	To monitor enviromental parameters such as gas, flood, smoke, extreme temperatures	
P	gas leaking	intoxication risk	gas detection	All together these parameters could provide an early warning to the caregiver (i.e. a relative). It could also be a useful complement to home care.
P	wet floor	wet floors, because of hydraulic failures or taps open, can increase risk of falling	sensors to detect flood	
P	fire	intoxication risk	sensors for smoke detection	
P	lower/higher temperature	Extreme temperatures can represent a threat to the health, especially for people with cardiovascular problems	sensors to detect extreme temperatures	
P	User daily routine	To check, i.e. how much time the person spends in the bathroom, in the bedroom, or how long it takes to cook, at what time he/she wakes up in the morning, at what time he/she goes to sleep, etc.	enviromental monitoring to check, for instance, user motion, home occupation, presence of rotted food into the refrigerator, etc.	
P	time person is in bed	unusual hours may suggest something is wrong or early signs of independent activity	pressure sensor under mattress	waking up too late in the morning or going to sleep too late in the night may lead to a shift in daily activities

P	time spent on prepare the lunch	First of all is important to know if the person spends time on prepare lunch. Then is important that the person doesn't take too much or too little time to do it, in order avoid risk of malnutrition. It could be an early sign of activity decline and increasing dependency	Sensor detecting occupation or motion into the kitchen with alarm if the stove are not used	
P	presence of rotten food into the refrigerator	risk of malnutrition		
P	motion	moving assure independent activity. Absence of motion can suggest some problems and decreasing independency	Sensors detecting motion into the house	



12.9 Questionnaires

12.9.1 Questionnaire for Care Givers

We are conducting a research investigation to assess people opinions with respect to their possible adoption of an intelligent system that supports them at home.

More specifically we refer to GiraffPlus, a support system designed for the older people who are willing to make their home a safer and more “intelligent” place. To this aim, a network of sensors should be installed in the house, which is able to detect environment changes (like movements, gas detection, etc.) and physiological data (like blood pressure, blood glucose level, body temperature, etc.) to be used in multiple ways. As an example they can trigger an alarm in case of danger (e.g., smoke in the room), or simple transfer mnemonic signals to the person to either remind or suggest him activities to be performed (like taking a medicine, turn off the stove).

The same information can be transmitted to a caregiver (like a relative or other trusted person) to keep them informed of the situation at home from remote. This is to allow them to come and rescue in case of need. An alternative scenario is the one of the information sent to your doctor to allow him to monitor the status of the person or for being sure that a certain therapy is followed.

The GiraffPlus system includes also robot in the house. This is a mobile platform with camera, screen and microphone, designed to facilitate communication of an old person and her family, or her doctor. Such a robot can be operated within the house to visually inspect aspects of the home environment and intervene in case of danger.

Please, compile the questionnaire following the following instructions carefully.

You will be described of a set of situation and parameters. We will kindly ask you to answer in any case also when the prospected scenario is not very realistic with respect to your personal situation.

Please also notice that it is not a matter of giving the right or the wrong questions: what we are interested in is your personal opinion on the subject.

It is very important for us that you answer with care and attention to all the questions, in the order suggested in the survey.

Instruction

The questionnaire consists of several questions that you should respond by placing a single tick on the alternative that corresponds to your opinion.

Please compile the questionnaire on your own.

The questionnaire is for the sole purpose of scientific knowledge and is anonymous. Your answers will then be treated in complete confidentiality, without reference to your person.

Thanks a lot in advance for your cooperation!



Socio-demographic data

Age..... Sex.....

Education

Elementary School

☐ Middle School

High School

☐ University**Are you retired?**☐ Yes☐ No1. Professional Role (current or before retirement)☐ Entrepreneur☐ Freelancer☐ Manager☐ Employee☐ Teacher☐ Craftsman☐ Merchant☐ Worker☐ At house☐ Other (please specify)2. Currently, are you taking care of a relative? ☐ Yes ☐ No**If Yes, please, state which degree**☐ Parent☐ Mother/Father-in-law☐ Other**If Yes, do you use some form of support?**☐ Caregiver☐ Home care☐ Admission day☐ Other

In general, which is your idea about new technologies?

Strongly Negative	Somewhat Negative	Neither Positive nor Negative	Somewhat Positive	Strongly Positive
0	1	2	3	4

Please find below a list of services that may be provided by the intelligent system just described. Please indicate, in your opinion, the degree of **USEFULNESS** of each service on a 5-point scale where

1 = strongly useless, 2 = useless, 3 = neither useless nor useful, 4 = useful, 5 = strongly useful

		STRONGLY USELESS	USELESS	NEITHER USELESS NOR USEFUL	USEFUL	STRONGLY USEFUL
1.	Detecting the position of the person inside the house	1	2	3	4	5
2.	Monitoring the movement of the person inside the house	1	2	3	4	5
3.	Detection of the absence of movement inside the house	1	2	3	4	5
4.	Temporal monitoring of a person's position (e.g. how much time he/she spends in the bed, kitchen, sitting, etc..)	1	2	3	4	5
5.	Detection of potentially dangerous environmental situations (i.e. gas leaks, risk of fire)	1	2	3	4	5
6.	Detection of changes of person's habit in the daily activities inside the house	1	2	3	4	5
7.	Monitoring of night of the person (e.g. how many times he/she gets out of bed to go to a place and how much time he/she stay there)	1	2	3	4	5
8.	Monitoring a person's ability to prepare lunch alone	1	2	3	4	5
9.	Monitoring the time taken to prepare for lunch	1	2	3	4	5
10.	Monitoring of time spent by the person in the shower or bath	1	2	3	4	5
11.	Monitoring of physiological parameters: e.g., ECG, Blood Pressure etc. (after hospitalization or for any illness)	1	2	3	4	5
12.	Facilitation of contact between person's family and the doctor	1	2	3	4	5
13.	Report of the day to you or a person you trust	1	2	3	4	5
14.	Facilitating contact between the person and the home care	1	2	3	4	5

		STRONGLY USELESS	USELESS	NEITHER USELESS NOR USEFUL	USEFUL	STRONGLY USEFUL
15.	Support the elderly person in remembering to take medicine or perform medication	1	2	3	4	5
16.	Direct notice to you if there are still lights on in the house during the night	1	2	3	4	5
17.	Monitoring of vital signs during the night (e.g., heart rate, breathing etc.)	1	2	3	4	5
18.	Monitoring the frequency with which the refrigerator is opened by your family member	1	2	3	4	5
19.	Detecting the presence of body fluids (sweat, urine, blood) of sofas, beds, etc.	1	2	3	4	5
20.	Detection of misplaced objects in the environment that could cause risk of falls	1	2	3	4	5
21.	Monitoring the frequency of social interactions (of the person) (e.g. if the person see and talk to someone or spend their days in solitude)	1	2	3	4	5
22.	Detecting a decline in the mobility of your family member (e.g. difficulty walking, difficulty maintaining balance)	1	2	3	4	5
23.	Detection of absence from home by your family member at unusual hours (e.g., overnight)	1	2	3	4	5
24.	Facilitating your contact between you and your family member	1	2	3	4	5
25.	Detection of open doors in the home	1	2	3	4	5
26.	Detection of lights on in the home	1	2	3	4	5
27.	Monitoring of the use of the stove in time (e.g., does the person cook?)	1	2	3	4	5
28.	Forced entry by you or someone you trust in case of emergency	1	2	3	4	5
29.	Warning of danger to you or others (e.g., relatives) in case of danger to your family member	1	2	3	4	5

		STRONGLY USELESS	USELESS	NEITHER USELESS NOR USEFUL	USEFUL	STRONGLY USEFUL
30.	Detecting the presence of gas leaks	1	2	3	4	5
31.	Monitoring extreme temperatures (e.g., too hot or too cold)	1	2	3	4	5
32.	Detecting the presence of risky situations for the development of fire (e.g. smoke in the environment)	1	2	3	4	5
33.	Detecting if there are any water leaks that may cause flooding (with risk of falls)	1	2	3	4	5
34.	Monitoring Heart function (e.g. Heart rate)	1	2	3	4	5
35.	Monitoring blood pressure	1	2	3	4	5
36.	Monitoring <u>blood glucose levels in blood</u> (glycemia)	1	2	3	4	5
37.	Monitoring blood oxygen levels (oximetry)	1	2	3	4	5
38.	Determining if the person fall to the ground	1	2	3	4	5
39.	Monitoring body temperature	1	2	3	4	5
40.	Detecting the presence of taps left open to avoid the risk of spills of water in the floor and, consequently of falls	1	2	3	4	5
41.	Determining whether the person suffers from episodes of incontinence (e.g., overnight)	1	2	3	4	5
42.	Monitoring the person keeps staying in bed (e.g. if in the morning she/he does not get up)	1	2	3	4	5
43.	Monitoring the person body weight	1	2	3	4	5
44.	Monitoring the person's sleep (e.g. if he/she moves a lot during the night this could a sign of a disturbed sleep)	1	2	3	4	5
45.	Monitoring your ability to maintain balance (e.g., standing)	1	2	3	4	5

We re-propose again the list of services of the system. Please indicate how much each service is **ACCETPABLE** in your opinion, on a 5-point scale where

1= strongly unacceptable, 2= unacceptable, 3= neither unacceptable nor acceptable, 4= acceptable, 5= strongly acceptable

		STRONGLY UNACCEPTABLE	UNACCEPTABLE	NEITHER UNACCEPTABLE NOR ACCEPTABLE	ACCEPTABLE	STRONGLY ACCEPTABLE
1.	Detecting the position of the person inside the house	1	2	3	4	5
2.	Monitoring the movement of the person inside the house	1	2	3	4	5
3.	Detection of the absence of movement inside the house	1	2	3	4	5
4.	Temporal monitoring of a person's position (e.g. how much time he/she spends in the bed, kitchen, sitting, etc..)	1	2	3	4	5
5.	Detection of potentially dangerous environmental situations (i.e. gas leaks, risk of fire)	1	2	3	4	5
6.	Detection of changes of person's habit in the daily activities inside the house	1	2	3	4	5
7.	Monitoring of night of the person (e.g. how many times he/she gets out of bed to go to a place and how much time he/she stay there)	1	2	3	4	5
8.	Monitoring a person's ability to prepare lunch alone	1	2	3	4	5
9.	Monitoring the time taken to prepare for lunch	1	2	3	4	5
10.	Monitoring of time spent by the person in the shower or bath	1	2	3	4	5
11.	Monitoring of physiological parameters: e.g., ECG, Blood Pressure etc. (after hospitalization or for any illness)	1	2	3	4	5
12.	Facilitation of contact between person's family and the doctor	1	2	3	4	5
13.	Report of the day to you or a person you trust	1	2	3	4	5
14.	Facilitating contact between the person and the home care	1	2	3	4	5

		STRONGLY UNACCEPTABLE	UNACCEPTABLE	NEITHER UNACCEPTABLE NOR ACCEPTABLE	ACCEPTABLE	STRONGLY ACCEPTABLE
15.	Support the elderly person in remembering to take medicine or perform medication	1	2	3	4	5
16.	Direct notice to you if there are still lights on in the house during the night	1	2	3	4	5
17.	Monitoring of vital signs during the night (e.g., heart rate, breathing etc.)	1	2	3	4	5
18.	Monitoring the frequency with which the refrigerator is opened by your family member	1	2	3	4	5
19.	Detecting the presence of body fluids (sweat, urine, blood) of sofas, beds, etc.	1	2	3	4	5
20.	Detection of misplaced objects in the environment that could cause risk of falls	1	2	3	4	5
21.	Monitoring the frequency of social interactions (of the person) (e.g. if the person see and talk to someone or spend their days in solitude)	1	2	3	4	5
22.	Detecting a decline in the mobility of your family member (e.g. difficulty walking, difficulty maintaining balance)	1	2	3	4	5
23.	Detection of absence from home by your family member at unusual hours (e.g., overnight)	1	2	3	4	5
24.	Facilitating your contact between you and your family member	1	2	3	4	5
25.	Detection of open doors in the home	1	2	3	4	5
26.	Detection of lights on in the home	1	2	3	4	5
27.	Monitoring of the use of the stove in time (e.g., does the person cook?)	1	2	3	4	5
28.	Forced entry by you or someone you trust in case of emergency	1	2	3	4	5
29.	Warning of danger to you or others (e.g., relatives) in case of danger to your family member	1	2	3	4	5

		STRONGLY UNACCEPTABLE	UNACCEPTABLE	NEITHER UNACCEPTABLE NOR ACCEPTABLE	ACCEPTABLE	STRONGLY ACCEPTABLE
30.	Detecting the presence of gas leaks	1	2	3	4	5
31.	Monitoring extreme temperatures (e.g., too hot or too cold)	1	2	3	4	5
32.	Detecting the presence of risky situations for the development of fire (e.g. smoke in the environment)	1	2	3	4	5
33.	Detecting if there are any water leaks that may cause flooding (with risk of falls)	1	2	3	4	5
34.	Monitoring Heart function (e.g. Heart rate)	1	2	3	4	5
35.	Monitoring blood pressure	1	2	3	4	5
36.	Monitoring <u>blood glucose levels in blood</u> (glycemia)	1	2	3	4	5
37.	Monitoring blood oxygen levels (oximetry)	1	2	3	4	5
38.	Determining if the person fall to the ground	1	2	3	4	5
39.	Monitoring body temperature	1	2	3	4	5
40.	Detecting the presence of taps left open to avoid the risk of spills of water in the floor and, consequently of falls	1	2	3	4	5
41.	Determining whether the person suffers from episodes of incontinence (e.g., overnight)	1	2	3	4	5
42.	Monitoring the person keeps staying in bed (e.g. if in the morning she/he does not get up)	1	2	3	4	5
43.	Monitoring the person body weight	1	2	3	4	5
44.	Monitoring the person's sleep (e.g. if he/she moves a lot during the night this could a sign of a disturbed sleep)	1	2	3	4	5
45.	Monitoring your ability to maintain balance (e.g., standing)	1	2	3	4	5



12.9.2 Questionnaire for Health Professionals

We are conducting a research investigation to assess people opinions with respect to their possible adoption of an intelligent system that supports them at home.

More specifically we refer to GiraffPlus, a support system designed for the older people who are willing to make their home a safer and more “intelligent” place. To this aim, a network of sensors should be installed in the house, which is able to detect environment changes (like movements, gas detection, etc.) and physiological data (like blood pressure, blood glucose level, body temperature, etc.) to be used in multiple ways. As an example they can trigger an alarm in case of danger (e.g., smoke in the room), or simple transfer mnemonic signals to the person to either remind or suggest him activities to be performed (like taking a medicine, turn off the stove).

The same information can be transmitted to a caregiver (like a relative or other trusted person) to keep them informed of the situation at home from remote. This is to allow them to come and rescue in case of need. An alternative scenario is the one of the information sent to your doctor to allow him to monitor the status of the person or for being sure that a certain therapy is followed.

The GiraffPlus system includes also robot in the house. This is a mobile platform with camera, screen and microphone, designed to facilitate communication of an old person and her family, or her doctor. Such a robot can be operated within the house to visually inspect aspects of the home environment and intervene in case of danger.

Please, compile the questionnaire following the following instructions carefully.

You will be described of a set of situation and parameters. We will kindly ask you to answer in any case also when the prospected scenario is not very realistic with respect to your personal situation.

Please also notice that it is not a matter of giving the right or the wrong questions: what we are interested in is your personal opinion on the subject.

It is very important for us that you answer with care and attention to all the questions, in the order suggested in the survey.

Instruction

The questionnaire consists of several questions that you should respond by placing a single tick on the alternative that corresponds to your opinion.

Please compile the questionnaire on your own.

The questionnaire is for the sole purpose of scientific knowledge and is anonymous. Your answers will then be treated in complete confidentiality, without reference to your person.

Thanks a lot in advance for your cooperation!



Socio-demographic data

AGE SEX

Professional role (specialization)

.....

In general, which is your idea about new technologies?

Strongly Negative	Somewhat Negative	Neither Positive nor Negative	Somewhat Positive	Strongly Positive
0	1	2	3	4

Please find below a list of services that may be provided by the intelligent system just described. Please indicate, in your opinion, the degree of **USEFULNESS** of each service on a 5-point scale where 1 = strongly useless, 2 = useless, 3 = neither useless nor useful, 4 = useful, 5 = strongly useful

		STRONGLY USELESS	USELESS	NEITHER USELESS NOR USEFUL	USEFUL	STRONGLY USEFUL
1.	Detecting the position of the person inside the house	1	2	3	4	5
2.	Monitoring the movement of the person inside the house	1	2	3	4	5
3.	Detection of the absence of movement inside the house	1	2	3	4	5
4.	Temporal monitoring of a person's position (e.g. how much time he spends in the bed, kitchen, sitting, etc.)	1	2	3	4	5
5.	Detection of potentially dangerous environmental situations (i.e. gas leaks, risk of fire)	1	2	3	4	5
6.	Detection of changes of person's habit in the daily activities inside the house (e. g., the person wakes up too late with respect to usual standard,)	1	2	3	4	5
7.	Monitoring of a person during night (e.g. how many times he/she gets out of bed to go to a place and how much time he/she stay there)	1	2	3	4	5
8.	Monitoring a person's ability to prepare lunch alone	1	2	3	4	5
9.	Monitoring the time taken to prepare for lunch	1	2	3	4	5
10.	Monitoring of time spent by the person in the shower or bath	1	2	3	4	5
11.	Monitoring of physiological parameters: e.g., ECG, Blood Pressure etc. (after hospitalization or for any illness)	1	2	3	4	5
12.	Facilitation of contact between the person and the doctor	1	2	3	4	5
13.	Report of the day to a care giver (e.g., to a family member)	1	2	3	4	5

14.	Facilitating contact between the person and the home care assistance	1	2	3	4	5
15.	Support the person in remembering to take medicine or perform medication	1	2	3	4	5
16.	Direct notice to the care giver (e.g. family member) if there are still lights on in the house during the night	1	2	3	4	5
17.	Monitoring of vital signs during the night (e.g., heart rate, breathing etc.)	1	2	3	4	5
18.	Monitoring the frequency with which the refrigerator is opened by the person	1	2	3	4	5
19.	Detecting the presence of body fluids (sweat, urine, blood) on sofas, beds, etc.	1	2	3	4	5
20.	Detection of misplaced objects in the environment that could cause risk of falls	1	2	3	4	5
21.	Monitoring the frequency of social interactions of the person (e.g. if the person see and talk to someone or spend their days in solitude)	1	2	3	4	5
22.	Detecting a decline in the mobility of the person (e.g. difficulty walking, difficulty maintaining balance)	1	2	3	4	5
23.	Detection of absence from home by you the person at unusual hours (e.g., overnight)	1	2	3	4	5
24.	Facilitating contact between the person and his/her family member	1	2	3	4	5
25.	Detection of open doors in the home	1	2	3	4	5
26.	Detection of lights on in the home	1	2	3	4	5
27.	Monitoring of the use of the stove in time (e.g., does the person cook?)	1	2	3	4	5
28.	Forced entry by you or someone you trust in case of emergency	1	2	3	4	5
29.	Warning of danger to a caregiver or others (e.g., relatives) in case of possible danger of the person	1	2	3	4	5
30.	Detecting the presence of gas leaks	1	2	3	4	5
31.	Monitoring extreme temperatures (e.g., too hot or too cold)	1	2	3	4	5
32.	Detecting the presence of risky situations for the development of fire (e.g. smoke in the environment)	1	2	3	4	5
33.	Detecting if there are any water leaks that may cause flooding (with risk of falls)	1	2	3	4	5
34.	Monitoring Heart function (e.g. Heart rate)	1	2	3	4	5
35.	Monitoring blood pressure	1	2	3	4	5
36.	Monitoring <u>blood glucose levels in blood</u> (glycemia)	1	2	3	4	5
37.	Monitoring blood oxygen levels (oximetry)	1	2	3	4	5

38.	Determining if the person fall to the ground	1	2	3	4	5
39.	Monitoring body temperature	1	2	3	4	5
40.	Detecting the presence of taps left open to avoid the risk of spills of water in the floor and, consequently of falls	1	2	3	4	5
41.	Determining whether the person suffers from episodes of incontinence (e.g., overnight)	1	2	3	4	5
42.	Monitoring the person keeps staying in bed (e.g. if in the morning she/he does not get up)	1	2	3	4	5
43.	Monitoring the person body weight	1	2	3	4	5
44.	Monitoring the person's sleep (e.g. if he/she moves a lot during the night this could be a sign of a disturbed sleep)	1	2	3	4	5
45.	Monitoring your ability to maintain balance (e.g., standing)	1	2	3	4	5



12.9.3 Questionnaire for Over65

We are conducting a research investigation to assess people opinions with respect to their possible adoption of an intelligent system that supports them at home.

More specifically we refer to GiraffPlus, a support system designed for the older people who are willing to make their home a safer and more “intelligent” place. To this aim, a network of sensors should be installed in the house, which is able to detect environment changes (like movements, gas detection, etc.) and physiological data (like blood pressure, blood glucose level, body temperature, etc.) to be used in multiple ways. As an example they can trigger an alarm in case of danger (e.g., smoke in the room), or simple transfer mnemonic signals to the person to either remind or suggest him activities to be performed (like taking a medicine, turn off the stove).

The same information can be transmitted to a caregiver (like a relative or other trusted person) to keep them informed of the situation at home from remote. This is to allow them to come and rescue in case of need. An alternative scenario is the one of the information sent to your doctor to allow him to monitor the status of the person or for being sure that a certain therapy is followed.

The GiraffPlus system includes also robot in the house. This is a mobile platform with camera, screen and microphone, designed to facilitate communication of an old person and her family, or her doctor. Such a robot can be operated within the house to visually inspect aspects of the home environment and intervene in case of danger.

Please, compile the questionnaire following the following instructions carefully.

You will be described of a set of situation and parameters. We will kindly ask you to answer in any case also when the prospected scenario is not very realistic with respect to your personal situation.

Please also notice that it is not a matter of giving the right or the wrong questions: what we are interested in is your personal opinion on the subject.

It is very important for us that you answer with care and attention to all the questions, in the order suggested in the survey.

Instruction

The questionnaire consists of several questions that you should respond by placing a single tick on the alternative that corresponds to your opinion.

Please compile the questionnaire on your own.

The questionnaire is for the sole purpose of scientific knowledge and is anonymous. Your answers will then be treated in complete confidentiality, without reference to your person.

Thanks a lot in advance for your cooperation!



Socio-demographic data

Age..... Sex.....

Education

Elementary School

☐ Middle School

High School

☐ University

Are you retired?

☐ Yes

☐ No

Professional Role (current or before retirement)

☐ Entrepreneur

☐ Freelancer

☐ Manager

☐ Employee

☐ Teacher

☐ Craftsman

☐ Merchant

☐ Worker

☐ At house

☐ Other (please specify)

Household Composition

☐ I live alone

☐ I live with my partner/wife/husband [and sons/daughters]

☐ I live with a caregiver/A caregiver support me some hours per day

☐ Other

In general, how much are you satisfied of your current health conditions?

Very Dissatisfied	Somewhat Dissatisfied	Fairly Well Satisfied	Very Satisfied	Completely Satisfied
0	1	2	3	4

In general, which is your idea about new technologies?

Strongly Negative	Somewhat Negative	Neither Positive nor Negative	Somewhat Positive	Strongly Positive
0	1	2	3	4

Please find below a list of services that may be provided by the intelligent system just described. Please indicate, in your opinion, the degree of **USEFULNESS** of each service on a 5-point scale where 1 = strongly useless, 2 = useless, 3 = neither useless or useful, 4 = useful, 5 = strongly useful

		STRONGLY USELESS	USELESS	NEITHER USELESS NOR USEFUL	USEFUL	STRONGLY USEFUL
1.	Detecting your position inside the house (if you are in kitchen, in the bed, sitting, etc.)	1	2	3	4	5
2.	Monitoring your movements inside the house	1	2	3	4	5
3.	Detection of the absence of your movement inside the house	1	2	3	4	5
4.	Temporal monitoring of a your position (e.g. how much time you spend in the bed, kitchen, sitting, etc..)	1	2	3	4	5
5.	Detection of potentially dangerous environmental situations (i.e. gas leaks, risk of fire)	1	2	3	4	5
6.	Detection of changes of habit in the daily activities inside the house (e. g., you wake up too late with respect to usual standard)	1	2	3	4	5
7.	Monitoring you during night (e.g. how many times you get out of bed to go to a place and how much time you stay there)	1	2	3	4	5
8.	Monitoring your ability to prepare lunch alone	1	2	3	4	5
9.	Monitoring the time taken to prepare for lunch	1	2	3	4	5
10.	Monitoring the time you spend in the shower or bath	1	2	3	4	5
11.	Monitoring of physiological parameters such as ECG, Blood Pressure etc. (after hospitalization or for any illness)	1	2	3	4	5
12.	Facilitation of contact between you and your doctor	1	2	3	4	5
13.	Report of the day to a care giver (e.g., to a family member)	1	2	3	4	5
14.	Facilitating contact between you and the home care assistance	1	2	3	4	5

		STRONGLY USELESS	USELESS	NEITHER USELESS NOR USEFUL	USEFUL	STRONGLY USEFUL
15.	Support you in remembering to take medicine or perform medication	1	2	3	4	5
16.	Direct notice to the care giver (e.g. family member) if there are still lights on in the house during the night	1	2	3	4	5
17.	Monitoring of vital signs during the night (e.g., heart rate, breathing etc.)	1	2	3	4	5
18.	Monitoring the frequency with which the refrigerator is opened	1	2	3	4	5
19.	Detecting the presence of body fluids (sweat, urine, blood) on sofas, beds, etc.	1	2	3	4	5
20.	Detection of misplaced objects in the environment that could cause risk of falls	1	2	3	4	5
21.	Monitoring the frequency of your social interactions (e.g. if you see and talk to someone or spend your days in solitude)	1	2	3	4	5
22.	Detecting a decline in your mobility (e.g. difficulty walking, difficulty maintaining balance)	1	2	3	4	5
23.	Detection of absence from home by you at unusual hours (e.g., overnight)	1	2	3	4	5
24.	Facilitating contact between you and the family member who usually assist you	1	2	3	4	5
25.	Detection of open doors in the home	1	2	3	4	5
26.	Detection of lights on in the home	1	2	3	4	5
27.	Monitoring of the use of the stove in time (e.g., do you cook?)	1	2	3	4	5
28.	Forced entry by your carer or family member or someone you trust in case of emergency	1	2	3	4	5
29.	Warning of danger to a caregiver or others (e.g., relatives) in case of possible danger for you	1	2	3	4	5

		STRONGLY USELESS	USELESS	NEITHER USELESS NOR USEFUL	USEFUL	STRONGLY USEFUL
30.	Detecting the presence of gas leaks	1	2	3	4	5
31.	Monitoring extreme temperatures (e.g., too hot or too cold)	1	2	3	4	5
32.	Detecting the presence of risky situations for the development of fire (e.g. smoke in the environment)	1	2	3	4	5
33.	Detecting if there are any water leaks that may cause flooding (with risk of falls)	1	2	3	4	5
34.	Monitoring your Heart function (e.g. Heart rate)	1	2	3	4	5
35.	Monitoring your blood pressure	1	2	3	4	5
36.	Monitoring your blood glucose levels in blood (glycemia)	1	2	3	4	5
37.	Monitoring your blood oxygen levels (oximetry)	1	2	3	4	5
38.	Determining if you fall to the ground	1	2	3	4	5
39.	Monitoring your body temperature	1	2	3	4	5
40.	Detecting the presence of taps left open to avoid the risk of spills of water in the floor and, consequently of falls	1	2	3	4	5
41.	Determining whether you suffers from episodes of incontinence (e.g., overnight)	1	2	3	4	5
42.	Monitoring if you keep staying in bed (e.g. if in the morning she/he does not get up)	1	2	3	4	5
43.	Monitoring your body weight	1	2	3	4	5
44.	Monitoring your sleep (e.g. in order to detect signs of a disturbed sleep)	1	2	3	4	5
45.	Monitoring your ability to maintain balance (e.g., standing)	1	2	3	4	5

We re-propose again the list of services of the system. Please indicate how much each service is **ACCETPABLE** in your opinion on a 5-point scale where

1= strongly unacceptable, 2= unacceptable, 3= neither unacceptable nor acceptable, 4= acceptable, 5= strongly acceptable

		STRONGLY UNACCEPTABLE	UNACCEPTABLE	NEITHER UNACCEPTABLE NOR ACCEPTABLE	ACCEPTABLE	STRONGLY ACCEPTABLE
1.	Detecting your position inside the house (if you are in kitchen, in the bed, sitting, etc.)	1	2	3	4	5
2.	Monitoring your movements inside the house	1	2	3	4	5
3.	Detection of the absence of your movement inside the house	1	2	3	4	5
4.	Temporal monitoring of a your position (e.g. how much time you spend in the bed, kitchen, sitting, etc..)	1	2	3	4	5
5.	Detection of potentially dangerous environmental situations (ie gas leaks, risk of fire)	1	2	3	4	5
6.	Detection of changes of habit in the daily activities inside the house (e. g., you wake up too late with respect to usual standard)	1	2	3	4	5
7.	Monitoring you during night (e.g. how many times you get out of bed to go to a place and how much time you stay there)	1	2	3	4	5
8.	Monitoring your ability to prepare lunch alone	1	2	3	4	5
9.	Monitoring the time taken to prepare for lunch	1	2	3	4	5
10.	Monitoring the time you spend in the shower or bath	1	2	3	4	5
11.	Monitoring of physiological parameters: e.g., ECG, Blood Pressure etc. (after hospitalization or for any illness)	1	2	3	4	5
12.	Facilitation of contact between you and your doctor	1	2	3	4	5
13.	Report of the day to a care giver (e.g., to a family member)	1	2	3	4	5
14.	Facilitating contact between you and the home care assistance	1	2	3	4	5

		STRONGLY UNACCEPTABLE	UNACCEPTABLE	NEITHER UNACCEPTABLE NOR ACCEPTABLE	ACCEPTABLE	STRONGLY ACCEPTABLE
15.	Support you in remembering to take medicine or perform medication	1	2	3	4	5
16.	Direct notice to the care giver (e.g. family member) if there are still lights on in the house during the night	1	2	3	4	5
17.	Monitoring of vital signs during the night (e.g., heart rate, breathing etc.)	1	2	3	4	5
18.	Monitoring the frequency with which the refrigerator is opened	1	2	3	4	5
19.	Detecting the presence of body fluids (sweat, urine, blood) on sofas, beds, etc.	1	2	3	4	5
20.	Detection of misplaced objects in the environment that could cause risk of falls	1	2	3	4	5
21.	Monitoring the frequency of your social interactions (e.g. if you see and talk to someone or spend your days in solitude)	1	2	3	4	5
22.	Detecting a decline in your mobility (e.g. difficulty walking, difficulty maintaining balance)	1	2	3	4	5
23.	Detection of absence from home by you at unusual hours (e.g., overnight)	1	2	3	4	5
24.	Facilitating contact between you and the family member who usually assist you	1	2	3	4	5
25.	Detection of open doors in the home	1	2	3	4	5
26.	Detection of lights on in the home	1	2	3	4	5
27.	Monitoring of the use of the stove in time (e.g., do you cook?)	1	2	3	4	5
28.	Forced entry by your carer or family member or someone you trust in case of emergency	1	2	3	4	5
29.	Warning of danger to a caregiver or others (e.g., relatives) in case of possible danger for you	1	2	3	4	5

		STRONGLY UNACCEPTABLE	UNACCEPTABLE	NEITHER UNACCEPTABLE NOR ACCEPTABLE	ACCEPTABLE	STRONGLY ACCEPTABLE
30.	Detecting the presence of gas leaks	1	2	3	4	5
31.	Monitoring extreme temperatures (e.g., too hot or too cold)	1	2	3	4	5
32.	Detecting the presence of risky situations for the development of fire (e.g. smoke in the environment)	1	2	3	4	5
33.	Detecting if there are any water leaks that may cause flooding (with risk of falls)	1	2	3	4	5
34.	Monitoring your Heart function (e.g. Heart rate)	1	2	3	4	5
35.	Monitoring your blood pressure	1	2	3	4	5
36.	Monitoring your blood glucose levels in blood (glycemia)	1	2	3	4	5
37.	Monitoring your blood oxygen levels (oximetry)	1	2	3	4	5
38.	Determining if you fall to the ground	1	2	3	4	5
39.	Monitoring your body temperature	1	2	3	4	5
40.	Detecting the presence of taps left open to avoid the risk of spills of water in the floor and, consequently of falls	1	2	3	4	5
41.	Determining whether you suffers from episodes of incontinence (e.g., overnight)	1	2	3	4	5
42.	Monitoring if you keep staying in bed (e.g. if in the morning she/he does not get up)	1	2	3	4	5
43.	Monitoring your body weight	1	2	3	4	5
44.	Monitoring your sleep (e.g. in order to detect signs of a disturbed sleep)	1	2	3	4	5
45.	Monitoring your ability to maintain balance (e.g., standing)	1	2	3	4	5

12.10 Detailed means and standard deviations among subjects within Countries

Detailed Means and Standard Deviations of “SOCIAL INTERACTION” subscale items within Countries for subjects.

		ITALY			SWEDEN			SPAIN		
		EP	CG	HP	EP	CG	HP	EP	CG	HP
ITEM11	M	4,42	4,58	4,54	4,22	4,57	4,26	4,67	4,75	4,67
	SD	0,66	0,65	0,83	1,15	0,79	0,7	0,68	0,45	0,62
ITEM12	M	4,16	4,48	4,47	4	3,86	4,3	4,67	4,92	4,67
	SD	0,97	0,67	0,75	1	0,9	1,02	0,49	0,29	0,62
ITEM13	M	3,72	3,79	4,11	3,74	4,57	3,7	3,92	4,17	4,4
	SD	1,06	0,82	0,63	0,98	0,78	0,87	0,79	0,83	0,83
ITEM14	M	3,86	3,97	4	3,89	4,57	4,17	4,08	4,42	4,67
	SD	0,91	0,81	0,77	0,97	0,53	1,26	0,9	0,52	0,48
ITEM15	M	4,16	4,55	4,32	3,85	4,57	4,35	4,67	4,75	4,73
	SD	0,81	0,56	0,67	0,82	0,53	0,98	0,65	0,45	0,46
ITEM16	M	3,53	3,45	3,43	3,19	3,14	3,09	4,25	4,5	4,33
	SD	0,93	0,9	0,84	1,18	0,9	1,08	0,75	0,67	0,68
ITEM24	M	4,12	4,27	3,89	3,74	3,86	3,87	4,75	4,67	4,47
	SD	0,79	0,51	0,87	0,86	0,69	1,22	0,45	0,49	0,74
ITEM28	M	4,4	4,52	4,04	4,3	4,57	4,13	4,58	4,75	4,6
	SD	0,73	0,56	0,83	0,82	0,79	1,32	0,51	0,45	0,63
ITEM29	M	4,56	4,64	4,32	4,26	5	4,09	4,67	4,83	4,87
	SD	0,59	0,65	0,77	0,86	0,0	1,34	0,49	0,39	0,35

Detailed Means and Standard Deviations of “PHYSIOLOGICAL MONITORING” subscale items within Countries for subjects.

		ITALY			SWEDEN			SPAIN		
		EP	CG	HP	EP	CG	HP	EP	CG	HP
ITEM17	M	4,23	4,27	4,29	4	4,57	4,46	4,42	4,58	4,53
	SD	0,78	0,87	0,82	1	0,78	0,64	0,9	0,52	0,64
ITEM19	M	3,47	3,88	3,82	3,22	4,14	2,78	4,42	4,25	4,47
	SD	1,16	0,86	0,61	1,31	1,21	1,16	0,67	0,62	0,64
ITEM34	M	4,47	4,3	4,36	4,07	4,29	4,13	4,83	4,5	4,33
	SD	0,74	0,73	0,73	1,07	1,11	0,92	0,58	0,8	1,11
ITEM35	M	4,4	4,33	4,29	4,15	4,14	4,04	4,83	4,5	4,53
	SD	0,85	0,69	0,71	0,98	1,06	0,92	0,58	0,79	0,92
ITEM36	M	4,33	4,21	4,14	4,11	4,14	4,13	4,75	4,58	4,47
	SD	0,86	0,82	0,93	0,97	10,9	0,97	0,62	0,67	0,74
ITEM37	M	4,21	4,21	4,11	3,85	3,71	3,87	4,75	4,33	4,33
	SD	1,01	0,78	0,91	1,02	1,11	1,18	0,62	0,78	1,11
ITEM39	M	3,93	3,94	3,86	3,85	3,71	3,78	4,58	4,25	4,27
	SD	0,86	0,56	0,85	0,9	1,11	0,9	0,67	0,75	0,7
ITEM41	M	3,56	3,7	3,71	3,96	4,14	2,91	4	4,25	4,2
	SD	1	0,77	0,66	1,01	0,9	1,08	0,74	0,45	0,68
ITEM43	M	3,65	3,55	3,21	3,37	3,43	2,83	3,67	3,83	3,87
	SD	1,08	0,83	0,87	1,08	0,97	1,11	0,98	0,72	0,99
ITEM44	M	3,7	3,55	3,64	3,7	3,43	3,65	3,92	4,08	4,07
	SD	1,01	0,67	0,83	0,99	0,54	0,89	0,67	0,52	0,88

Detailed Means and Standard Deviations of “ACTIVITY MONITORING” subscale items within Countries for subjects.

		ITALY			SWEDEN			SPAIN		
		EP	CG	HP	EP	CG	HP	EP	CG	HP
ITEM1	M	3,58	3,85	4,14	3,04	4,71	3,74	4,25	4,33	4,6
	SD	1,03	0,83	0,71	0,76	0,76	1,32	0,62	0,65	0,51
ITEM2	M	3,51	3,91	4,11	3,07	4,14	3,43	4,25	4,25	4,47
	SD	0,94	0,8	0,74	0,83	0,9	1,31	0,75	0,75	0,74
ITEM3	M	3,74	4,12	4,32	3,48	4,43	4,35	4,08	4,67	4,8
	SD	1	0,78	0,9	0,98	0,98	0,98	1	0,65	0,41
ITEM4	M	3,53	3,61	3,93	3,33	3,43	3,43	3,67	4,08	4,4
	SD	0,93	0,9	0,77	0,73	1,13	1,16	0,89	0,67	0,74
ITEM6	M	3,74	3,76	3,82	3,33	3,71	3,61	3,67	4	4,33
	SD	1	0,83	0,72	0,92	0,95	0,94	0,89	0,95	0,62
ITEM7	M	3,7	3,76	3,79	3,15	4	3,48	3,92	4,25	4,4
	SD	0,96	0,79	0,79	1,03	1	0,79	0,79	0,45	0,63
ITEM8	M	3,23	3,52	3,75	3,19	3,43	3,17	4,08	4	4,27
	SD	1,13	0,91	0,65	1,03	0,78	1,03	0,67	0,43	0,46
ITEM9	M	3,35	3,24	3,36	2,74	3,29	2,61	3,58	3,92	3,93
	SD	1,11	0,9	0,62	1,02	0,95	1,03	0,79	0,67	0,7
ITEM10	M	3,63	3,61	3,57	3	3,86	3,13	4	4,5	4,33
	SD	1,07	0,93	0,63	1,07	1,21	1,01	0,74	0,67	0,72
ITEM18	M	2,84	2,91	3,21	2,85	3,14	2,52	3,75	3,92	4
	SD	1,17	0,91	0,69	1,1	0,69	1,12	1,3	0,8	0,65
ITEM21	M	3,6	3,55	3,82	2,96	3,29	2,91	4,08	4,17	4,2
	SD	0,95	0,83	0,82	1,02	1,25	1,28	0,9	0,58	0,68
ITEM22	M	4,09	4,15	4,11	3,85	4,29	4,13	4,58	4,5	4,67
	SD	0,84	0,87	0,88	1,06	1,25	0,87	0,67	0,52	0,62
ITEM23	M	3,79	4,39	3,93	4	5	4,57	4	4,33	4,4
	SD	1,15	0,9	0,98	1,14	0	0,66	1,13	0,78	0,74
ITEM27	M	3,44	3,55	3,64	3,7	4	3,3	4,08	4,08	4,2
	SD	1,12	0,79	0,68	1,1	1	1,02	0,51	0,51	0,68
ITEM38	M	4,63	4,79	4,39	4,59	5	4,78	4,83	4,92	4,93
	SD	0,54	0,48	0,96	0,69	0	0,42	0,39	0,29	0,26
ITEM42	M	3,98	3,85	4	4,11	4,29	4	4,33	4,58	4,4
	SD	0,86	0,91	0,67	0,93	0,95	1,13	0,65	0,51	0,63
ITEM45	M	3,91	4,03	4,04	4,11	4,14	3,74	4,58	4,42	4,2
	SD	0,89	0,85	0,79	0,89	0,9	1,1	0,67	0,67	0,68

Detailed Means and Standard Deviations of “ENVIRONMENTAL MONITORING” subscale items within Countries for subjects.

		ITALY			SWEDEN			SPAIN		
		EP	CG	HP	EP	CG	HP	EP	CG	HP
ITEM5	M	4,67	4,82	4,89	3,96	4,71	4,09	4,75	4,75	4,87
	SD	0,52	0,39	0,32	1,12	0,5	1,5	0,45	0,45	0,35
ITEM 20	M	3,95	3,91	4,21	3,74	4,14	4,04	4,67	4,5	4,53
	SD	0,98	0,88	0,79	1,16	1,22	0,77	0,65	0,52	0,52
ITEM 25	M	4,16	4,33	3,68	3,7	4,43	3,78	4,08	4,33	4,53
	SD	0,84	0,69	0,95	0,91	0,98	0,99	0,79	0,65	0,74
ITEM 26	M	3,67	3,27	3,14	3,37	3,57	3,09	4,08	4,25	4
	SD	0,92	0,91	0,97	1,11	0,98	1,04	0,51	0,62	0,76
ITEM 30	M	4,72	4,82	4,54	4,11	4,43	4,04	4,92	5	4,93
	SD	0,5	0,47	0,88	1,05	1,13	1,36	0,29	0	0,26
ITEM 31	M	3,67	4,18	3,93	3,63	3,43	3,17	4,5	4,25	4,73
	SD	0,97	0,73	0,81	0,93	0,79	1,23	0,8	0,75	0,46
ITEM 32	M	4,49	4,67	4,64	4,15	4,86	4,09	4,92	4,92	5
	SD	0,5	0,48	0,49	0,9	0,38	1,5	0,29	0,29	0
ITEM 33	M	4,47	4,48	4,54	4,41	4,71	3,87	4,58	4,75	4,87
	SD	0,5	0,56	0,58	0,84	0,48	,051	0,51	0,45	0,35
ITEM 40	M	4,42	4,24	3,93	4,33	4,43	4	4,58	4,58	4,6
	SD	0,59	0,7	0,85	0,87	0,98	1,16	0,67	0,51	0,50

12.11 Workshop method, structure, guide and analysis

12.11.1 The workshop method with older participants according to Task 1.2

A workshop is a way to be creative in a structured manner and with a clear objective.

The most important resource is the participants. The workshop involve preferably 15 people, aged 65 and older, living in their own home.

The basic tools for the workshop are the design sketches (models) produced by the Industrial design division in Lund. These sketches should take into consideration the basic hardware, the functions of the sensor system and the possibility for the Giraff to move around. *Playfulness* has been the key concept in the development of these sketches. Other aspects have been *cross-cultural* differences and lifestyles.

The sketches are expected to provide suggestions for product design with comments and aspects that concern the GiraffPlus system including the home environment with sensors and a mobile tele-presence robot. For the older person the system should offer ambient support and comfort, well integrated into everyday life.

The main objective for the workshop is to evaluate the models in order to understand which of them the participants prefer and why, and what the participants find acceptable, meaningful and supportive for them and their specific situation.

The result from the workshop will be handed over to Task 1.4 in the form of drawings and sketches with written comments. The result will be used in three ways:

- Together with user requirements in Task 1.1 for defining functional specifications.
- If manageable and simple enough, inspire the design of the product in a short term perspective.
- Inspire the project in a long term perspective to enrich and deepen the understanding of what is understood as meaningful, acceptable and useful.

This workshop is planned for five hours, lunch included. With respect for the fact that elderly people is not a heterogeneous group there are certain things that can make a difference from having younger participants involved. Previous experiences show that the *length* of the meetings and the *hours* are important. Five hours is about what you can manage if it is necessary to economize the person's energy because of age. For the same reason the workshop should not start too early in the morning. This might be a differentiating aspect in between northern and southern Europe. Also the *number* of participants in the group is important. Their concentration and attention to others dramatically fell when there were more than three in a smaller group and fifteen in total (Östlund 2008, Zajicek, 2005). The relevance of the *content* is also important for the concentration. Since the participants have been invited and have accepted the invitation the content is hopefully attractive to them.

One aspect of being invited to a workshop about the use of robots in the home is that it will raise emotions associated with earlier impressions of robots are. This is being considered in the beginning of the workshop where the participants will be given the opportunity to express what initially comes on their mind.

12.11.2 The structure of the workshop

The structure of the workshop is based on experiences of designing robotics for elderly and participatory design within the Ageing and design program in Lund. We propose a workshop with five steps:

1. The aim of the first step is:
 - To make it clear for the participants what is the goal of the workshop, what will happen with the result and who is going to take care of them. See the guide below.
 - To make a short presentation of the participants
 - To present the schedule for the day.
 - To tell them how and when they will get feedback and information of what happened with their contributions.
2. The aim of the second step is to get the participants to express their feelings and ideas about robots, mainly to get that out of the way and make it possible to focus on the models that will be presented. Pictures of different robots, fictive and real, are displayed on a screen. The participants are asked to make free comments on what they see and what they feel. This can be done in the big group but preferably in smaller groups of two or three persons.
3. The third step is a lunch that the participants and the leaders are eating together.
4. The fourth step is to introduce the Giraff concept to the participants. Show them a picture or the Giraff robot itself and describe the system with sensors, that it is mobile and provide communication opportunities.
5. The fifth step is to get the participants comment on and develop the design sketches provided by Industrial design at Lund University. The participants will work in groups of 3-4 and be provided with a picture of each design sketch, blank papers and different kind of crayons and pencils in different colors. It is valuable if workshop leaders can act as facilitators in every group, not to run the discussion but to listen and to take notes. They are asked to:
 - Comment on the pictures and individually rank them on a piece of paper and motivate in why they prefer certain models and why not the others. Encourage them to talk about themselves as "I" instead of discussing the elderly in general. The rankings should be motivated why low/why high related to special needs, expressed life style, the physical space/home environment, usefulness, to be used for what and other unpredictable comments.

- Ask them to write down their comments or make their own changes and drawings. The sketches have a few alternatives on the side that might encourage them to bring up new ideas. Elaborate further in drawing or writing, how to develop the design, the color, the function to fit into their home, to be attractive to them.
 - Discuss the result in the big group.
6. The aim of the fifth step is to conclude the day. Let every group give any concluding remarks on the content of the day and their experience of being a part of this workshop. Remind them about when and how they will get feedback.

12.11.3 Guide for workshop leaders

The workshop need three leaders, one who is leading the work, one who assist and one who is responsible for the documentation. The most important outcome of the workshop is the sketches, drawings and writings that the participants do themselves and the conclusions of the discussions. The person responsible for the documentation takes notes and collects the sketches, drawings and writings from the participants. Recording is not necessary unless video recording is possible. However, video recording can raise ethical problems and should for that reason be avoided.

The room and the surrounding are important. Make it comfortable for group work from the beginning, don't refurnish during the workshop. Let them keep their seat and the smaller group thorough the day. Put fruit and candy on the tables for them to get extra energy. Choose candy that is kind to old people's teeth and consider that some of them can have problems with diabetes.

Prepare for pictures of different robots, fictive and real, for the second step. We can recommend a search for Paro, Hector the companion robot, Kompaí, Taizo, Asimo, Hospi-Rimo, Nao, Elfoid, Pearl the nursebot, Keepon and Giraff.

Don't hesitate to give them the opportunity to make drawings. For some this is much easier than writing and talking. The second step will make them start to reflect. When they listen to the other participants, they will discover and develop their own views and ideas. This may take a minimum of one hour of discussion in both the large and the small group. Give them one task at a time ie. tell them to comment and rank first, then draw or write.

12.11.4 Analysis and delivery of result

The result of the participants' own work in the fourth step has be compared with the documentation provided by the workshop leaders responsible for taking notes. The quality of the analysis is strongly dependent on the clarity of the drawings and the documentation of the workshop leader.

The following table presents the detailed results of the workshop. In the following a description of the different fields in the table is provided.

Number = number of the sketch

User = the kind of user generating the request, organized in partner countries.

Description = a brief description. In Sweden we define this as requirements

Justification = A short reference to the motivations for the requirements dvs. motivation

Priority = Mandatory, Desirable, Optional.

Users	Description of requirements	Justification	Priority
Appearance			
SW	Grip bar round	Square bar has no affordance, signal: don't touch me.	Mandatory
SP	Human appearance, preferably female	Better acceptance	Desirable
IT	Human shape, especially with regard to face	Makes it more familiar	Desirable
SP SW	Small table	Could be used as a serving trolley. To be able to use the camouflage function totally and cover it with for example flowers.	Desirable
SW	Stable table surface	To be used as a support when standing up from sitting or risk falling.	Mandatory
IT	The robot should be lower and less bulk	Space problems	Desirable
SP	No taller than 1,50 meters	More stability, more acceptance	Mandatory
SW	Cover sheets (clothes)	For the grandchildren and to create a sense of taking care of it	Desirable
Voice and sound			
SP	Silent engine	To avoid nuisance	Mandatory
IT	Sensors could make sound	Alarm function can be useful	Optional
SP SW	Voice and sound are important Voice tone selection	To have confidence in him or her that is on the screen.	Optional
SP SW	Voice control	We don't need to use a keyboard or buttons	Optional
Materials and colors			
IT	No plastic, prefer a good leather	Comfortable to touch and nice to look at	Desirable

SW	Soft materials	Nicer appearance	Desirable
IT	No bright colors, prefer pastel colors.	Soft colors are better integrated into the home	Desirable
Screen and camera			
SP	PC screen	Used with a wireless keyboard for more functionality	Desirable
SP	Night vision camera	No need for the secondary user to be dependent on lights during nighttime when moving the Giraff, useful for emergencies.	Mandatory
IT	A monitor to see the person you are talking to. At the same time old people prefers a robot without screen, instead a humanoid face o the robot.	Robots with faces seem more sympathetic and acceptable. Face could be cashed in and disappear when not using it.	Mandatory
SW	Screen vertically adjustable	Need to meet caregivers on the same level, whenever laying, sitting down or standing.	Mandatory
Sensors			
IT	Sensors should have different shapes	In particular with religious reminding that “make feel better”. Secondly, other shapes have been taken into account, such dolls, child statue, pictures or picture frames, flower vases, plants vases and compartments (?!)	Desirable
IT	No sensors into the bedroom	Because of the privacy	Desirable
IT	No sensors into the bathroom	Because of the privacy	Desirable
IT	A limited number of sensors in the house	Five seem a sufficient number of them, in any case no more than ten.	Mandatory
IT	Sensors – the technical artifact – should be camouflaged	People prefer them as wristwatches, more than bracelets or necklaces. Could be camouflaged as a part of the ornament in	Desirable

		the home.	
IT	Sensors – the technical artifact – can be attached to the robot	Not a need	Optional
Position in the home			
IT	Robot should stay in the room where most time is spent	Desire to keep it near themselves, for instance if most time is spent in the living room, the robot should also stay there.	Mandatory
IT	Not in the bathroom	Privacy	Mandatory
IT	Not in the bedroom	Privacy	Desirable
SW	Charging station placed where there is space	Homes are differently organized (rooms, doors etc.) and furnished.	Mandatory
IT	Could be problems related to space	Don't have big houses and needs robots or sensors not bulky.	Mandatory
Utility			
SP SW	Be reminded to take medication	It is easy to forget	Mandatory
SW	Alarm when in need of help	Feeling of safety, avoid being left alone if falling	Mandatory
IT	Utility more important than the shape	The shape is not important, it is the utility that matters	Mandatory
SW	Bringing up memories with for example pictures or tunes.	Wellness, be a little happier.	Optional
SW	Help to remember for the coming daily errands (recording function)	What did we talk about this morning, what were we supposed to buy	Optional
SW	Take social contacts, order different types of services for example food delivery, cleaning.	What's in it for me? Need to get more out of it myself, not only be monitored.	Mandatory
SW	Watch messages	We need to know what is going on or be reminded of appointments	Mandatory
SP SW	Ability to provide general information from Internet (for example Wikipedia, Google)	Increases functionality	Desirable
SP	Long life easy to replace battery Double battery system, each battery charging independently	Increases acceptance. One battery would remain in the charging block when the Giraff is in use, automatic swap battery	

		system	
SP	Possibility to be used as a book reader	Increased functionality	Desirable
SP	Language selection		Desirable
SW	Rehabilitation, training programs provided by a physiotherapist.	Help to perform exercise movements in the best way	Mandatory
SW	Help when I forget where I put things	You do not know how often I forget where I put things every day	Optional
SW	Get a massage	Wellness, to feel better	Optional
SP	Mechanical hand or grasping device	To hang things on or some other daily activities	Desirable
SP	Obstacle detection	Obstacles in the home to prevent falling?	Mandatory
Other concerns			
IT	Payment, who is going to pay for this? The National Health System?	Economic concerns	Mandatory