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PeerAssist

A P2P platform supporting virtual communities to assist independent living of senior citizens

Deliverable 2.3
"Definition of global requirements, trials and demonstration"

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Table of Contents

1. Introduction

This document presents the list of global system requirements for the PeerAssist project. The goal is to describe the functionalities and characteristics it must have, in a formal way. These requirements will drive the future development of the system, and will serve to verify that it works as expected.

It must be noted that this is a research-driven project, rather than a custom solution for a client. Therefore, there are no tight constraints on the behaviour, nor detailed stakeholder demands. Instead, a global outline of the intended product is given, while allowing some freedom to modify features based on the results of the ongoing research (e.g. types of communities, modes of interaction, etc.).

The data sources and criteria for the Requirements Analysis have been the following:

Knowledge and Evaluation of target users

The preliminary State-of-the-Art research provided substantial knowledge about special needs of the elderly concerning lifestyle, social interaction and ICT. The conclusions are reflected in the document D2.1.

Besides that, a practical evaluation was carried out on a focus group of elderly people, both in Spain and Greece. Full details are presented in D2.2. The resulting data showed some interesting conclusions that led to the identification of user needs, i.e. features that should be offered by the system. This information helped to model the functional requirements (use cases) as well as some non-functional requirements.

Intended technology research

This project is also intended to foster technological investigation in some specific areas. Therefore, assuming some technical solutions (P2P, semantics, multimodality), some functionalities were included to fully exploit the benefits these technologies can offer.

Technical constraints (standards, tools...)

One of the priorities is to make the system compatible and compliant with industry standards, which will affect the choice of the most appropriate languages or protocols (HTML, VoiceXML, RDF...). Also, the expertise of participants or acknowledged convenience may determine the election of a specific technology (P2P, OSGi). However, these are design decisions to be made in subsequent phases.

Legal constraints

Some law regulations may apply, and they must be carefully considered. This is a major concern for privacy and confidentiality issues.

The content in this document is organized in the following sections:

Section 1 makes an introduction to the document, and explains the sources and procedures used in the definition of requirements.

Section 2 exposes the full list of requirements, organized by topics and divided between functional and non-functional.

Section 3 provides some tables to show how the user's needs are addressed by these system requirements.

Section 4 describes the plan for trials and demonstration of the platform.

2. Requirements analysis

The requirements are specified as a list of numbered items. For clarity, they are organized according to the topic they are related to (general, interfaces, semantics, network...). This separation is inspired by software layers, although this document should not attempt to describe the architecture.

For each section, two types of requirements are enumerated. Functional requirements are those which indicate a functionality, i.e. something the system must do. Non-functional requirements place constraints on the implementation (performance, security, reliability...), so they detail how the system must be.

2.1. General

2.1.1. Functional

Use cases defined which functionalities the system must offer to the user. Now, these requirements indicate which characteristics the system must have to be able to deliver that functionality.

For easier lookup, the aspects defined in D2.2 are applied again to further classify these requirements.

Social interaction

R1. The system shall allow users to search for other users.

R2. The system shall allow users to communicate with each other through specific channels.

R3. The system shall allow users to create and participate in groups of users.

R4. The system shall allow users to perform online activities among a group of people.

R5. The system shall allow users to set up and organize events among a group of people.

R6. All types of groups can be open (free access) or closed (only selected users are allowed). However, the system may impose access restrictions in specific cases.

R7. The system shall find and propose matching peers to join an open group.

R8. The user must be allowed to select specific peers for a closed, private group.

R9. The users must be allowed to accept or reject group membership invitations.

R10. The users must be allowed to join open (public access) groups, even if they were not initially matched and invited by the system.

R11. The users must be allowed to leave a group at any time.

R12. The system shall provide the necessary software applications to perform online activities.

R13. The groups shall provide facilities to enable interaction between users: communication channels, data sharing, etc.

R14. The system shall allow users to search for groups.

R15. The system shall allow the owner of a group to delete it, in which case notifications are sent to its members.

Services

R16. The system shall allow users or 3rd parties to publish services.

R17. The system shall allow users or 3rd parties to advertise services.

R18. The system shall allow users to search for services.

R19. The system shall allow users to use (i.e. book) a service.

R20. The system shall allow users to rate a service.

Content access

R21. The system shall allow users to search content in the platform.

R22. The system shall allow users to publish content in the platform.

R23. The system shall provide users with content suggestions.

R24. The system shall allow users to advertise items (events, groups...).

R25. The system shall allow users to receive advertisements based on filtering criteria.

Care giving

R26. The system shall allow users to add an authorized caregiver to his/her caregiving community.

R27. The system shall allow users to set up and perform monitored tasks with trusted caregivers.

R28. The system shall raise an alarm when an anomaly is detected from the user. The alarm is notified to selected caregivers.

R29. The system shall allow users to communicate with a designated and authenticated doctor for private medical consultations.

General

R30. The system shall allow the user to edit the data on his/her profile.

R31. The system shall allow the user to add, delete or modify peers on his/her contact list.

R32. The system shall help the user to perform tasks through a Personal Assistant.

2.1.2. Non-functional

Some non-functional properties are crucial for and can be applied to most IT projects where actual systems are being created. Availability describes the up time of the system. This is fairly dependent on the chosen infrastructure and location of the semantic services. If it is centralized, we have to guarantee a certain QoS and availability. Durability is one of the four ACID properties (Atomicity, Consistency, Isolation and Durability) that characterize transactions in database systems, Durability guarantees that after the successful commit of a transaction, all actions within the transaction are persisted. Reaction time is not only important in user interfaces, but moreover affects the user's overall perception of a systems. It is very important to avoid hazards caused by system components and procedures. Privacy issues have to be regarded as well as exchanging data only between trusted sources. Security itself, with respect to communication over the internet, has to be handled on the (P2P) communication layer.

R33. The system's latency shall be within acceptable limits.

R34. The system shall be reliable.

R35. The system shall be safe and secure on a technical layer and furthermore shall foster trust mechanisms on a conceptual level.

2.2. Interfaces

2.2.1. Functional

R36. The user shall be able to use the system on a PC with monitor, keyboard and mouse.

R37. The user shall be able to use the system on a TV with a remote control.

R38. The user shall be able to use the system on a touch screen.

R39. The user shall be able to use the system through an input/output voice interface using a microphone and speakers or a phone.

R40. The user interface should be accessible from local peripherals as well as from network-attached devices in a LAN.

R41. The user interface shall be adaptable to each of the supported devices.

R42. The user interface shall be personalized according to the user's semantic data (profile).

2.2.2. Non-functional

R43. The user interface shall feature a level of usability that allows its use to the elderly, or people not familiar with computers.

R44. The user interface shall be accessible for people with some age-related impairments.

R45. The user interface shall support multiple languages, both for visual and speech (recognition and synthesis) interfaces.

R46. The user interface shall be Web-based in order to run on all supported devices.

R47. The presentation data shall be encoded in portable, standard languages that enable loose coupling between components.

2.3. Semantics

2.3.1. Functional

R48. The system shall store information entered by the users about themselves and information inferred from user behaviour as user profiles represented semantically in a machine-readable formalism.

R49. The system shall represent requests and offers made by users semantically in a machine-readable formalism.

R50. The system shall capture relevant context parameters and represent them semantically in a machine-readable formalism.

R51. The system shall perform matching of user queries to services available in the market place or to peer groups dynamically formed, taking into account relevant context parameters.

R52. The system shall learn usage patterns derived from the tasks carried out and the requests made by a user over time.

R53. The system shall store semantic descriptions of the services that are available on the system.

R54. The system shall export data stored by the services (perhaps partially) as semantic data in order to enable faster and more sensible searches.

2.3.2. Non-functional

Semantic data will be presented as ontologies created in machine-readable format, with basic inference features. Persistent knowledge storage will be achieved through one of the main OOS solutions available (e.g. Sesame, Jena, Owlim, ...). The aim of the semantic layer is to answer complex queries such as people/service recommendations. Thus the underlying information provided must guarantee to fulfill some requirements. Completeness of available information (respectively information returned in query answers) can be reached to a certain amount, but it can be very hard to guarantee full completeness dependent on the size of the knowledge base, level of knowledge inference and different other factors. There is a trade-off between completeness, consistency, correctness and latency. In a centralized semantic layer these properties can be controlled and achieved better. In a distributed scenario they cannot be easily guaranteed. Consistency guarantees that a query delivers the same result, when no triples have been added or deleted in the store. This requirement can also be more easily achieved in a centralized semantic layer rather than a distributed knowledge base. The amount of falsely or irrelevant data returned

should be minimized or even eliminated. In the PeerAssist system correctness of data has a much higher priority than completeness of the data retrieved by different parties.

Additionally to the specific NFPs also the general NFPs apply to the semantic layer. If the semantic layer is distributed, availability becomes more crucial and measures have to be in place on the P2P layer guaranteeing the availability of certain nodes. Persistency affects the performance of the semantic layer since in-memory (i.e. non persistent) storage solutions perform much better with respect to inference and query answer times. Lying deep inside the overall system an execution failure in the semantic layer will lead to an unusable system. Therefore reliability and availability have to be maximized. Reaction time of the semantic layer is to be considered since inference can be a time consuming process for huge ontologies with many entities and instances. For the semantic part of the project, the data security and trust (which is also a part of the semantic web layer architecture) properties are very important.

R55. The system's knowledge base and information returned in query answers shall reach sufficient level of completeness.

R56. The system's semantic layer shall answer queries consistently.

R57. The answers provided by the system shall be correct.

The CAP theorem established by Brewer (http://en.wikipedia.org/wiki/CAP_theorem) outlines the trade-offs between data Consistency, Availability and Partition-tolerance within a P2P system. In order to find a good compromise of these NFP's we must consider the findings of Brewer's work.

2.4. Network

The proposed/required network architecture will be based on peer-to-peer (P2P) systems.

- A P2P system enables entities at the edges of the network to communicate and share services and resources without the need of centralized control.
- A modular P2P overlay architecture will be built that resides between the network and the service layer. The P2P layer will be responsible for the transparent and efficient communication of the messages described in each of the services. This network overlay will provide efficient routing and the formation and maintenance of virtual communities.

- The P2P layer is a distributed system architecture paradigm that will provide all desired system characteristics.
- P2P networks are typically used for connecting nodes via largely ad hoc connections.

2.4.1. Functional

R58. The system shall allow for the formation of communication groups and building up virtual ad-hoc communities.

R59. The system shall support the creation of P2P communities based on semantically retrieved information.

R60. The system shall provide remote service discovery and management. Service management and discovery will be independent of the network layer.

R61. The system shall provide identity management.

R62. The system shall provide fundamental security services such as authentication, confidentiality and integrity.

R63. The system shall support the enforcement of security policies.

2.4.2. Non-functional

R64. The P2P overlay network shall be scalable, decentralized, extensible and flexible.

R65. The P2P network shall provide an application agnostic communication overlay.

R66. The P2P network should be a tailored overlay layer to the needs raised by the services and applications running on top.

R67. The P2P communication will be implemented using technologies already in place through the Service Oriented Architecture (SOA). Through this mechanism communication functionalities can be implemented in an efficient cross platform manner that does not rely on the underlying network infrastructure.

2.5. Hardware

2.5.1. Functional

R68. The system shall support a wide range of end-user terminals in terms of processing power and display capabilities.

R69. The hardware that will run the service platform must have adequate network interfaces to communicate with other devices in the home network and the P2P network.

2.5.2. Non-functional

R70. The hardware that will run the service platform must have enough processing power to handle speech recognition and TTS software. If necessary, different hardware shall be used for this purpose.

R71. The hardware that runs the service platform must have enough resources to support installation of extended services.

R72. Handheld device should be suitable (simple enough and lightweight) for use by the elderly.

R73. The hardware must be installed in suitable places to serve the most possible the everyday life of the elderly. For example speakers and mics must be placed in the room where the elderly spend most of their time.

2.6. Service platform

The service platform is the core component of the PeerAssist platform. It is the end-user premises platform that enables the delivery of peer-to-peer services: it provides the means for communication with external (not in house) peers and entities as well as a mechanism for provisioning and delivering user services. The service platform may be integrated with other end-user equipment in order to fully implement the PeerAssist use cases.

2.6.1. Functional

R74. The service platform must support service life cycle management at runtime.

R75. The service platform must provide installation and capability of web services.

R76. The service platform must provide an interface for communication with hardware or network I/O devices.

R77. The service platform must support communication using P2P networking.

R78. The service platform may support to contact a central location for obtaining new services, security updates etc. apart from the P2P network.

2.7 Privacy requirements

PeerAssist will carefully consider the ethical aspects of the project with the aim of ensuring at every moment and in every situation the adequate protection of the data privacy and the personal rights of the users. This aim will not only affect the end-users participating in the project, but will also consider the ethical aspects relevant for the persons and organizations participating in the project and in general the limitations and regulations that must be applied to every project activity: research, development, testing and evaluation.

General ethical framework. Persons and organizations participating in the project will guide their activities by means of the following four principles:

1. Non-maleficence. The study and general operation of the device should not harm the participant, or put him or her under unacceptable risk (this includes risks to privacy).

2. Beneficence. The study and general operation of the device should benefit the participant according to his or her own conception of the good (this is a non-paternalistic interpretation of the principle, and includes making sure that participants hold authentically those conceptions).

3. Justice. The study and general operation of the device should take into account the legitimate interests of third parties, and not incorporate or promote any bias based on gender, culture, nationality, or other sources of social prejudice (this includes fair selection of the subjects for the user trials). Benefits of the study will be shared with the involved communities (this includes publication of the results of the study).

4. Respect for autonomy. With the general aim of promoting the participants' cognitive and functional abilities, participation in the study and in the general operation of the device should be based upon a process of informed consent, and the participants right to control their personal information will be respected at all times (this includes issues of confidentiality and data security).

2.7.1 PeerAssist working

This point refers to the way in which PeerAssist will keep the safety and privacy of the users when it will be installed at their home. The first draft is the table in which the scenarios and the possible conflictive ethical issues as well as their possible solution are specified. This table will be continuously readapted along the project keeping the conveyed information up-to-date..

The main point that should be improved is to find the necessary measures to protect the privacy of people interacting with the system in live operations and to ensure the ethical soundness of the system, but also balancing this with usability of taken steps. A number of ethical 'risks' during live operations of deployed PeerAssist system have been identified and are addressed within the project. These elements are described in the ethical risk & remedy table.

In this sense, some actions have been identified by the consortium in order to keep the privacy when PeerAssist system will be implemented. These are the main actions:

1. *Restricted access* (username/password) for each user in multi-user operation modes.
2. *Encryption* as a per-default setting for storage of personal information.
3. *Scenario-based privacy levels* that are selected by the user.

The following table summarizes the possible ethical risks and also their remedies.

Table 1: Risk and Remedy Table for Social Interaction use cases

SOCIAL INTERACTION		
Use case	**Risk**	**Remedy**
Search users The user wants to find other users in the platform.	Putting information at sight of unknown people	The user is informed that in order to meet new people, he/she may need to adjust his/her privacy level, but in a way the user knows exactly which type of information is sharing at any specific time.

SOCIAL INTERACTION		
Communicate with users The user wants to communicate with other users through a specific communication channel.	Data that the users do not want to share appear as available for the rest of the community	Defining privacy levels in terms of: - people with whom the user wants to share the information. - type of information the user wants to share (which the user could customize depending on the privacy settings): • Personal preferences • Pictures • Video/voice recordings • Health data - this privacy customization must be easy for the older user.
Create a group The user wants to form a group of people with the purpose of communicating between them or performing some joint action.	Depending on the topic of the group	The user voluntarily addresses the topic for which he creates the group. Topics based on personal interests should not mean a privacy problem (i.e. reading group, mountain climbing group…). Topics based on health related conditions are at users' own risk and responsibility. If users forming the group agree on the amount and type of information exchange, that means a explicit consent to share sensitive information (i.e. to form an Alzheimer caregivers' group, a diabetes sufferers group, etc.).
Do an online activity The user wants to perform an Online Activity with other people.	None for the user performing this action.	

SOCIAL INTERACTION		
Organize an event The user wants to organize a social event, and wants to gather interested people.	None for the user performing this action.	As in previous cases, user preferences can have set a different level of privacy from other type of personal information. In this way, participants can perform this use cases without providing sensitive information (which can be irrelevant for the purpose of this use case).
Search a group The user wants to find a Group to see its details, and possibly join it to interact with its members.	User not being informed about terms and conditions to join the community	The user ust be informed about terms and conditions by means of which he joins the community and to be informed about the privacy level required to join the community, so he can decide whether to join it or not at the specified conditions.
Delete a group The user wants to cancel a Group so it is no longer available.	Participants' information may still be available	To ensure that the deletion of a community goal implies the deletion of the tracking of personal information of participants belonging to this community. Participants should be informed by the user in advance, when they enter the community, that this community may be deleted at any time by the community creator, and that the shared information will be no longer stored.

Table 2: Risk and Remedy Table for Services' use cases

SERVICES		
Use case	**Risk**	**Remedy**
Publish a service The service provider wants to publish a service on the PeerAssist platform.	None	
Advertise a service The service provider wants to advertise a service.	The user receives a lot of service publications, which annoys him a lot	- The user can decide at any time whether he wants to receive information or not on specific service publications.
Search services The user needs to find relevant services.	None	
Rate a service or service provider The user wants to give a rating to a service or provider to express his perceived quality.	The user receives undesired messages or answers to this rating	- The user specifies whether he wants his rating to be anonymous or not.

Table 3: Risk and Remedy Table for Content access use cases

CONTENT ACCESS		
Use case	**Risk**	**Remedy**
Search content The user wants to find and access some content in the platform	None	
Publish content The actor wants to make some content available to the public	The user does not know how to set privacy level for the contents	The user may need to have the option to choose whether he wants to make the information completely public or whether he wants to establish privacy levels ("only show information to people I know… only to people from my friends' group…, etc").
Get suggestions The system offers the user recommendations about entities of the PeerAssist platform, e.g. content items, peers, groups, etc.	The user receives a lot of content suggestions, which annoys him a lot	The user can decide at any time whether he wants to receive information or not on specific content suggestions.

CONTENT ACCESS		
Advertise an event A social organization wants to advertise an event so that users can make groups to attend it.	The user receives a lot of advertisements, which annoys him a lot	The user can decide at any time whether he wants to receive information or not on specific advertisements.

Table 4: Risk and Remedy Table for Health care use cases

CARE GIVING		
Use case	**Risk**	**Remedy**
Add an authorized care giver The user needs to have a specific person as a trusted authorized caregiver.	The user may not be willing to share all the information required	The user decides at every stage of the authorizing process which kind of information he wants to share with a third-party (i.e. relative, trusted friend, etc.). This authorization level can be changed by the user at any time.
Do monitored tasks The user must perform some real-world tasks that should be monitored.	The user may not want to be monitored	The user decides whether he wants this option to be activated and to which level of privacy.
Raise an alarm The user needs to get help in an emergency situation	The alarm does not reach the appropriate person	People who will receive an eventual alarm will be predefined, for example, as users to contact with “in case of emergency”. In this case, the alarm will be prioritized to any privacy restrictions customized for those specific users to be contacted,

CARE GIVING		
Consult a doctor The user has a medical problem or doubt and s/he wants to talk with his/her doctor to ask for advice.	The connection with the doctor is not safe, somebody accesses the users' medical information.	The doctor needs to identify himself with an appropriate credential or certificate of identity, in order to provide consultation to users. Users need specific privacy requirements addressed for this particular use case. Users are informed on the regulation of data protection that affects them in the exchange of medical information. Users' may quit this service at any time, and they have the right to have their data erased from any existing database used to perform this use case.

Table 5: Risk and Remedy Table for general use cases

GENERAL		
Use case	**Risk**	**Remedy**
Manage the personal profile The user wants to edit the information in his profile	The user inadvertently sets the wrong privacy requirements	User is warned about any change related to sensitive information, so he needs to confirm twice any change of this kind.
Manage contacts The user wants to organize his contact list	None	
Get help from Personal Assistant The user wants to perform a task with some assistance	None	
Use PeerAssist through an ubiquitous interface The user wants to use the system in non-home environments	These non-home environments may not provide the same security and privacy as the home PeerAssist environment	Let the user know risks derived from using a device out of home.

2.7.2 Functional

R79. The system shall provide users authentication.

R80. The user shall be able to set what personal information wants to share and with whom he/she wants to share it.

2.7.3 Non-functional

R81. The personal user's information shall be protected from untrusted accesses.

3. Addressing the user needs

The following tables show the issues considered in the user study, along with their assigned priority based on the amount of occurrences inside the focus group. Some of them include the identified user need that should be addressed by the system. The last column contains references to the actual system requirements that cover these needs.

3.1. Familiar situation

Nr.	Issue	Prio. H/M/L	User need	Requirement
I-1	Difficulties to see relatives face-to-face	M	The PeerAssist project could increase the communication face-to-face of the user using for example the webcam. Nevertheless it is necessary to resolve the problem of webcam because it is not a common device among the users (I-51), and their relatives and friends. They are not accustomed to use the webcam, so the integration of this device in the PeerAssist platform is something to be considered because it must be easy to use.	R2, R3, R8
I-2	Difficulties to visit relatives (it is necessary to take transportation)	H	User using PeerAssist should be able to call a taxi or check the schedule of other transportation (e.g. train, bus, etc)	R18, R19
I-3	Living along	H	User using PeerAssist should be able to: - ask for help for activities of daily living: cleaning, dress up, etc. - resolve a momentary problem - notify emergency situations	R19, R26, R27, R28
I-4	Feel bad because they do not meet relatives very often	H	PeerAssist should allow users to easily communicate with friends and relatives	R2
I-5	Speak to relatives by phone	H	They usually speak with their relatives and friends (I-8) using the phone. Almost all of them	R2

			have a mobile phone. Control the call function through the system (e.g. Skype)	

3.2. Social relationships

Nr.	Issue	Prio. H/M/L	User need	Requirement
I-6	Keep social relationships outside home	H	Create in the PeerAssist system the function of "meet friends" without the need to call friends using the phone. (eg to notify a message through the system itself or with a vote on something similar to Doodle)	R2, R3, R4, R5
I-7	Meet friends frequently	H		
I-8	Speak to friends by phone frequently	H	Same as I-5	R2
I-9	Somebody who could take care of me as long as I need	M	Create a network of caregivers with friends who are available to take care of the user who is ill at a particular time. Create a network of professional caregivers. Create a network of caregivers with people who want to realize volunteer activities (e.g. Nursing or teaching to manage platform PeerAssist	R26, R27
I-10	Meet people at structured places	H	Facilitate to the users the search of compatible people in the system. Divide any compatible people based on their main interests.	R3, R4, R5, R6, R7

3.3. Leisure activities (frequency)

Nr.	Issue	Prio. H/M/L	User need	Requirement
I-11	Go to pubs	H	Facilitate scheduling of meetings	R5
I-12	Go to cinema	M	Search information about news film and opinions from other users	R5, R18, R21
I-13	Exchanging books/magazines	L	None	None
I-14	Physical activity	H	Provide opportunity for physical exercise. Recommend exercises, support, reinforcement. (e.g. Wii play)	R18, R21
I-15	Play cards/chess	M	Develop an easier application to play in the PeerAssist system (e.g. Solitaire, others??)	R4
I-16	Go to museum	M	Facilitate scheduling of meetings	R5
I-17	Go to concert	H	Search information about news concerts (e.g. prices, public transportation)	R5, R18, R21
I-18	Travel	H	General information about travel (e.g. prices, possible “new travel friends”)	R5, R18, R21

3.4. Perceptual abilities

Nr.	Issue	Prio. H/M/L	User need	Requirement
I-27	Can not recognize a person to a distance of four meters	M	The PeerAssist screen (font size, icons size) should be large enough	R44
I-28	Can not recognize a person to a distance of one meter	L		

I-29	Use headphones to improve hearing	L	The PeerAssist system must accommodate to different hearing levels of users	R44
I-30	Can not hear a TV at a level that considere standard	M		

3.5. Motor symptomatology

Nr.	Issue	Prio. H/M/L	User need	Requirement
I-31	Degenerative osteoarthritis problems	L	There is no motor symptomatology, but it is necessary to control and watch the sensivity of the touch display. In addition, the touch display is not a common type of screen between the users and their close family and friends.	R38
I-32	Arthritis problems	L		

3.6. Memory levels

Nr.	Issue	Prio. H/M/L	User need	Requirement
I-33	Difficulties to remember the name of a person who has just been introduced	M	During all the time the system offers the name of the person with whom he/she is interacting (e.g. a little screen with the name of the person)	R43
I-34	Difficulties to intend to take something as a house before going out	L	Whenever the user performs an activity in which he/she uses memory and completes the activity correctly the system must provide positive feedback	R43
I-35	Describe their memory as bad compared to the	M		

	rest of society			
I-36	Describe their memory as bad compared to the highest capacity he/she got in the past	H		
I-37	Describe their speed ability to process new information as bad	M	The system should repeat the information as often as necessary. The information offered by the system must be clear and should offer it up slowly. **Personal assistant is an important element of the system. Will need to spend time to properly design the main features of the wizard people	R32, R43

3.7. Uses of PC

Nr.	Issue	Prio. H/M/L	User need (keep current uses?)	Requirement
I-38	Search for information	H	Yes	R21
I-39	Chat	L	No	R2
I-40	Facebook	L	No	None
I-41	Check e-mail	M	Yes	R2
I-42	Read digital newspaper/books	M	Yes	R21
I-43	Watch film	L	No	None
I-44	Play videogames	L	No	None
I-45	Work	L	No	None
I-46	Wish of meet new people or to talk	H	Yes	R2, R3, R4, R5

	with relatives via Internet			

3.8. Interaction with technologies

Nr.	Issue	Prio. H/M/L	User need	Requirement
I-47	Never use Mouse	H	Provide a simple UI with mouse	R36
I-48	Never use Webcam	H	Enable easy video communication through a webcam	R27
I-49	Never use Keyboard	H	Provide a simple UI with keyboard	R36
I-50	Never use Headphones	H	Provide a simple voice UI with headphones	R39
I-51	Never use Microphone	H	Provide a simple voice UI with microphone	R39
I-52	Never use TV	L	Provide a simple UI with a TV	R37
I-53	Never use Mobile	L	Provide a simple UI with a mobile phone	R39
I-54	Never use Big touch screen	H	Provide a simple UI with touch screen	R38
I-55	Never use Small touch screen	H		
I-56	Never use Speech recognition	H	Provide a simple voice UI based on speech recognition	R39
I-57	Difficulties to use a touch screen	M	Provide a simple UI with touch screen	R38
I-58	The use of touch screen is uncomfortable	M	Remote control with a touch screen. For some of them it is uncomfortable to touch directly the screen and they do not like the idea of stand up constantly to use the system. The use of speech	R38, R39

			recognition could be a good solution, but this type of technology is not very common among the users.	

4. Trials and demonstration

4.1 Evaluation plan

This section describes the evaluation plan of the applications to be developed in PeerAssist, the sample of users involved, and the description of the validations tests to be performed.

The primary goal of the PeerAssist evaluation and demonstrations phase is to verify the concepts that will be designed during the project and to provide feedback to PeerAssist designers and developers to future possible improvements in the platform.

The usability and the functionality of the product of the PeerAssist project will be verified in only one tests phase in the middle-end of the year 2012, probably trying that people involved in the initial assessment also participate in the final tests. In this way, we get evaluated people that are more familiar with the project and the type of technology that it employs. In addition, we hope to ensure that the results obtained are adequately translated into recommendations and improvements in the subsequent development of the PeerAssist Platform.

4.1.1 Definition of target users

Spanish trial users

The composition of the target user group at INGEMA will be decided during the project. Probably the people could be part of the community of San Sebastian; who are older than 55 years-old, have a normal cognitive aging (no age associated cognitive decline), and are actively implied in their community. INGEMA, as part of the Matia Foundation, a Foundation with more than a hundred years of experience assisting elderly people and their relatives in San Sebastian (Spain) and the surroundings, has developed different activities specifically for elderly people, such as Memory Training Groups (groups to teach elderly people different strategies to maintain and/or improve their memory abilities) and what is known as the “Escuela de la Experiencia” (School of Experience), whose purpose is to provide knowledge and enlarge the range of social activities in elderly people, understanding this group of people as those who have already retired or are close to retirement, and who have interest in broadening their occupational level to domains different from their home or their family environment.

In general, people involved with INGEMA's projects receive many courses, among others, related to social relationships, health, well being and communication abilities, training in cognitive functions, health prevention and promotion, importance of physical exercise, relaxation techniques, literature, etc. In this context, INGEMA recruits these people as users to participate in the projects, since they are usually very cooperative. Though their implication in many activities may also include some basic training in computers, this is not always the case, so it comprises a heterogeneous range of people in terms of experience with technology: those who have recently started to use it and want to be more implied with it, and those who are less interested or even may refuse technology "invading" their daily life (as long as they feel technology may make them feel more dependent). Our sample of elderly people involved in PeerAssist project at INGEMA will comprise elderly people from this heterogeneous profile and context. More specifically, it is expected that most of the people involved in the final tests belong to the group of "School of Experience." However, the profile of end users will be specified more precisely at the end of the project.

Greek trial users

Participants in the trial phase of the Program in Athens will be selected by experienced employees of the Municipality of Athens Development Agency (AEDA) and in cooperation with officials from the Department of Social Services of the City of Athens who successfully implement several projects for the elderly.

AEDA implement the "Help at Home" Project since 1998, serving approximately 300 people per month. "Help at Home" serve senior citizens who cannot fully take care of themselves and people with mobility difficulties and problems, giving priority to those who live alone, do not have the attention of their families or whose income prevents them from having the necessary services to improve the quality of their life.

The program aims at improving the quality of life of elderly people, supporting the independent and dignified living of people, as well as supporting their family environment. Beneficiaries of this program receive services of a social worker, a nurse and a house assistant.

Another base for finding the right participants of Peer Assist Project is the Friendship Clubs of Athens. 24 Friendship Clubs operate at the neighborhood of the 7 Municipal districts, providing services to elderly people. They are actually places where the elderly Athenians can seek warmth, social support, contact with peers, information, entertainment, etc. More than 2500 citizens attend the Clubs and are in close relationship with the municipal staff.

The Friendship Club program includes creative activities, occupational therapy, physiotherapy, visits to cultural sites, cultural activities, excursions and walks. The aim of the Friendship Club is to familiarize the elderly with problems of third age, adaptation to new conditions of life, smooth co-existence with younger and providing a supportive environment, especially for people who have no financial means or family to look after them.

Moreover, a very interesting project was organized by the City of Athens Vocational and Training Centre; computer lessons for the eldrerly, where many citizens attended the lessons.

Taking into consideration all the above mentioned programs it is being clear that all conditions exist in order to make a high quality choice of 20 beneficiaries to participate in the project Peer Assist.

4.1.2 Other general aspects related to evaluation

Due to the fact that we are still in the early stages of the PeerAssist project, it is complex to set some aspects of assessment such as materials, people, the months dedicated to the tests, etc.. Such issues will be further specified in D6.1 (Evaluation design report).

Specifically, the general aspects that should be shaped are the following:

Places - locations: countries and homes that will be the final tests. The home trials issue is very complex because there are many aspects to consider. For that reason, this will be one of the first general aspects which will need to be solved and upheld in the final evaluation.

Dates: another aspect that should be specified concerns the final testing dates. In the Description of Work (DoW) is proposed that the final tests are performed between 26 and 30 months of the project. It must be managed and planned ahead so that all people who ultimately have to participate (end users and partners) are informed on time.

Material: aspects to evaluate; the following are a set of questions we need to answer in advance during the project runtime:

- What kind of materials are needed?
- What materials are provided by the partners?

- What materials are needed by the end users? (if they need new material, who can provide it? What partner will buy it?)
- How will the materials – equipment be transported and delivered?
- Who will be responsible for the installation of the PeerAssist platform?
- Who gives the support needed in case the system fails when installed in homes?

4.1.3 Validation plan

During the evaluation it is expected to perform not only a neuropsychological evaluation of individuals, but also an assessment of the usability of the system. In addition, the main objective of the evaluation will examine the levels of quality of life of participants and their subjective well-being and social inclusion.

Pre and Post evaluation

First, an individual evaluation of users' quality of life will be performed, which will include: an internationally validated scale to measure quality of life, as it is the WHO-QoL-BREF (World Health Organisation – Quality of Life – Abbreviated version). After an extensive State-of-the-art review, it has been decided to choose this one, since there is a lack of appropriate measures of quality of life that do not mainly focus on health issues like cancer, osteoporosis, etc. This scale provides rapidly a global score of quality of life in different domains and will let us have a validated reference tool with to which compare the differences between the countries (Spain and Greece).

Second, a common questionnaire that it is intended to be fulfilled by the evaluator in the context of a more open interview, where more qualitative data can be gathered regarding the following domains:

Age is the primary criteria to form the user groups.

Sex we will observe expected differences in user behavior according to the sex.

Educational: years of education, greatest level of education achieved, and current educational activities.

Basic Health Data: sensory, motor or other health problems that may interfere or, at least, affect the evaluation results to some extent.

Familial Situation: Questions about the marital status, children, how easy is to interact and/or relate to relatives in their daily life, the nature and quality of familial relationships,

frequency of visits in the user's home as well as visits from the user to other relatives, etc. will be asked in this section.

Occupational Data: It is not just a matter of knowing their occupational status, but also to gather specific information about their approach to work, likes and dislikes about their occupation, maintenance of social contact with co-workers (or previous co-workers, if retired), and current development of any kind of voluntary work in the community which may increase their sense of value and meaningfulness.

Social relationships: Quality of social contacts, its diversity and frequency, how confident the individual feels with them, frequency of meetings/phone calls, visits to them and from them, others' availability in case of problems or emergency, and a subjective comparison about the progression of social relationship during his life will be gathered through this section, also with an estimation of their current level of activity and the preferred way to establish social relationships.

Experience with technology is an auxiliary criterion to form the groups. We will observe user behavior according to experience with modern technologies. The users will be asked about certain attitudes and technology toward specific technological devices.

Finally a subjective well-being test will be administered, as well as tests of memory and attention. These tests will be specified during the project.

The idea is to be given to participants throughout the testing protocol before and after using the Platform PeerAssist. We make this pre and post assessment in order to observe differences in the subjects before and after using the PeerAssist device.

There is certain probability that, in the post evaluation stage, only some of the tests of the final protocol will be administered (those considered most relevant or on which a pre- post-comparison makes sense). However ,this decision will be taken at the end of the project. Finally, we emphasize that this assessment plan we propose is only a proposal and may suggest that some tests could be replaced. A detailed evaluation plan with significantly more specific procedures will be provided in D6.1 deliverable.

Applications of PeerAssist platform to be evaluated

The ultimate goal of this evaluation is to assess the PeerAssist platform and its applications. Probably PeerAssist device review is divided according to final applications based on proposed use cases. Therefore, the following use cases will be evaluated:

- **Social interactions: search for peers, create a group and event, etc.**

- **Services: publish, advertise, find and rate a service.**
- **Content access: search content, advertise an event, etc.**
- **Health care: add an authorized caregiver, raise an alarm, consult a doctor.**
- **General: manage general profile and contacts, help from Personal Assistant, etc.**

Usability and Accessibility criteria

In general, the developers tend to show a technology centred approach more than a user centred perspective. For this reason, it is very important to evaluate the user skills in their interaction with the interface. Some of the criteria to be considered are to following:

- Time to complete the tasks or sub tasks, e.g.,
  - Understanding of the system and its intention
  - Decision making
  - Transaction completion
- Problems to fulfill the tasks
- Subjective evaluation, regarding:
  - Difficulty of the task
  - Intuitiveness of the device
  - Subjective assessment of the user interface for each device (visual features, audio feedback, font types, colours)

The end of the document includes a brief general assessment proposal for any application. (Annex 1).

Methods to obtain the information

However, it is still without specification what type of methodology we are going to use to obtain this information from the users. The possibilities are broad and it is necessary to set the final methodology. The possibilities are the following:

- Individual user's tests at INGEMA's lab (usability tests to get feedback from the users).
- Interviews (to gather more subjective views about the devices: whether they find the device necessary, interesting, or, on the contrary, difficult, boring, or not needed).
- Questionnaires (to address specific issues about the devices).
- Focus groups (when testable prototypes are available can be performed focus group with elderly users to obtain feedback so the technical partners can have recommendations.

4.2 System test plan

The objective is to define the test and trials of the PeerAssist system functionalities. In order to achieve that, the consortium will use the use cases as a starting point to define the tests. Depending on the requirements and description of the test, several partners, apart from the use case creator, could be involved in a test.

The testing process has two distinct goals:

- To demonstrate that the software meets the requirements. This means that there should be at least one test for each user requirement described in the deliverable D2.2
- To discover incorrect behaviors of the system

Viewing the system as a black box, the tests can be oriented in two ways:

- Validating testing. A set of input data which reflect the system works correctly is needed in order to get correct outputs. There would be a bug if an input generates an erroneous output.
- Defect testing. In this case, a set of incorrect data would be used to check if the system responds correctly and does not fail.

To verify and validate the system it is very important to have detected and described the use case requirements. If not, it could lead to system errors not-detected which could affect to the reliability, availability, safety and security of the system. This is a list of possible consequences:

- More effort and possible delays: If the error is detected in the later stages of testing (system testing or user testing), it is necessary to check all the components of the system to detect where the problem is

- Business reputation loss: If an error is found in a system in production. the user can think that the company does not offer enough quality in its developments

4.2.1 Testing environment

A testing environment will be set up. It will be composed of a number of End User Devices connected on a network, in a controlled medium, including other supporting machines (e.g. servers, operator PC's, etc.). This is necessary to test use cases that involve several interacting peers. These tests will probably need some mock users, service providers, caregivers, etc. which will be simulated for that purpose.

Concerning the user interface, testers will be provided diverse UI devices (e.g. TV, smartphone, headset...). This devices will be set up in a home network for each EUD. This will enable to carry out tests about hardware integration, as well as testing accessibility issues as discussed above.

Apart from hardware assets, it will be necessary to generate a set of fake data (fixtures) to simulate all involved elements within the platform (e.g. profiles, contexts, service descriptions...). Some features are only testable when the system is populated with meaningful data.

The complete specification of the test-supporting infrastructure will be done in WP6, as soon as the design of the PeerAssist platform is definitely established, and prototype implementations are available.

4.2.2 Test definition

The set of use cases (D2.2) constitutes the specification of the functional features offered by the system that must be tested. Use case tables provide structured data to characterize the expected behaviour of the functions. Therefore they can be taken directly as the source for test definitions.

Each test can be described in a way very similar to use cases:

- Goal: What the user wants from the system
- Precondition: System state before the execution of the functionality
- Postcondition: System state after the execution of the functionality
- Actors: Users or external systems involved
- Related requirements: What is necessary to execute the use case (based on the system requirements, deliverable D2.3)

- Description: Steps followed by the user in order to get the result he or she expects

The common procedure to carry out each test is quite straightforward. First, it must be ensured that the Preconditions hold true for the target user in the testing environment (e.g. have a profile, be a group member). Then the steps in the Description are executed by a tester, and perhaps other involved actors. Finally, it must be checked that the Postconditions are met as expected.

It is possible, however, that the final tests need to be updated according to the actual implementation of the system, especially the detailed steps of execution in the Description field. Hence, the test definitions will be fully determined on WP6.

4.3 Evaluation method

According to [1], the different approaches to study the user technology acceptance are i) the Human-Centered Design process, which aims at producing usable and, consequently, acceptable products, ii) the Technology Acceptance Model (TAM), which predicts the usage behavior based on user and environment characteristics as well as perceived product attributes, iii) the Innovation Diffusion Theory (IDT), which studies the likelihood and the rate of an innovation being adopted by different user categories, and iv) the Hype cycle of technologies, which describes the transition of new technologies from increased expectations created by publicity and over-enthusiasm to disappointments and negative hype and then again to a new start from more realistic ground.

4.3.1 Human-Centered Design Process

ISO13407:1999 [2] defines the design process to make systems usable. The standard defines the organization and management of a human-centered design process. Specifically, the incorporation of a human-centered approach is characterized by:

a) active involvement of users and clear understanding of user and task requirements,

b) an appropriate allocation of functions between users and technology,

c) the iteration of design solutions,

d) multidisciplinary design.

Individual evaluation activities are used to assess how well the system meets the goals of the user or the organization, to diagnose potential problems and identify needs for

improvements, to select the proposed design option that best fits the user and organizational goals and/or to elicit feedback and further requirements from the users. The human-centered design process is initiated by the identification of the respective need and consists of successive cycles of i) specification of the intended context of use, ii) specification of the user and organizational requirements, iii) production of the design solutions, iv) evaluation of the solutions against the requirements, and v) refinement of the context of use. (Figure 1).

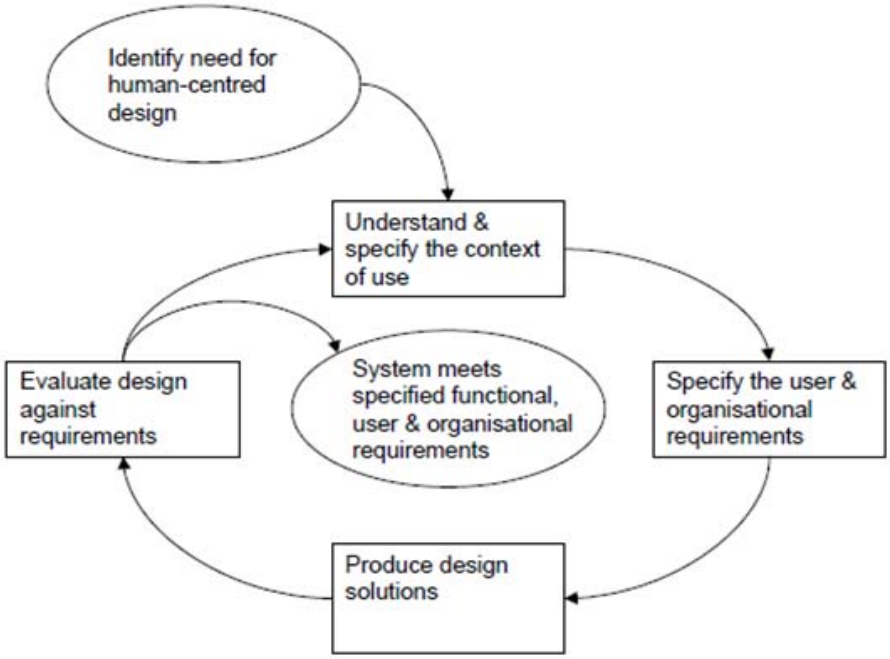

Figure 1: Human-Centered Design Process

However, the Human-Centered Design Process has been criticized for not taking into account current software engineering practices. Software engineering is today based on system modeling, and prototyping suggested by the human-centered design approach is technically very difficult, especially as the systems are getting more complex, services are distributed and design work is concurrent. It is claimed that this basic difference in the approaches is an obstacle to the adoption of human-centered design in software engineering.

4.3.2 The Technology Acceptance Model

One of the most common acceptance models is the Technology Acceptance Model (TAM) introduced in [3]. TAM introduces the notions of *Perceived Usefulness* and *Perceived Ease*

of Use that are considered to be relevant factors for the evaluation of user acceptance. According to TAM, Perceived Usefulness is defined as “the degree to which a person believes that using a particular system would enhance his job performance”. A system high in perceived usefulness is one for which a user believes in the existence of a positive use-performance relationship. On the contrary, Perceived Ease of Use is defined as “the degree to which a person believes that using a particular system would be free of effort”. Thus it can be claimed that an application perceived to be easier to use than another is more likely to be accepted by users. Perceived ease of use also affects the perceived usefulness while the intention to use affects the real usage behavior (Figure 2).

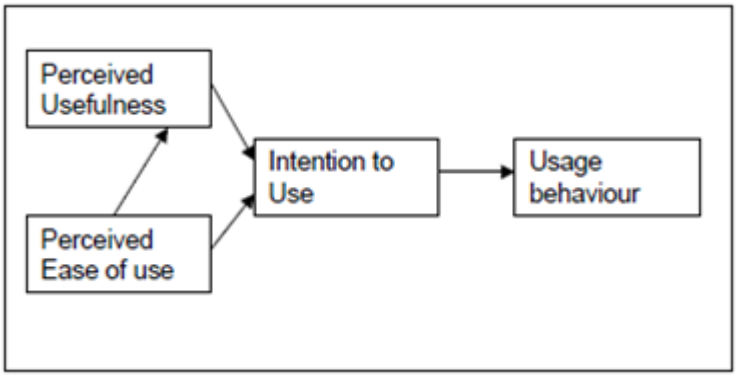

Figure 2: The Technology Acceptance Model

The main characteristic of TAM is that it deals with the way the services are perceived by the end users. It is not based on observations of real usage but on the impressions reported by the users. The main methods used are surveys, where the questions are constructed in order to reflect the different aspects of TAM. The survey questions related to usefulness can be for instance “Using this system improves the quality of the work I do” or “Using this system saves my time”. The survey questions related to ease of use can be for instance “The system often behaves in unexpected ways” or “It is easy for me to remember how to perform tasks using this system”.

TAM was extended in [6], introducing TAM2, which included social influence processes (subjective norm, voluntarism, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and Perceived Ease of Use (Figure 3).

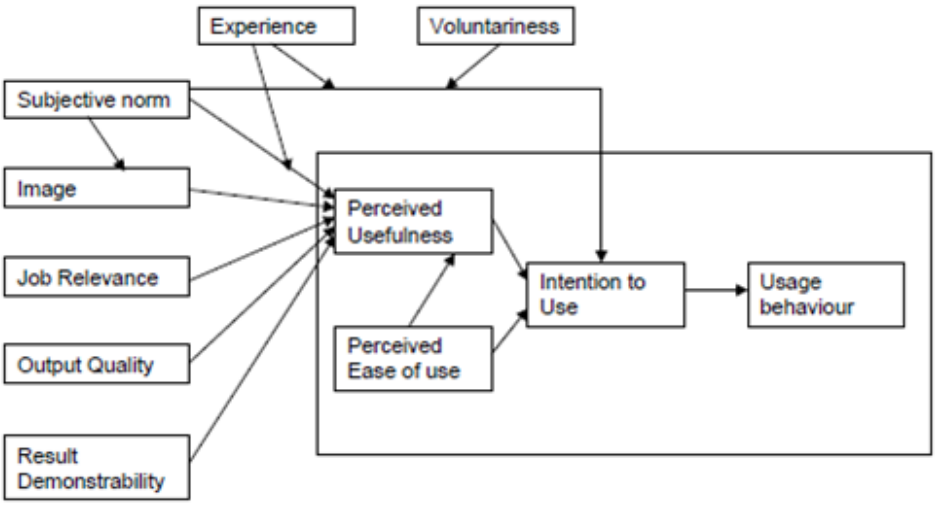

Figure 3: TAM2: Enhanced Technology Acceptance Model

4.3.3 Innovation Diffusion Theory

Innovation Diffusion Theory is a theory that studies user adoption of different innovations in target populations. The theory explains the process of the innovation decision process, the determinants of the rate of adoption, and various categories of adopters. It aims at predicting the likelihood and the rate of an innovation being adopted by different adopter categories. Five factors that explain 49-87 per cent of the variance in the rate of the adoption of an innovation are described in [4]:

- *Relative advantage* is the degree to which the innovation is perceived as being better than the practice it supersedes.

- *Compatibility* is the extent to which adopting the innovation is compatible with what people do.

- *Complexity* is the degree to which an innovation is perceived as relatively difficult to understand and use.

- *Trialability* is the degree to which an innovation may be experimented with before making the adoption or rejection decision.

- *Observability* is the degree to which the results of an innovation are visible to others.

Five adopter categories are defined (Figure 4):

i) *Innovators*. They are described as adventurous risk-takers who serve as gatekeepers for the following users.

ii) *Early Adopters*. They are opinion leaders who are the first within their group to adopt, and willing to maintain their position by evaluating innovations for the others.

iii) *Early Majority*. This category includes users who are conscious in their adoption decision but want to wait until others have assessed the innovation. However, they do not want to be the last to change.

iv) *Late Majority*. This category includes skeptical users who prefer to wait until most others have adopted the innovation.

v) *Laggards*. They base their decisions on the past rather than the future

These categories illustrate variability around the mean, when half of the target population has adopted an innovation.

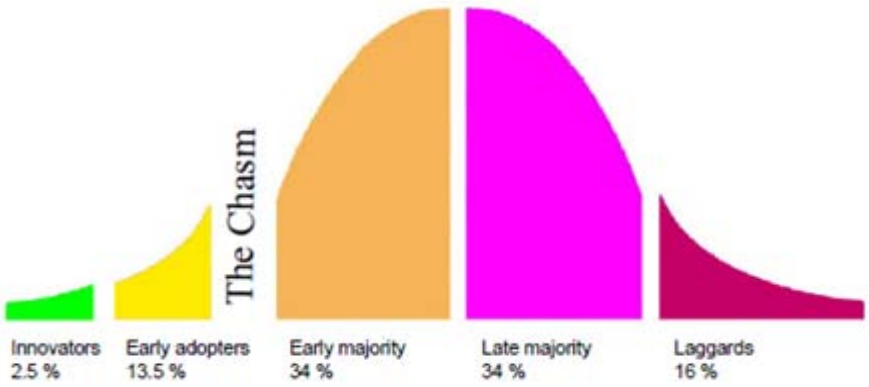

Figure 4: Innovation adopter categories

4.3.4 Hype cycle of technologies

New emerging technologies tend to have a high profile in the media and public debate compared with more mature technologies. This often leads to overinflated expectations, so-called hype, around a particular technology. This phenomenon is illustrated by hype cycles that aim at giving an overview of the relative maturity of technologies in a certain domain compared with their visibility [5]. The hype cycle characterizes the typical progression of an emerging technology from business and media over enthusiasm through a period of disillusionment to an eventual understanding of the technology's relevance and its role in a market or a domain (Figure 5).

Figure 5: The Hype Cycle

According to [5] the phases of the hype cycle are the following:

i) *Technology trigger:* a breakthrough, public demonstration, product launch or other events generate significant press and industry interest.

ii) *Peak of inflated expectations:* over-enthusiasm and unrealistic projections result in some successes but more failures, as the technology is pushed to its limits.

iii) *Trough of disillusionment:* because the technology does not live up to its overinflated expectations it rapidly becomes unfashionable. Media interest wanes, except for a few cautionary tales.

iv) *Slope of enlightenment:* focused experimentation and solid hard work by an increasingly diverse range of organizations lead to a true understanding of the technology's applicability, risks and benefits.

v) *Plateau of productivity:* the real-world benefits of the technology are demonstrated and accepted. The final height of the plateau varies according to whether the technology is broadly applicable or benefits only a niche market.

The hype cycle is a good tool to understand the inevitable pattern of excitement and disillusionment about technologies. It helps to understand why the recommendations from technology planning groups may be different than what is heard or read in the media. The lesson to learn is that enterprises should not invest in technologies just because they are

being hyped. On the other hand, technologies should not be ignored just because they are currently not living up to early over-inflated expectations.

5. Conclusions

The presented set of requirements characterizes the intended system and its features in a formal way. First, the high-level functionalities are described based on the use cases. Then, the list includes several issues related to specifics parts or layers of the system (interfaces, semantics, network...) which are crucial for the intended platform functionality. In addition, each part is completed with the non-functional requirements that impose quality constraints on different dimensions (reliability, efficiency, security, etc.).

Concerning technical issues, some requirements have been included to state the desirable characteristics of the technologies, languages, protocols, etc. to be used. This permits to drive the project development in line with current industry standards and research advancements.

Special attention has been paid to privacy management. Several risks have been identified which may threaten the confidentiality of users' data, or even their safety or welfare from an ethical perspective. To solve that, a remedy is proposed for each risk, which should be applied during the design of the system.

As section 3 demonstrates, most of the high priority issues discovered in the user research (D2.2) are addressed by the system requirements listed in this document. This guarantees that the design will surely satisfy the user's needs and wishes.

As for the trials phase, an evaluation of the system will be carried out with real users. The focus group and all related infrastructure will be carefully set up to enable a methodical evaluation of the acceptance level of the platform. The effectiveness of the system will be accurately checked, both by specialized testers and end users, so the validity and applicability of the PeerAssist platform will be assessed.

References

[1] Eija Kaasinen, “User acceptance of mobile services – value, ease of use, trust and ease of adoption”, Thesis for the degree of Doctor of Technology, Tampere University of Technology, June 2005.

[2] ISO 13407:1999. Human-centered design processes for interactive systems. International standard. International Standardization Organization. Geneve.

[3] Davis, F.D. (1989) “Perceived usefulness, perceived ease of use, and user acceptance of information technology”, MIS Quarterly, Vol. 13, No. 3 (8/1989), pp.319-341.

[4] Rogers, E. M. “The diffusion of innovations”. Fourth edition. New York. Free Press. 1995.

[5] Linden, A. and Fenn, J. “Understanding Gartner’s Hype Cycles”, Strategic Analysis Report R-20-1971, Gartner Research, 30 May 2003.

[6] V. Venkatesh, F.D. Davis, “A theoretical extension of the technology acceptance model: four longitudinal field studies”, Management Science 46(2), 2000, pp. 186–204.

Annex 1. Semi-structured interview

1. What do you think about the screen?

2. What do you think about the letters (i.e. font size)?

3. Do you understand the keys at a first sight?

4. What do you think about the colours?

5. What do you think about the application?

6. How do you think it works?

7. Do you find it useful?

8. Would you use it?

9. What would you add to it?

10. What would you remove from it?

11. What problems do you think it has?

12. Do you think it would help you with your social relationships?

13. Do you think it would help you to communicate better with other people?