Coordination Action in R&D in Accessible and Assistive ICT

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CARDIAC

Coordination Action in R&D in Accessible and Assistive ICT

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Table of Contents

Table of Figures

Table of Tables

Executive Summary

The aim of this project was to generate a research agenda roadmap highlighting research priorities in accessible and assistive ICT that will favour eAccessibility.

Assistive devices have helped many people with activity limitations – these devices vary from inexpensive low technology aids for daily living to sophisticated special computer terminals. However the trends in technological development mean that it is increasingly important for all users to be able to use mainstream systems and services. All too often these systems have been designed for what has been perceived as a 'typical' user, and little allowance has been made for people with activity limitations.

Prioritising research for social inclusion in the emerging information society is not just about determining what new technological developments to fund, but how to influence mainstream design teams to take into account the needs of people with activity limitations when designing new products or services. In the longer term the full integration of various technologies offers exciting possibilities to provide a wide range of services that are inclusive and able to support people when necessary.

Whilst the core objective of the project was to advise the European Commission as to where to direct research funding in the short, medium and more distant future within the context of ICT for independent living, inclusion and governance, the results are also of value to all stakeholders involved in the field of accessible and assistive ICT.

A wide range of multidisciplinary experts and stakeholders were involved in a systematic methodology to develop the roadmap. The overall result is a research agenda roadmap containing 72 different research actions structured into 14 research lines, reflecting the complex issues involved that require a holistic and interdisciplinary approach.

The first conclusion is to support the research actions which exert the most influence on the other research actions. The eight fundamental research actions are:

- Explore how users interact and cooperate with intelligent systems
- Promote methodologies that consider not only the interface but the entire interaction dialogue
- Reduce the complexity of user interaction whilst retaining functionality
- Methodologies to safely collect and manage the information about the user when using the ICT system
- Use reasoning techniques for personalisation
- Involvement of end users throughout the design and development process
- Methodologies and tools for the development of accessible and assistive ICT
- Methodologies for collaborative research in the field of assistive ICT and accessible ICT

A second phase of research actions include:

- Identify impact of cloud platforms
- Systems to enhance the safety and user trust and confidence of locally and remotely provided services
- Use of context awareness to adapt user interfaces
- Further static and adaptive user interaction profiles
- Innovative interaction devices for accessibility: advanced assistive technologies
- Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments

- Analyse end-user needs and personal barriers with respect to ICT
- Research on the use of social media to reduce isolation
- Research on the ethical and legal requirements and consequences

Additional consultation was carried out where the respondents were asked to score the research lines in terms of impact, probability of requiring public funding and feasibility. The main finding was that all the research lines received high or fairly high scores on all three aspects. This indicates that all the research lines were deemed by the respondents to have a high level of potential impact, have a high probability of requiring public funding and to be feasible.

Nevertheless the various rankings indicate that the three research lines to emerge as a priority are "Innovative user interfaces" (top of ranking in terms of joint impact and probability of requiring public funding) "Holistic approach to human computer interaction" (second in ranking in terms of joint impact and probability of requiring public funding top of ranking in terms of impact), and "Advanced design and development methodologies and tools" (third in ranking in terms of joint impact and probability of requiring public funding).

"Innovative user interfaces" include a wide range of aspects relating to user interaction, such as:

- Affective computing to assist accessibility interfaces and interactions
- Accessible human-robot and human-robot-environment relationships
- Novel human-machine interfaces for recreational activities
- Accessible telecommunications technologies for people with little or no speech
- Practical adaptive user interfaces and multi-modal interaction methods
- Means for customization of UI and open interfaces
- Principles for adaptable end-user interfaces
- Enhance and universalize Web 2.0 accessibility
- Extension of web accessibility knowledge to general HCI

"Holistic approach to human computer interaction" includes research actions on:

- Methodologies that consider not only the interface but the entire interaction dialogue
- Methodologies that include the human diversity in user interface design
- Reducing the complexity of user interaction whilst retaining functionality and avoiding cognitive barriers in the design of human machine interfaces, especially in multimodal interfaces.

"Advanced design and development methodologies and tools" include:

- Methodologies and tools for the development of accessible and assistive ICT
- Tools to facilitate the creation of digital accessible materials to non-accessibility experts
- Design and authoring tools supporting and automating e-inclusion
- Tools for decision making in the user-centred design process
- Translate user needs into product design
- Development of training modules about needs of people with disabilities for developers

The research agenda roadmap along with the various levels of information and tables included both in this report and on the project website (http://www.cardiac-eu.org) are meant to be used as tool. In order to help the reader digest this complex, intertwined set of tables, influence trees and roadmaps, a short 'user manual' has been included in annex 3 of this report. The concept behind this tool is that whatever the particular constraint of any given stakeholder, appropriate research actions or research lines can be selected whilst ensuring that any related research actions that may support this research can easily be identified from the information provided.

List of Partners

No	Name	Short name	Country
1	**ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE**	**EPFL**	Switzerland
2	**CENTRAL REMEDIAL CLINIC**	**CRC**	Ireland
3	**Cyprus Neuroscience and Technology Institute**	**CNTI**	Cyprus
4	**UNIVERSIDAD DEL PAIS VASCO**	**UPV/EHU**	Spain
5	**CONSIGLIO NAZIONALE DELLE RICERCHE**	**CNR**	Italy
6	**EVANGELISCHE STIFTUNG VOLMARSTEIN**	**FTB**	Germany
7	**JOHN GILL TECHNOLOGY Ltd**	**JGT**	United Kingdom
8	**STICHTING SMART HOMES**	**SMH**	Netherlands
9	**UNIVERSITETET I OSLO**	**UIO**	Norway
10	**TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY.**	**IIT**	Israel
11	**FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS**	**ICS-FORTH**	Greece
12	**UNIVERSIDAD DE SEVILLA**	**USE**	Spain
13	**FACULDADE DE MOTRICIDADE HUMANA**	**FMH**	Portugal

1 The Overall Vision

The purpose of the following sections is to take the reader through the various levels of the overall CARDIAC Research Agenda Roadmap, show the links between the various levels and describe the steps taken in generating the overall roadmap.

The overall aspect of the integrated Research Agenda Roadmap can best be presented by the drawing in figure 1.

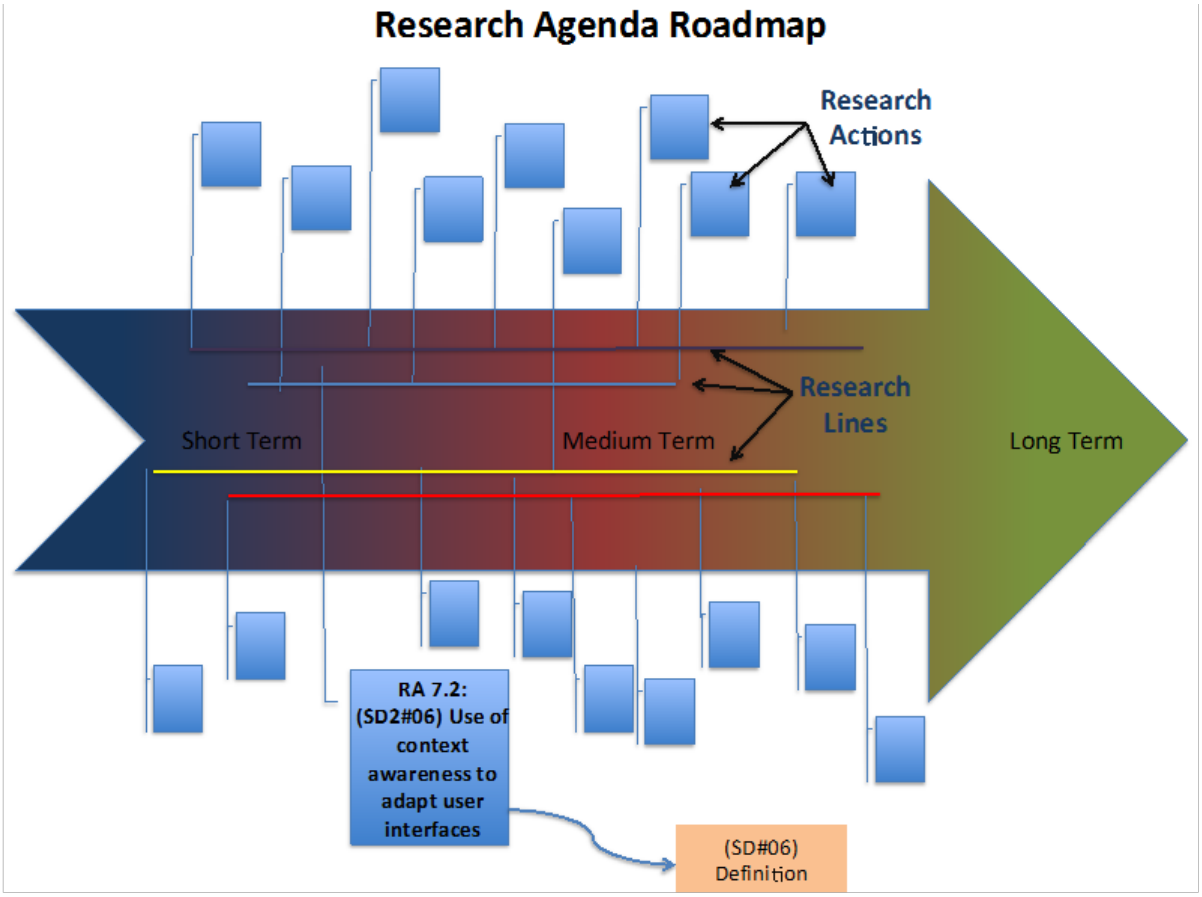

Figure 1: Vision of overall CARDIAC roadmap

The following elements can be seen in the roadmap: time (left to right), the research actions, taken from the SDDP meetings and suggestions from external experts, and the research lines which are a grouping of all the research actions (not necessarily corresponding to the clusters as defined during the SDDP meetings).

The reference numbers for each research action are given in brackets so that the source of each idea can be traced, so in the example given in Figure 1 of research action RA 7.2 (SD2#06), the source of the idea is number 6 from the second SDDP in San Sebastian.

The process has been both top down, from the point of view of the vision, the generation of the overall roadmap as well as the regrouping of the research actions, but also bottom up from the point of view of the collection and structuring of the research actions into influence trees, which have strongly influenced the logical ordering of the research actions.

The road-mapping process can be graphically summarised as a pyramid as shown in Figure 2. At the foot of the pyramid are the three areas or strands of research taken up by the project: technology transfer, inclusive HCI and network-based services. The rationale behind

the selection of each of these areas, along with all the background information (taken from deliverables D1.1, D3.1 and D4.1) is included at this level. The next level up contains the research actions with their clarifications as given during the SDDPs or as provided by external experts in response to various questionnaires. The next level up contains the research lines, which can be represented in detailed tables (section 4) or graphically represented with links to their research actions in the same format and positioning as in the overall roadmap. The top level represents the overall research agenda roadmap in accessible and assistive ICT.

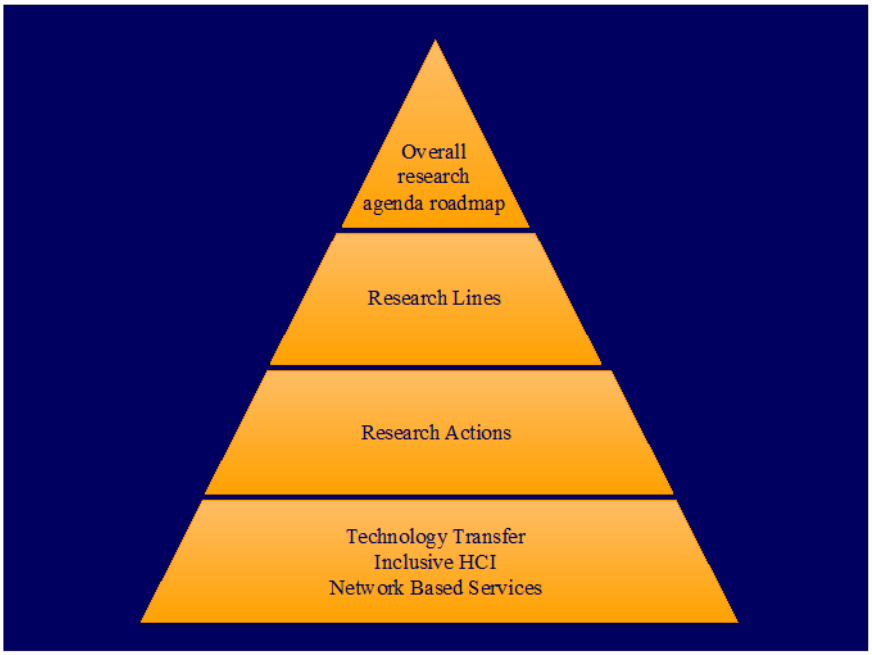

Figure 2: Representation of the various levels of the CARDIAC Research Agenda Roadmap in Accessible and Assistive ICT

The overall Research Agenda Roadmap can also be found on the project Website at: http://www.cardiac-eu.org/roadmap/index.htm.

From the way that the html version of the roadmap has been generated, the Website visitor is able to navigate from the overall roadmap down to the individual research actions and background information or back up from the research actions up to the overall roadmap. A brief description of the website structure is given in Annex 2.

2 Steps taken to generate the overal research agenda roadmap

The entire CARDIAC road-mapping process can be described according to the following systematic steps, where the first six steps have been carried out in each of the three Work Packages WP1, WP3 and WP4. (As an example, the following first six steps are given for WP1.)

1. Describe and analyse the ***current situation***. – The results are described for WP1, for example, in D1.2, Chapter 2 "The Market of Assistive ICT and Accessible ICT" and Chapter 3 "Successes and Failures of Technology Transfer in ICT and AT-Analysis".
2. Build a ***vision*** of a desired future (5 to 15 years) with respect to technology transfer, inclusive HCI and Network-based services. – These visions are an implicit result from the three CARDIAC SDDP workshops on technology transfer, inclusive HCI and network-based services, especially from the explanations of the generated ideas.
3. Identify the ***gaps*** between the current situation and the vision and identify supporting factors ("***bridges***") and limiting factors ("***barriers***") in realising the vision. – This step is based on the analysis and comparison of the current situation with the vision.
4. Identify ***activities to overcome the gaps***. – A structured list of ideas for activities was a major outcome of each of the three CARDIAC SDDP workshops. (In the course of the project, this list was complemented with results from the two other SDDP workshops, responses from a variety of questionnaires (ICT companies' interrogation, service delivery organisations interrogation and external HCI experts) and literature study.
5. Prepare a ***first plan of activities*** to reach the vision. – The first plan of action in the form of a dependency graph was the second major outcome of the 1st CARDIAC SDDP workshop.
6. Build a ***draft roadmap*** with goals, actions, activities, involved stakeholders, and potential support activities of the European Commission.

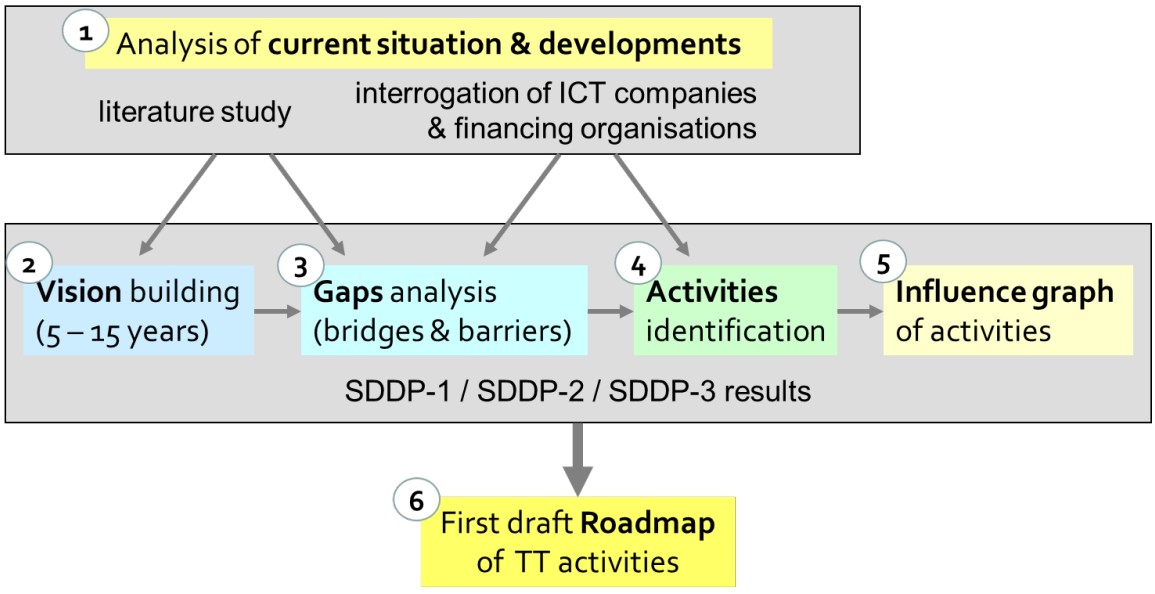

Figure 3: First steps of road-mapping

While in the ideal case, the whole sequence of steps is gone through only once, there is the opportunity to cycle back from each step to one of the previous steps if necessary. This gives the chance to include new findings from other sources later on (other projects, feedback from external experts, future SDDP meetings) and enhance the roadmap in this way without destroying earlier results.

Six additional steps have been taken during the course of the CARDIAC project:

7. Define ***research actions*** which combine related activities of the draft roadmaps from WP1, WP3 and WP4 and take into account existing resources and necessary prerequisites, define in more detail specific R&D activities, and mention accompanying policy activities. This step has been done in close cooperation with WP1, WP3, and WP4 in order to ensure that the research actions for technology development (WP3 and WP4) are complemented by research actions for technology transfer (WP1).
8. Define ***research lines*** which combine related research actions and put the actions in a reasonable dependency / time sequence, using the structuring from all three influence trees as a basis and indications of short, medium, long term with suggestions from external experts. This is the key part of the roadmap generating process and forms the ***roadmaps of WP1, WP3 and WP4***.

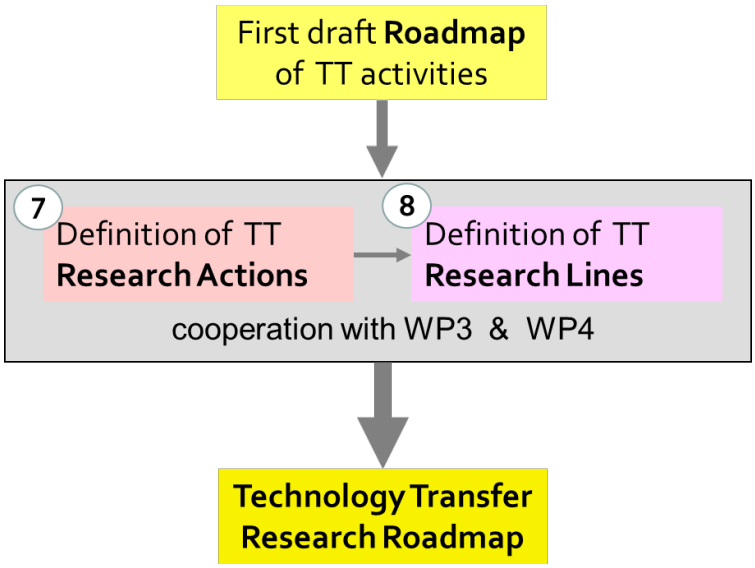

Figure 4: Further steps of road-mapping

9. Compose the **overall Research Agenda Roadmap** by combining related research lines of WP1, WP3 and WP4.
10. ***Apply*** the roadmap in the studies on Smart Homes (WP1, deliverable D1.4) and eLearning (WP4, deliverable D4.3).
11. ***Present*** the research roadmap in the final conference and **consult** the various stakeholders on the research priorities through a questionnaire-based interrogation of external experts for the ***assessment of impact, necessity of public funding, and feasibility*** (see deliverable D2.4).
12. **Complement** and **consolidate** the Research Agenda Roadmap according to the results of the two previous steps. Final presentation of the Research Agenda Roadmap in printed version and on the CARDIAC web site.

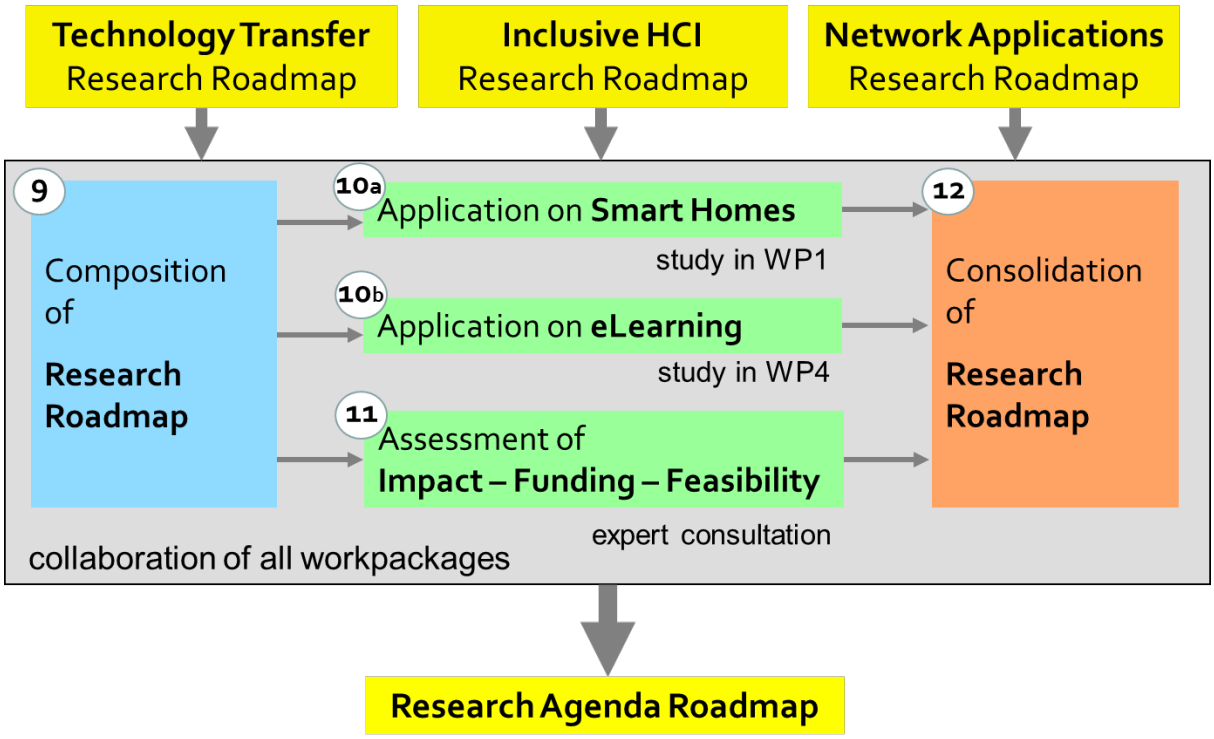

Figure 5: Building of the overall Research Agenda Roadmap

As mentioned, the first six steps have been carried out in WP1, WP3 and WP4 and are extensively reported in deliverables D1.2, D3.2 and D4.2 respectively. Step 10 is reported on in deliverables D1.4 and D4.3 with a summary of the main results included in section 6 of this report. The focus of this report will therefore be on the four additional steps 7, 8, 9, 11 and 12.

However, for reasons of convenience, the three influence trees generated during the three SDDPs, which is the main outcome of step 4, are reproduced here in figures 6, 7 and 8.

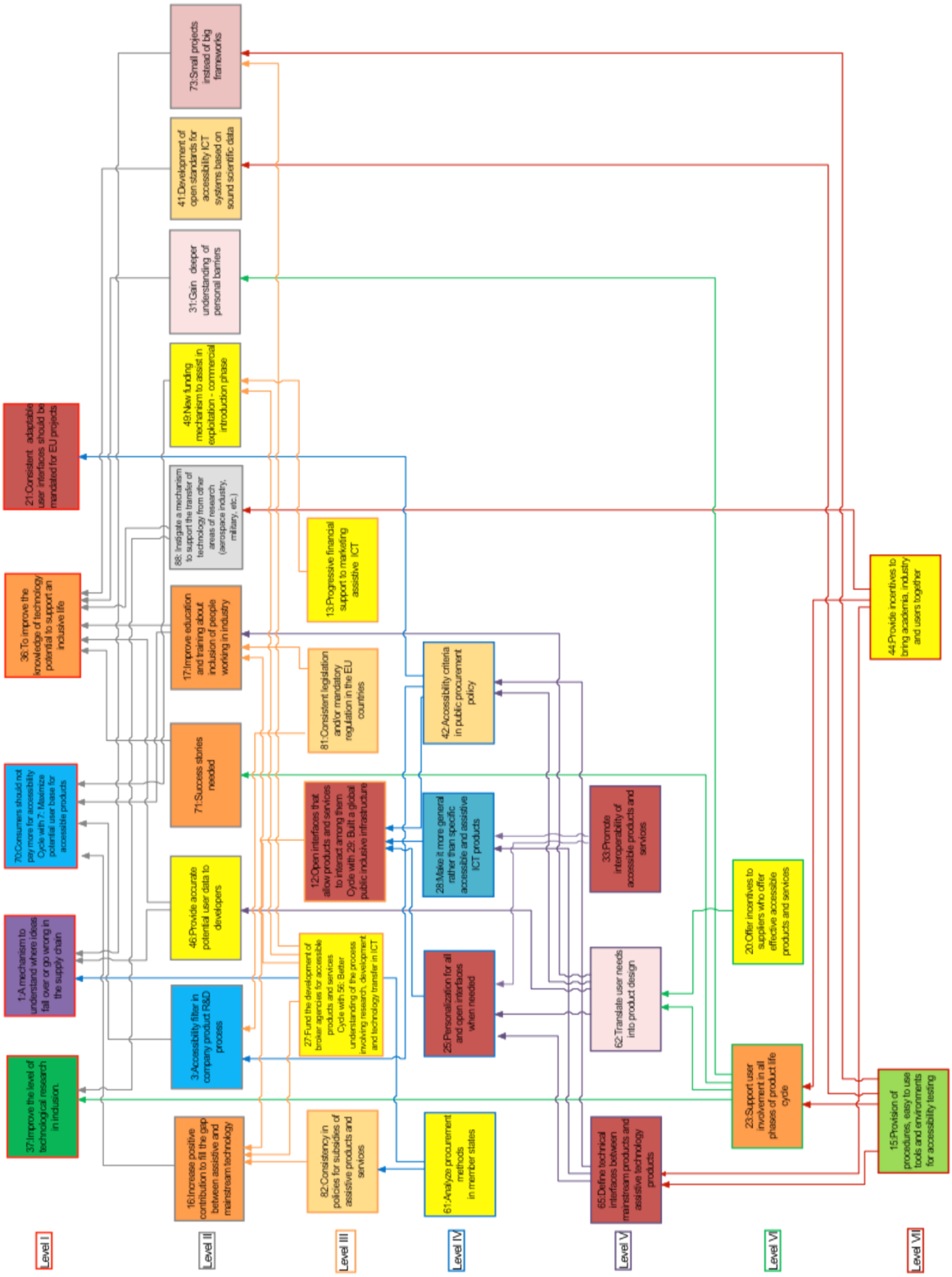

Figure 6: Influence tree from SDDP1 on technology transfer

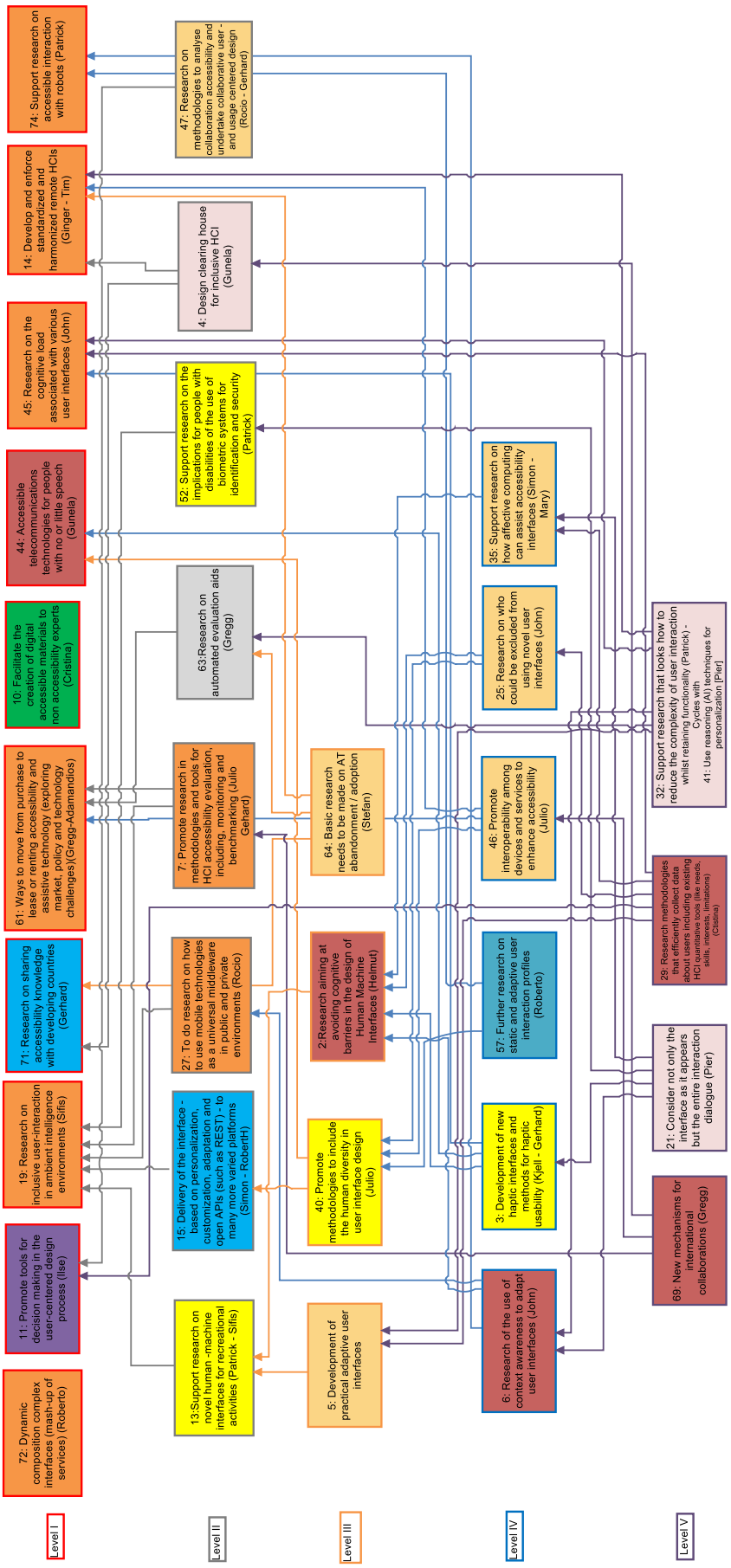

Figure 7: Influence tree from SDDP2 on technology transfer

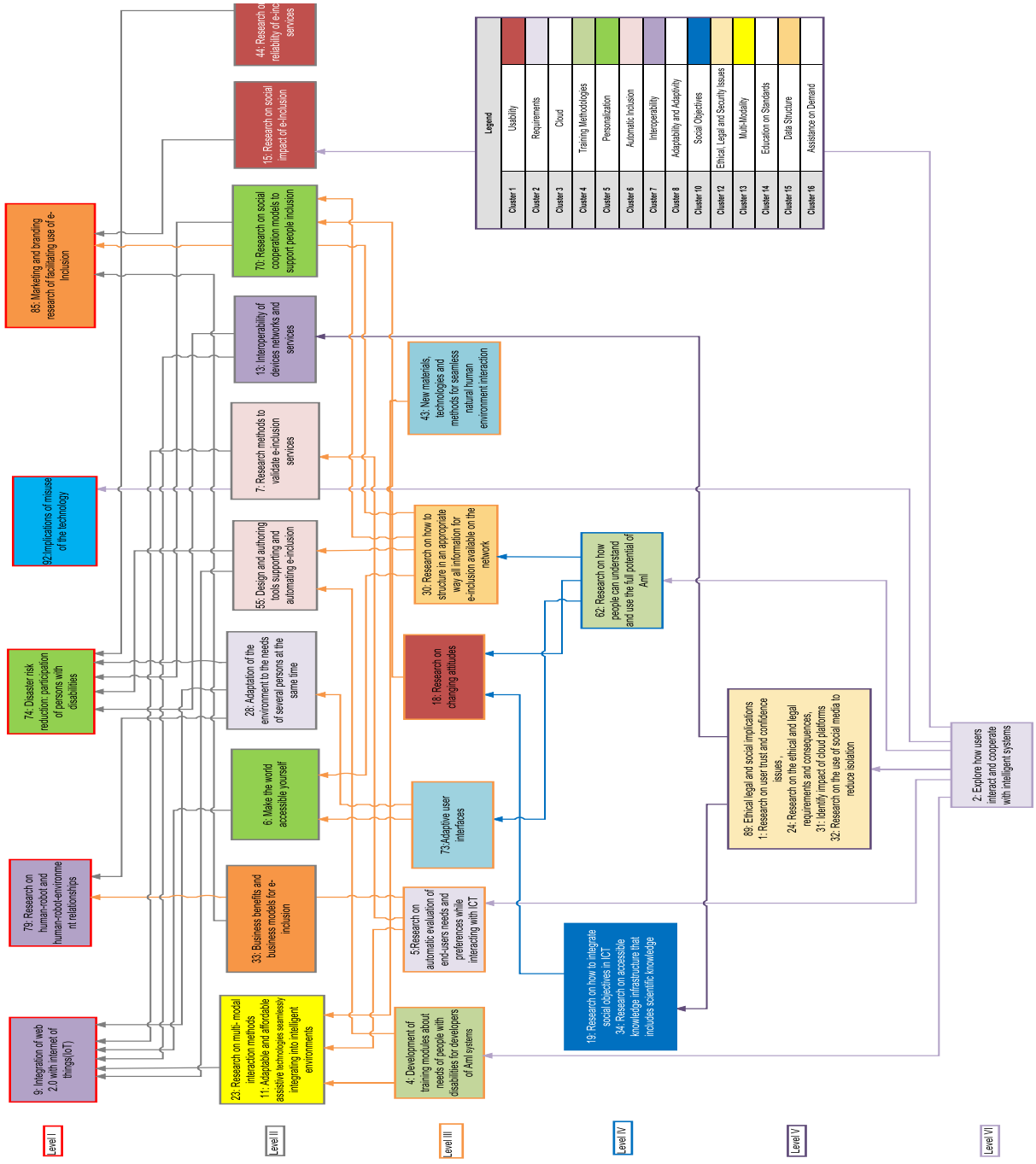

Figure 8: Influence tree from SDDP3 on network-based services

3 Research actions (step 7)

The complete list of 255 ideas and clarifications collected during the three SDDP workshops is given in Annex I of this report. The ideas generated during SDDP1 were is response to the Triggering Question **"What mechanisms would ensure successful technology transfer in accessible and assistive ICT products and services?"**, those generated during SDDP2 were in response to the Triggering Question **"What type of research is missing that could facilitate development of inclusive HCI?"** and those generated during SDDP3 were in response to the Triggering Question **"What research actions should be supported in network infrastructures and services to facilitate eInclusion?"**.

This entire list ideas and proposals, along with other suggestions collected from external experts through questionnaires, was then reviewed, filtered and edited in close collaboration between all the Work Package leaders. This was a complex process that went through several cycles before reaching the final list 72 research actions shown below in Table 1. In some cases the ideas were left almost untouched and in other cases they were edited and/ or merged with other proposals.

In order to be able to trace the origin of the research actions, the source of the idea is given in brackets, where the number after SD corresponds to the workshop in which they were generated, so for example, SD2#06 is the idea number 6 from the second SDDP workshop in San Sebastian on inclusive HCI. The research actions gathered from external experts are denoted as EXP or EAP +#number and those received via the questionnaires on Technology Transfer are denoted as QTT +#number. The thinking here is that, should any of the research actions be selected for funding, it should then be easy to follow the trail back to the original ideas and clarifications contained in any given research action. A link can also be found on the Internet to videos, where the authors give additional explanations and clarifications on their ideas. A link to these videos on YouTube can be found via the three CARDIAC SDDP Wikispaces (click on 'videos') at:

SDDP1: http://accessible-assistive-sdd-cardiac.wikispaces.com

SDDP2: http://userinteraction-sdd-cardiac.wikispaces.com

SDDP3: http://network-based-applications-sdd-cardiac.wikispaces.com

Table 1: List of Research Actions grouped into 14 Research Lines

Research Line #1: Human Factors studies

RA 1.1: (SD2#64) Basic research on Assistive Technology abandonment/adoption
RA 1.2: (SD2#25) Research on who could be excluded from using novel user interfaces
RA 1.3: (SD2#52) Implications for people with disabilities of the use of biometric systems for identification and security
RA 1.4: (SD3#02) Explore how users interact and cooperate with intelligent systems
RA 1.5: (SD3#31) Identify impact of cloud platforms
RA 1.6: (SD3#92) Implications of misuse of technology

Research Line #2: Privacy, safety and trust

RA 2.1: (SD3#44) Research on the reliability of e-Inclusion services,
including: (SD1#63) Ensure reliability, robustness and security of Assistive ICT
RA 2.2: (SD3#01) + (EXP) Systems to enhance the safety and user trust and confidence of locally and remotely provided services

Research Line #3: Holistic approach to HCI

RA 3.1: (SD2#21) Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue
RA 3.2: (SD2#40) Promote methodologies to include the human diversity in user interface design
RA 3.3: (SD2#32 , SD2#45) Reduce the complexity of user interaction whilst retaining functionality
RA 3.4: (SD2#02) Avoid cognitive barriers in the design of Human Machine Interfaces, especially in multimodal interfaces

Research Line #4: User modelling and adaptive user interfaces

RA 4.1: (SD2#29, EXP) Methodologies to safely collect and manage the information about the user when using the ICT system
RA 4.2: (SD2#06) Use of context awareness to adapt user interfaces
RA 4.3: (SD2#57) Further static and adaptive user interaction profiles
RA 4.4: (SD2#41) Use reasoning techniques for personalisation

Research Line #5: Innovative user interfaces

RA 5.1: (EXP, SD2#03) Innovative interaction devices for accessibility: Advanced Assistive technology
RA 5.2: (SD2#35) Affective computing to assist accessibility interfaces and interactions
RA 5.3: (SD2#74) + (SD3#79) Research on accessible human-robot and human-robot-environment relationships
RA 5.4: (SD2#13) Novel human-machine interfaces for recreational activities
RA 5.5: (SD2#44) Accessible telecommunications technologies for people with no or little speech
RA 5.6: (SD2#05) + (SD3#73) Practical adaptive user interfaces
RA 5.7: (SD3#23) Research on multi-modal interaction methods
RA 5.8: (SD1#25) Means for customization of UI and open interfaces,
including: (SD1#21) Principles for adaptable end-user interfaces
RA 5.9: (EXP) Enhance and universalize Web 2.0 accessibility
RA 5.10:(EXP) Extension of Web accessibility knowledge to general HCI

Research Line #6: Access to advanced ubiquitous computing environments

RA 6.1: (SD2#27) Mobile technologies as access interfaces for public and private ubiquitous environments
RA 6.2: (SD2#19) Inclusive user interaction in ambient intelligence environments
RA 6.3: (SD3#09) Integration of web 2.0 with internet of things (IoT)
RA 6.4: (SD3#11) Adaptable and affordable assistive technologies seamlessly integrating into intelligent environments
RA 6.5: (SD3#28) Adaptation of the environment to the needs of several persons at the same time
RA 6.6: (SD3#43) New materials, technologies and methods for seamless natural human environment interaction

Research Line #7: Interoperability and standardisation

RA 7.1: (SD1#41) Open standards for accessible ICT systems based on sound scientific data,
    including: (SD1#86) Environments for interoperability testing
RA 7.2: (SD1#65, SD1#12, SD1#33) Technical interfaces between mainstream ICT products and Assistive Technology products
    including: (SD1#12, SD2#46) Open interfaces that allow ICT products and services to interact
    including: (SD1#33) Promote interoperability of accessible products and services
RA 7.3: (SD2#46) + (SD3#13) Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
RA 7.4: (SD2#14) Standardized and harmonized remote HCIs
RA 7.5: (SD2#72) Dynamic composition of complex interfaces (mash-up of services)
RA 7.6: (SD2#15) Open APIs for the delivery of the interface to many more varied platforms

Research Line #8: End-user participation and user needs analysis

RA 8.1: (SD1#31, SD1#26, SD2#55, SD3#01, SD3#42, SD3#84) Analyse end-user needs and personal barriers with respect to ICT
RA 8.2: (SD1#23, SD1#44, SD3#47, EAP#203) Involvement of end users throughout the design and development process
RA 8.3: (SD3#06) Make the world accessible yourself
RA 8.4: (EAP#204, SD3#59) User testing in real or realistic environments

Research Line #9: Advanced design and development methodologies and tools

RA 9.1: (SD1#15, SD1#35, SD1#53, SD2#26) Methodologies and tools for the development of accessible and assistive ICT
    including: (SD1#35) Standardized technical solutions or modules for accessibility development in specific domains
    including: (SD2#26) Specific and clear accessibility guidelines for application developers
    including: (SD1#53, SD1#15) Methodologies and tools for the development of assistive ICT
RA 9.2: (SD2#10) Tools to facilitate the creation of digital accessible materials to non-accessibility experts
RA 9.3: (SD3#55) Design and authoring tools supporting and automating e-inclusion
RA 9.4: (SD2#11) Tools for decision making in the user-centred design process
    including: (SD1#62) Translate user needs into product design
RA 9.5: (SD3#04) Development of training modules about needs of people with disabilities for developers

Research Line #10: Test and evaluation methodologies and tools

RA 10.1: (SD1#15, SD2#07) Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking

including: (SD1#15, SD2#63, SD1#86, SD3#07, SD3#82) Methods, tools, and environments for testing accessibility of ICT

RA 10.2: (SD3#07) Research on formal methods to validate e-Inclusion services

including: (SD3#77) Define criteria for success and failure of e-Inclusion

RA 10.3: (SD1#15, SD3#48, SD3#82) Procedures, tools and environments for usability evaluation of Assistive ICT

RA 10.4: (SD3#05) Research on automatic evaluation of end-users needs and preferences while interacting with ICT

Research Line #11: Collaborative research and knowledge sharing

RA 11.1: (SD1#44, SD1#88) Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT

including: (SD2#47) Methodologies to analyse collaborative accessibility and undertake collaborative user- and usage-centred design

including: (SD1#44): Provide incentives to bring academia, industry and end-users together

including: (SD1#88) Instigate a mechanism to support the transfer of technology from other areas of research

including: (SD1#37) Improve the level of technological research in inclusion

including: (SD2#69) New mechanisms for international collaborations

RA 11.2: (SD1#56) Process involving research, development and technology transfer in Assistive ICT and Accessible ICT

RA 11.3: (SD1#27, SD2#04, SD1#17) Infrastructure for shared knowledge in the field of Assistive ICT and Accessible ICT

including: (SD2#04) Clearing house for inclusive HCI

including: (SD1#27) Broker agencies that support the technology transfer of Accessible and Assistive ICT

Including: (SD2#71) Research on sharing accessibility knowledge in the field of Assistive ICT and Accessible ICT

RA 11.4: (SD3#30) Research on how to structure in an appropriate way all information for e-Inclusion available on the network

RA 11.5: (SD3#34) Research on accessible knowledge infrastructure that includes scientific knowledge

RA 11.6: (SD2#42, SD3#16) Research on reasons why knowledge / standards on accessibility are not known or applied

Research Line #12: Social networking and applications

RA 12.1: (SD3#32) Research on the use of social media to reduce isolation

RA 12.2: (SD3#74) Disaster Risk Reduction: participation of persons with disabilities

RA 12.3: (SD3#70) Research on social cooperation models to support people inclusion

RA 12.4: (SD3#62) Research on how people can understand and use the full potential of AmI.

Research Line #13: Social context and impact

RA 13.1: (SD1#36, SD1#10) Knowledge of the potential and the social effects of ICT to support an inclusive life

including (SD3#15) Research on social impact of e-Inclusion

including: (SD1#29) Build a global public inclusive infrastructure

RA 13.2: (SD3#89, SD3#24) Research on the ethical and legal requirements and consequences

RA 13.3: (SD3#18) Research on changing attitudes of different stakeholders towards eInclusion.

RA 13.4: (SD3#19) Research on how to integrate social objectives in ICT

Research Line #14: The market, service delivery and public procurement

RA 14.1: (SD1#46, SD1#28, QTT#18, QTT#19, SD2#55, SD2#61) Analysis of market potential of accessible ICT

including: (SD1#28) Make it more general rather than specific accessible and assistive

RA 14.2: (QTT#15, SD2#61) Analysis of market potential of assistive ICT

RA 14.3: (SD3#33) Business benefits and business models for eInclusion

including: (SD1#49) New funding mechanism to assist in exploitation - commercial introduction phase

RA 14.4: (SD3#85, SD1#75) Research on the marketing and branding for facilitating the use of eInclusion.

RA 14.5: (SD1#1, SD2#64, SD3#81) Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view

including: (QTT#16, QTT#17) Explore ways of effective quality assurance in service delivery of assistive ICT

RA 14.6: (SD1#61, QTT#16, QTT#17, SD2#61, SD2#70) Analysis of models and processes of Service Delivery and procurement

including: (SD1#61) Analysis of procurement methods of assistive ICT in the member states

including: (SD1#42) Accessibility criteria in public procurement policy

including: (SD2#61, SD2#70) Alternative ways of financing service delivery of assistive ICT

RA 14.7: (QTT#20, SD1#39, QTT#1, SD2#70, SD3#62) How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services.

4 Research lines (step 8)

The next step was to structure the 72 research actions into logical and meaningful groups. This again was a complex process that went though several cycles before arriving at the structure of 14 research lines as shown in Table 1 above.

The numbers and colours of the research lines were attributed as follows:

- Research lines 1–4, human-technology related, green colours
- Research lines 5–7, technology related, blue colours
- Research lines 8–11, methodology related, yellow and brown colours
- Research lines 12–14, society related, red, pink, purple colours

The numbering of the research actions within the research lines is completely random and no meaning should be sought in the numbering (for example, importance or time placement etc.).

Once the research lines had been defined, the next task was to put the research actions in a reasonable dependency / time sequence. For the ideas generated during the SDDP workshops, this was accomplished using the structuring from the influence trees generated during these three workshops, as reported in deliverables D2.1, D2.2 and D2.3 and as shown in the previous section (Step 4, figures 6-8). In this way the influences between various ideas identified during the workshops are reflected in the overall roadmap and this valuable logical structuring of the ideas is implicitly maintained.

As an example, idea SD3#64 contained in research action RA1.4 was at the foot of the third influence tree generated in Florence during SDDP3 (see figure 8). This led to RA1.4 being placed on the left-hand side of research line 1, as shown in Figure 5. It will also mean that RA1.4 will be towards the extreme left hand-side of the overall roadmap (see figure 23). Equally, ideas located towards the top of the influence trees will be located towards the right-hand side of the research lines and overall roadmap.

For the ideas that came from external experts, their indications of short, medium, long term were used as a basis for placing their suggestions in the research lines.

The results of this dependency / time sequencing are shown in figures 9 to 22 for all 14 research lines. Besides this graphical representation, a detailed analysis for each of the research lines is given in tables 2 to 15. The tables include an overall description, the existing resources and prerequisites (left column) for each of the research actions as well as any specific developments and supporting actions (right column). These tables are at the heart of the roadmap and form a core part of the detailed material. Similar tables were presented for Work Packages WP1, WP3 and WP4 in deliverables D1.3, D3.2 and D4.2 respectively. The tables presented here, are a synthesis of all these tables.

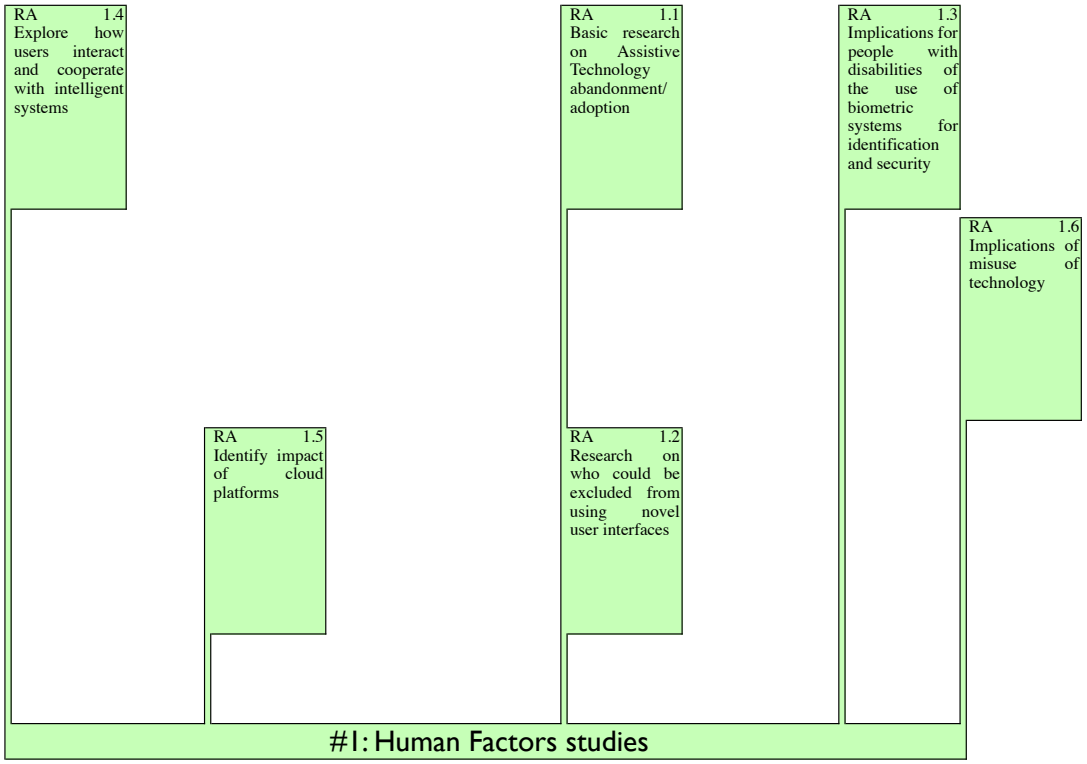

Figure 9: Graphic representation of research line 1

Table 2: Research line 1, Human factors studies

Research line # 1: Human Factors Studies The progress to full accessibility, usability and usefulness of network applications requires a design centred on the user, taking into account human diversity and avoiding all types of barriers that affect users with permanent or occasional limitations of activity due to cognitive, sensory or physical restrictions or occasional limitations of activity due to contextual factors. Knowledge about user abilities, needs, requirements and preferences and the way technology is used by them in the different contexts is a fundamental support to the design of accessible interactions and usable and useful services and applications. Studies about the impact of emerging interactions, services and applications on eInclusion and the resulting possible exclusion are urgent. Side effects, such as impact over safety and privacy cannot be neglected either. In addition, the causes of success/failure and acceptance/rejection of Assistive Technology must be studied.		
Existing resources AT prescription, and Databases of technology use and abandonment	**Research action 1.1: *Basic research on Assistive Technology abandonment/adoption*** There is very little knowledge about the reasons for AT abandonment (only a handful of papers, mostly from the 90's). In order to address fully the distressing level of AT abandonment (40-70%) a principled, longitudinal research agenda of this phenomenon, segmented by AT and user type and compared to similar non-AT systems needs to be launched. The implications of the resultant body of	***Specific developments:*** Methodologies and tools for accurate prescription, adaptation, monitoring, evaluation, replacement, etc., of AT equipment
Prerequisites Standard classification of		***Accompanying policies:*** Policies for sharing, and

AT systems and list of AT abandonment motivations to allow worldwide studies Case studies of successful use of AT in workplaces (EEX#102)	knowledge could potentially deeply affect AT from design to marketing. **References:** (SD2#64)	replacement when needed, of expensive AT equipment
Existing resources Large experience in the Human Factors area	**Research action 1.2: *Research on who could be excluded from using novel user interfaces*** Companies designing products with new interfaces need to know, before the product is on the market, which will find their interface difficult or impossible to use. This needs to be matched against the target market for their new product. **References:** (SD2#25)	***Specific developments:*** Repositories of knowledge about the specific needs for interaction of a large sample of users. Workbenches to check the validity of the prototypes
Prerequisites Research methodologies that efficiently collect data about users including existing HCI quantitative tools (SD2#29). Research about the exclusion created by HCI (SD2#28). Identify HF barriers to health, education and participation of low-income groups (SD2#55).		***Accompanying policies:*** Legislation that impedes digital exclusion and supports applications designed for all
Existing resources Abundant Codes of Ethics from many institutions related to disability and aging.	**Research action 1.3: *Implications for people with disabilities of the use of biometric systems for identification and security*** ICT technologies to solve the needs of people with disabilities have been frequently applied without considering their side effects on privacy, autonomy, socialization, etc. This lack of non-technological vision often led to systems being developed with a serious impact on ethical issues. Even if this issue requires deep research in general, it is especially required in the case of systems that collect biometric information. How to guarantee privacy and the provision of alternative ways for	***Specific developments:*** Methodologies, workbenches and tools that can be used by ethics inspectors in order to verify the ethical impact of the developments for people with disabilities ad elderly people.
Prerequisites Consider not only the interface as it		***Accompanying policies:*** Legislation to protect the

<table>
<tr><td>appears but the entire interaction dialogue (SD2#21)

Consensus on values, ethical principles, rights, safety and privacy issues (EAP#202).</td><td>people rejecting this possibility are two of many topics that should be studied.

References: (SD2#52)</td><td>civil rights of dependent people

Inclusion of topics about the impact of Technology on Ethics and human rights in engineering studies.</td></tr>
<tr><td>Existing resources:

Large experience in the Human Factors area</td><td rowspan="2">Research action 1.4: Explore how users interact and cooperate with intelligent systems

Interaction with an intelligent environment offering potentially useful functionalities may have different levels of difficulty as a function of the activity to be carried out. Different components can impact on the possibility of being independent in such an environment, interacting and cooperating with it:

· the view the user has of the system (mental model);

· the view the system has of the user (user model);

· the type of interaction that the user considers natural for the activity to be carried out and the context of use (e.g., for privacy reasons, interacting with voice could not be acceptable in a public environment);

· the capability of the environment to adapt itself according to the user, context of use and functionality to be carried out;

· the capability of the environment of matching its adaptations to the mental model of users, in order not to confuse them.

References: (SD3#02)</td><td>Specific developments:

User modelling: identification of necessary abilities for the different functions and environments.

Multimedia interactions (with the interface of the environment and its functionalities).

Adaptation constraints (to meet user expectations) according to the mental model of the user</td></tr>
<tr><td>Prerequisites:

Models of the ICT environments: foreseen functionalities and technology used to implement them</td><td>Accompanying policies:

Legislation that aims to impede digital exclusion and supports applications designed for all</td></tr>
<tr><td>Existing resources:

Analyses carried out in the increasing number of projects active in Europe and worldwide on the cloud approach.</td><td rowspan="2">Research action 1.5: Identify impact of cloud platforms

Cloud platforms are certainly interesting from a commercial perspective. They allow for the use of information and processing resources only when are needed without the requirement of investing financial resources in hardware and software.

In eInclusion, it is necessary to find answers to questions as, for example, the following:

· Are there services and applications of interest for eInclusion that cannot exist without being made available on a cloud?

· Approaches based e.g. on central servers would be less efficient and why?

· Will cloud-based solutions force people to use</td><td>Specific Developments:

Identification of (classes of) ICT applications relevant for eInclusion that lead themselves to a cloud–based implementations

Analysis on the possible positive/negative impact of a cloud implementation (availability, reliability, security and privacy)</td></tr>
<tr><td>Prerequisites:

General analysis of</td><td>Accompanying policies:</td></tr>
</table>

<table>
<tr><td>cloud applications from the perspective of availability, reliability and privacy</td><td>specific ICT products and software applications?
· Are cloud-based platforms available and reliable enough to allow a continuous and seamless use, compatible with applications, which could be crucial for living?
References: (SD3#31)</td><td>Standardisation of the approach
Regulations about availability, reliability, security and privacy standards</td></tr>
<tr><td>Existing resources:
Extended knowledge about human factors and user centred design</td><td rowspan="2">Research action 1.6: Implications of misuse of technology
Technology can crucial for supporting social inclusion, including people with activity limitations, if designed for being usable by all and if used correctly for the purpose for which it was designed.
Therefore activity meant to identify how people use available technology is important:
· For understanding if and how they conceptualise the single systems and applications (are they able to construct a correct mental model of them?)
· For observing how they interact with the available interface and use the available functionalities
It is also important, particularly for people who could not have available all the abilities considered by the designer during the development of the technology, to figure out if the technology can be used in such a way to cause injuries or damage to both the user and the environment.
This research action has obvious connections with research line 5, dealing with safety and trust.
References: (SD3#92)</td><td>Specific Developments:
Development of usage scenarios for emerging technology.
Application and observation studies to point out how people use technology in different contexts of use, even when they do not have abilities considered available during the design.
Development of scenarios of technological development and simulation/emulation of them in order to test possible impact of the use or misuse of technology.</td></tr>
<tr><td>Prerequisites:
Identification of functionalities and uses of available technology and applications based on it.
Identification of lines of development of new technology and corresponding applications.</td><td>Accompanying policies:
Legislation on security of technology</td></tr>
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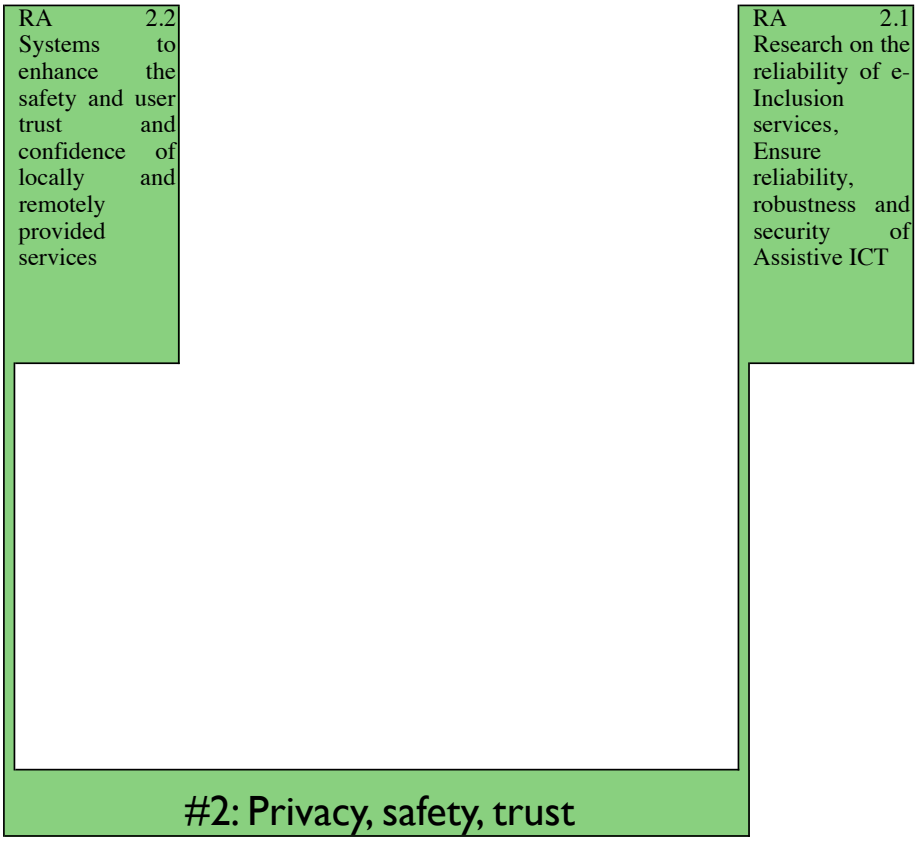

Figure 10: Graphic representation of research line 2

Table 3: Research line 2, Privcy, safety, trust

<table>
<tr><td colspan="3">Research line # 2: Privacy, Safety, and Trust
Most ICT designers concentrate their work on the functionalities of services and applications. They do not take care of problems potentially caused by their possibly inadequate provision (for example continuity in time) or of the impact on the privacy and autonomy of the user. From one side, it is necessary to advance in the development of services and applications that are safe and trustful. On the other hand, the management of user data collected and stored by the system must be controlled.</td></tr>
<tr><td>Existing resources:
Experience with available applications (e.g. alarm services)</td><td rowspan="2">Research action 2.1: Research on the reliability of e-Inclusion services
Network-based applications can be crucial to allow independent living of people, supporting them in critical activities. This means that the reliability of products and services for e-Inclusion, the reliability of their interoperability, and the capability of coping with eventual failures are particularly important. The following problems have to be considered:
· From a technical perspective: investigating how and up to which level reliability can be guaranteed, with the constraint that reliability requirements may be more stringent in comparison with many applications for the general public;</td><td>Specific developments:
Study of how critical for eInclusion are the activities that can be supported by new network-based applications
Study of possible actions to recover from service failure</td></tr>
<tr><td>Prerequisites:
Concerns about these problems in the activities aimed to the development of new networks and corresponding applications</td><td>Accompanying policies:
Improve legal certainty and technology trustfulness for a higher consumer acceptance</td></tr>
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<tr><td></td><td>· From a user perspective: finding out what are the consequences of possible failures
· Whether and how is possible to offer different support in case of failure.
References: (SD3#44), including: (SD1#63) Ensure reliability, robustness and security of Assistive ICT</td><td></td></tr>
<tr><td>Existing resources:
Analyses of trust and confidence in available applications
Research on privacy
Information Technology Security Evaluation Criteria</td><td rowspan="2">Research action 2.2: Research on user trust and confidence issues
Trust and confidence in (the reliability, availability and safety of) new systems, services and applications is of paramount importance in the field of eInclusion, since they are often crucial in granting people support in activities that are very important for their independent living and social interactions.
Trusted products that users can inspect and update system information at an appropriate level (EAP#205): Several people that use e-Health monitoring services or remote support services to carry out everyday life tasks, are extremely dependent on the availability of network technology. Any disruption of the service may cause anxiety, isolation and even life danger.
Different lines of activity are necessary to answer the following questions, e.g.:
· What are the features of network-based applications (e.g. quality, easiness of use, reliability) that have an impact on increasing/reducing the trust of confidence of users?
· How and how much is it possible to assess their relevance?
· How is it possible to help people in forming mental models of the different applications that can allow them to conceptualise the situation and construct trust and confidence about them?
· How and up to what level is it possible to guarantee the necessary features with available and foreseen technology, within reasonable cost constraints?
References: (SD3#1)</td><td>Specific developments:
Identification of critical features of applications relevant for eInclusion from the perspective of reliability and availability
Identification of critical features of possible network-based applications that can affect trust and confidence
Strategies for supporting people in conceptualising the new environments and acquire trust and confidence in them
Identification of critical privacy issues from an eInclusion perspective.
Systems to enhance the safety and trust of locally and remotely provided services</td></tr>
<tr><td>Prerequisites:
Identification of foreseen network applications.
Identification of features of emerging net-works, services, and applications.
Explore how users interact and cooperate with intelligent systems (SD3#02).
Definition of a catalogue of trusted services including network technologies</td><td>Accompanying policies:
Improve legal certainty and technology trustfulness for a higher consumer acceptance (EAP#208).</td></tr>
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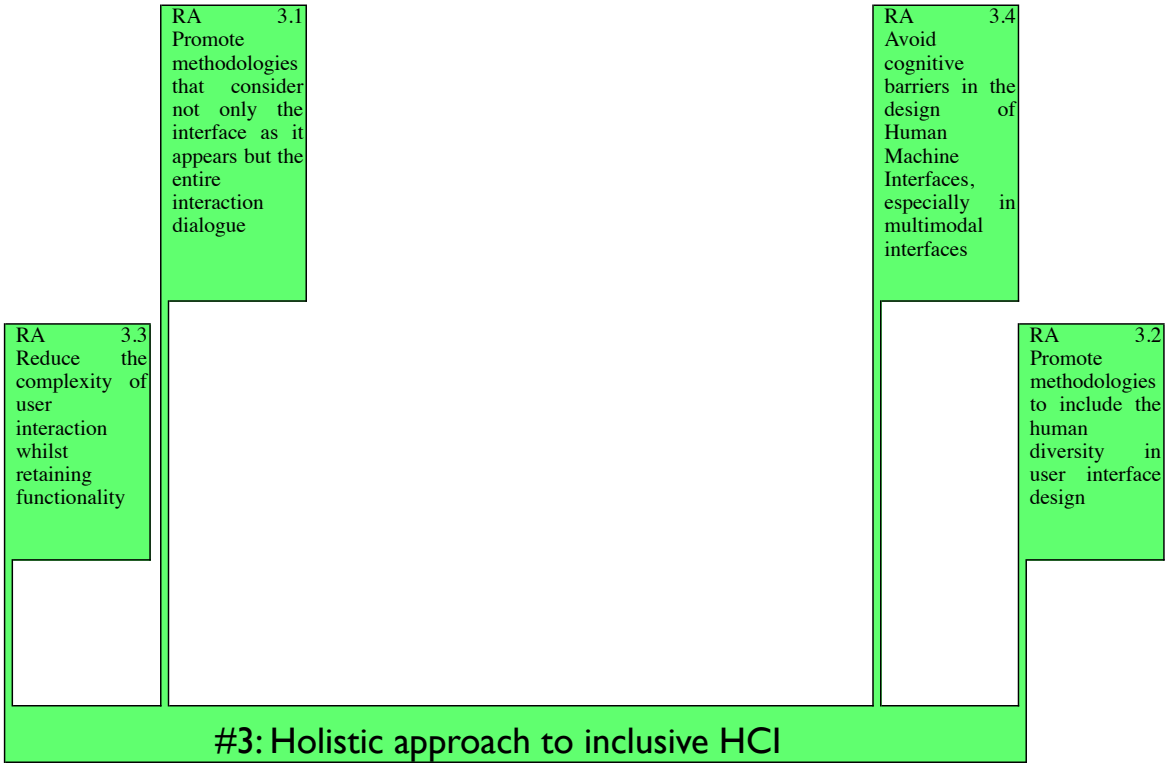

Figure 11: Graphic representation of research line 3

Table 4: Research line 3 Holistic approach to inclusive HCI

Research line # 3: Holistic approach to inclusive HCI Most current User Centred methodologies are not able to cope with the requirements and characteristics of all people. Designers wanting to produce accessible Human-Machine interaction systems need sound methodologies and commercial tools to do it. Since designers are used to advanced design environments, inclusive methodologies must be sound and usable in the context of large-scale software development projects in order to be adopted by the industry. In addition, it is necessary to reduce the complexity of the interface and therefore the effort required for the interaction: many users experience frustration and displeasure when trying to perform a task using computers, just because they require an extra effort due to the cognitive overload imposed by the interface. This frequent situation gets worse for people who experience physical, sensory or cognitive restrictions, because they cannot use alternative sources of information or alternative ways to carry out the task, if these are not provided by the system. Evidently all the advancements in overcoming the cognitive load imposed by the use of computers will not only be beneficial to people with disabilities, but also to other users.		
Existing resources Current user centred methodologies and tools for HCI design	**Research action 3.1: *Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue*** The traditional separation between applications and human-computer interfaces has been very beneficial to the progress of HCI methodologies. Nevertheless, the danger exist that designers concentrate only in the interface itself, ignoring relevant aspects	***Specific developments:*** Methodologies that extend Design for All to a wider range of potential limitations to accommodate for the ageing population (EEX#111) Advanced user models that include all the factors involved in the interaction

Prerequisites Studies to learn all the diverse factors involved in the interaction	of the interaction such as the physical and social context, the tasks to be performed, etc. For optimal accessibility, the design has to consider the entire interaction process, including human mental models and procedures. **References:** (SD2#21)	***Accompanying policies:*** Legislation that impedes digital exclusion and supports applications designed for all. Training HCI designers in the use of user- centred methodologies and tools for HCI design
Existing resources Current user centred methodologies and tools for HCI design	**Research action 3.2: *Promote methodologies to include the human diversity in user interface design*** Most current User Centred methodologies are not able to cope with the requirements and characteristics of all people. Designers wanting to produce accessible Human-Machine interaction systems need sound methodologies and commercial tools to do it. Most designers are used to dealing with advanced design environments, therefore, in order to be adopted by the industry; these methodologies must be sound and usable in the context of large scale software development projects. **References:** (SD2#40)	***Specific developments:*** Repositories of knowledge about the specific needs for interaction of a large sample of users. Workbenches to check the validity of the interfaces (EEX#115)
Prerequisites Further research on static and adaptive user interaction profiles (SD2#57). Promote interoperability among devices and services to enhance accessibility (SD2#46). Research on how to enforce accessibility in consumer goods (SD2#34). Research on mid- to long-term interaction by disabled and elderly people (SD2#38). Common research on user needs and preferences to be used by all e-inclusion projects (SD2#60).		***Accompanying policies:*** Promote deeper understanding of how to measure the quality of ICT inclusive usage experience reported by excluded groups Promote a better understanding of older and disabled people's strengths (while may be superior to the mainstream) rather than just considering them less able (EEX#118)
Existing resources Large number of Usability studies, procedures and recommendations.	**Research action 3.3: Reduce the complexity of user interaction whilst retaining functionality** Many user interfaces are created taking into account a mental model of the task that is not shared by most users. That means that they do not clearly understand several procedures, making the interaction complex and unpleasant. Methods are needed to facilitate the	***Specific developments:*** Extend the usability recommendations about cognitive load to take into account users with specific cognitive restrictions.
Prerequisites Models of the Cognitive Load imposed by user		***Accompanying policies:*** Legal requirement of minimal cognitive load on information

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<td>interfaces.

Research methodologies that efficiently collect data about users including existing HCI quantitative tools (SD2#29).

Support research that looks how to reduce the complexity of user interaction whilst retaining functionality (SD2#32).

Use reasoning (AI) techniques for personalization (SD2#41).</td>
<td>intelligibility of the whole interaction simplifying the procedures, but without losing the functionalities provided by the application.

References: (SD2#32, SD2#45)</td>
<td>systems for safety, security, warnings, alarms for disasters, etc.</td>
</tr>
<tr>
<td>Existing resources

Large number of Usability studies, procedures and recommendations

Research on who could be excluded from using novel user interfaces</td>
<td rowspan="2">Research action 3.4: Avoiding cognitive barriers in the design of Human Machine Interfaces, especially in multimodal interfaces

The introduction of computers eased or even allowed many tasks to be carried that were not previously possible for many people. However, computers frequently increase the cognitive workload required to perform some tasks. The lack of matching between the mental models of the user and the computer, the complexity of the language, and the ignorance of the user’s needs are some of the causes of complexity that have to be avoided.

In the case of interfaces provided in more than one modality, the different modalities may impose different cognitive demands on the user. For instance, it is easy to get ‘lost’ with auditory output of a complex interface, which was designed for visual presentation.

References: (SD2#02)</td>
<td>Specific developments:

Decrease the cognitive load associated with multimodal user interfaces (SD2#45).

Simulation facility for cognitive impairments (EEX#126).

Systems for text normalization, simplification, personalization and evaluation (SD2#37).</td>
</tr>
<tr>
<td>Prerequisites

Development of new haptic interfaces and methods for haptic usability (SD2#03).

Research on who could be excluded from using novel user interfaces (SD2#25)

Research of the use of context awareness to adapt user interfaces (SD2#06).

Support research on how affective computing can assist accessibility interfaces (SD2#35).</td>
<td>Accompanying policies:

Legal requirement of minimal cognitive load on information systems.</td>
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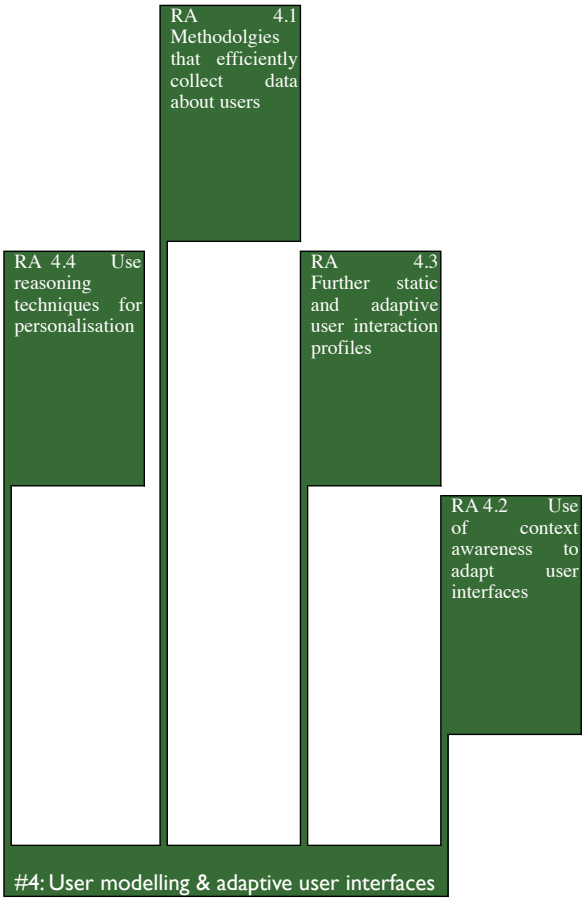

Figure 12: Graphic representation of research line 4

Table 5: Research line 4, User modelling and adaptive user interfaces

<table>
<tr><td colspan="3">Research line # 4: User modelling and adaptive user interfaces to tailor the interaction

Initially applications included a single and inseparable user interface. Due to human diversity only a part of the users were able to adapt themselves to the (physical, sensory and cognitive) requirements of the interface. Currently, the separation between the application and the interface allows the design of interfaces that are adapted to the specific characteristics and needs of each user.</td></tr>
<tr><td>Existing resources

Current data collection methods</td><td rowspan="2">Research action 4.1: Methodologies that efficiently collect data about users (including existing HCI quantitative tools).

The creation of user profiles by directly questioning the user can be disruptive, inopportune and annoying. To minimize the need to explicitly provide personal data, automatic collection of user information is required. Collection may be based in reasoning over statistical measures of user activities. In addition, methodologies such as Data Mining may be useful to collect large quantities of data that can be used to model the users by means of Machine Learning techniques. In any case it is crucial to develop</td><td>Specific developments:

Support the research in detecting behaviour, emotions and intentions of the user without the conscious control by the user (SD2#22), preserving their rights.</td></tr>
<tr><td>Prerequisites

Definition of a catalogue of sensible data</td><td>Accompanying policies:

Adopt the initiative to enforce Personal Data Protection legislation for products and services</td></tr>
</table>

	techniques that preserve user privacy. **References:** (SD2#29)	(EAP#209)
Existing resources Context and task models in the literature	**Research action 4.2: *Use of context awareness to adapt user interfaces*** The physical and social contexts where users perform their actions are valuable sources of information that allow the optimization of the human interface in order to minimize the physical effort and the cognitive load and maximize the efficiency of the user actions. Context models, similar to user models, may be required to store and process this type of information. In addition, task models can be useful to complete the information required by adaptive user interfaces. **References:** (SD2#06)	***Specific developments:*** Understanding of the environment and other context factors, and smoothly adaptable to the needs of each senior individual (EAP#201).
Prerequisites Agreement on a common taxonomy of context and task models Support research that looks how to reduce the complexity of user interaction whilst retaining functionality (SD2#32). Use reasoning (AI) techniques for (SD2#41). Consider not only the interface as it appears but the entire interaction dialogue (SD2#21).		***Accompanying policies:*** Enforce privacy protection legislation for exposed and frail people
Existing resources Web data mining	**Research action 4.3: *Further static and adaptive user interaction profiles*** Medically based categories of disabilities do not provide useful information about the needs of the individual. Many people "fall through the cracks" or feel that their needs are stereotyped according to one classificatory category when ICT access solutions are delivered according to traditional disability groupings, because such categories do not provide useful information for configuring an ICT system. Diverse approaches to user interaction profile creation and maintaining are possible. The user (maybe assisted by an expert) can create her or his own individualized personal profile from a list of common functional descriptors. This enables a one-size-fits-one response from a system that is able to transform, augment or choose from a pool of diverse resources. There is also the possibility of designing systems for automatic collection and maintaining of user models, usually based on	***Specific developments:*** Support research in detecting the behaviour, emotions and intentions of the user without the conscious control by the user preserving their rights. Understanding of the environment and other context factors, and smoothly adaptable to the needs of each senior individual (EAP#201)
Prerequisites Definition of a catalogue of sensible data		***Accompanying policies:*** Adopt the initiative to enforce Personal Data Protection legislation for products and services

	ontologies. **References:** (SD2#57)	(EAP#209).
Existing resources Reasoning Methods for Personalization in diverse environments such as the Semantic Web	**Research action 4.4: *Use reasoning techniques for personalization*** The interaction system should be able to "reason" about the needs and purposes of the users, in order to help them in a practical way in reaching the desired outcome. The system should thus be able to organise a dialogue in such a way that it can deduce the most adequate way to interact with specific people taking into account the knowledge collected about the user and its environment. **References:** (SD2#41)	***Specific developments:*** Create dynamically Adaptive User Interfaces based in reasoning over knowledge bases.
Prerequisites Agreement on a common taxonomy of context and task models		***Accompanying policies:*** Measures to prevent the impact over the privacy of user modelling techniques.

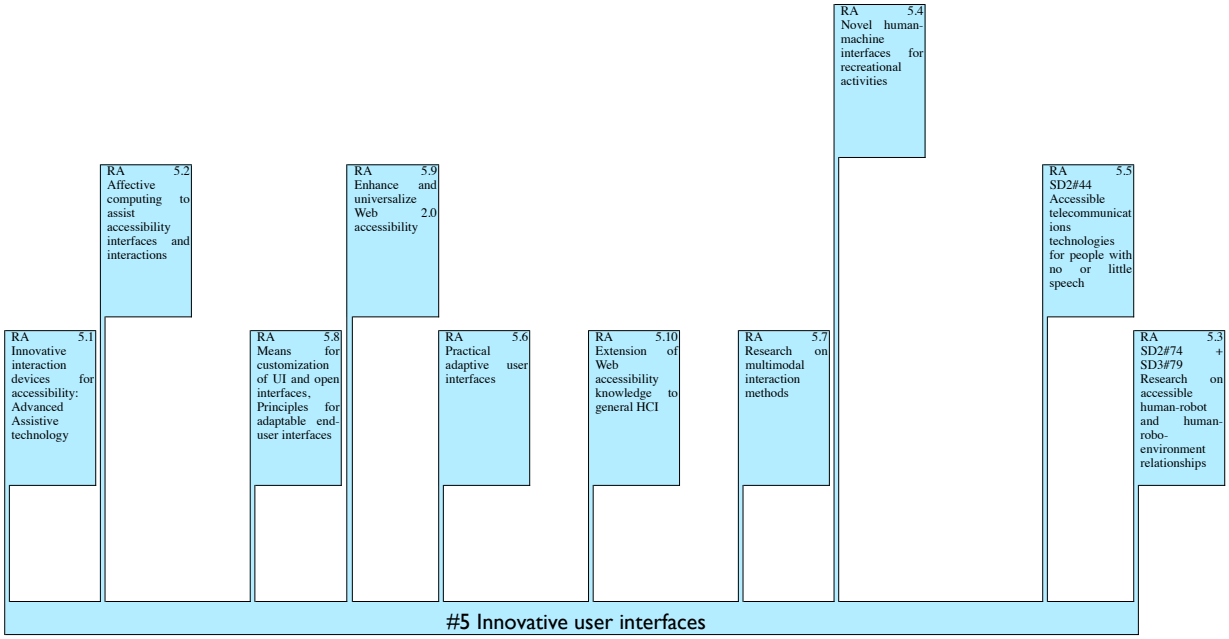

Figure 13: Graphic representation of research line 5

Table 6: Research line 5, Innovative user interfaces

Research line # 5: Innovative user interfaces The access to services provided by ICTs is frequently prevented by the use of "traditional" user interfaces. Recent advancements in sensoring, wireless networking, among other technologies, make possible the development of new kinds of user interfaces able to avoid the barriers imposed by previous interaction systems. These advancements would also be fundamental to develop new types of Assistive Technology that provides access to mainstream devices and services.		
Existing resources Interfaces for specific application	**Research action 5.1: *Innovative interaction devices for accessibility: Advanced***	***Specific developments:*** Tangible artefacts to promote e-inclusion of people with special needs in technologically mediated environment

fields, such as computer games, virtual reality, augmented reality, control of machinery, etc., that can be adapted to the needs of people with disabilities or can serve as a base to the development of new accessible interaction paradigms.	***Assistive technology*** Current technologies provide a number of new interaction methods that are able to enhance the capacity to handle the interaction of specific groups of users. For instance, haptic interfaces have proved to be useful to blind people (SD2#03). Similar techniques should be developed for other categories of disabilities, e.g. people with cognitive and motor impairments. Similarly, enhanced interfaces based on eye tracking could be beneficial. The accessibility of other alternative input systems, such as multi-touch surfaces and brain-computer interaction, etc., should also be explored. **References:** (SD2#03)	(SD2#08). Realistic brain-computer interfaces for people with special needs (SD2#23). Eye-tracking and tongue piercing based interfaces (SD2#31). Non-visual interfaces for all (SD2#36). Inclusive HCI for highly dynamic impairments (e.g. hospitalized people that temporally cannot speak) (SD2#50). Improvements in existing screen readers, less expensive alternative keyboards and pointing devices (EEX#101). Technologies to extend the world of congenital deaf-blind children beyond their fingertips (EEX#106). Technologies to make less expensive tactile and Braille displays (EEX#107). Technologies to help people to make use of their skills in physical world in dealing with the virtual world things (EEX#112). Tools to read out or enlarge paper based documents (post, instructions/labels, etc.) (EEX#114). Virtual helpers to provide specific help on any IT activity (EEX#119). A database and search facility based on a single person's own history to give them memory support (EEX#120). Cash machines that can safely be used by visually impaired people (EEX#123). Computers that prompt mental and physical development by challenging people with specific impairments to overcome them (EEX#125).
Prerequisites New interaction metaphors and paradigms for computing (SD2#16).		***Accompanying policies:*** Improve legal certainty and technology trustfulness for a higher consumer acceptance (EAP#208). Legal requirement on minimal load on information systems
Existing resources Ontologies modelling affective issues Consider not only the interface as it appears but the	**Research action *5.2:*** ***Affective computing to assist accessibility interfaces*** While still novel, measures of stress – based on say Galvanic Skin Response (GSR) – have been, and are becoming, increasing common	***Specific developments:*** Affective recognition by means of gesture, voice analysis. Inclusion of affective cues in voice based communicators for AAC Affective synthesis via avatars, synthetic

<table>
<tr><td>entire interaction dialogue (SD2#21) Research methodologies that efficiently collect data about users including existing HCI quantitative tools (SD2#29).</td><td rowspan="2">measures in experiments to quantify human behaviour, particularly anxiety frustration disorientation and hesitation. However, it is necessary to investigate what is the possibility of using other affective detection systems (along with predictive task models) to quantify interaction problems and automatically adapt the interface in such a way that stress is reduced and interactivity progresses faster. They can also contribute to understand the areas of frustration that are common among different user groups and change the interface such that these areas of stress are reduced.

References: (SD2#35)</td><td>faces and voice

Enhance the process of understanding human affectivity in a computer-based technology</td></tr>
<tr><td>Prerequisites

Agreement on a common taxonomy of affective parameters</td><td>Accompanying policies:

Adopt initiative to enforce Personal Data Protection legislation for products and services (EAP#209).</td></tr>
<tr><td>Existing resources

Home and Social Robotics

Smart wheelchairs

Portable articulated arms

Extensive knowledge about robotic and interactions with them in the industrial environments.</td><td rowspan="2"><u>Research action 5.3:</u>
Research on accessible human-robot and human-robot-environment relationships

It is foreseen that robotics will be increasingly common in supporting people in their everyday activities. Some questions are of interest in this respect from the interaction perspective:

How will humans communicate with robots?

Will it be a natural language communication?

Will there be an instruction-based (command and control) style?

Will there be any room for emotions?

How should the service robots behave?

Will they be considered as extensions of the machines or, for example, as some type of maids with human-like attributes and characteristics?

References: (SD2#74), (SD3#79)</td><td>Specific developments:

Technologies to help people to make use of their skills in dealing with objects in the virtual world.

Increased capabilities of communication with robots and control of them by human users

Simplified (natural language) interactions. User interfaces for mixed initiative (or “shared control”, in robotics) Intelligent interfaces for Smart Wheelchairs control</td></tr>
<tr><td>Prerequisites

Studies on transportability of robotic software

Research of the use of context awareness to adapt user interfaces (SD2#06).

Further research on static and adaptive user interaction profiles (SD2#57).

Further development of</td><td>Accompanying policies:

Improve legal certainty and technology trustfulness for a higher consumer acceptance

Identification and regulation of ethical and legal implications.</td></tr>
</table>

<table>
<tr><td>robot technology.</td><td></td><td></td></tr>
<tr><td>Existing resources

User interfaces for computer games</td><td rowspan="2"><u>Research action 5.4:</u> Novel human-machine interfaces for recreational activities

The need of having a satisfactory life includes access to communication, education, labour and leisure. Even if research has concentrated on the firsts areas, the last one is by no means less important than the others. A special effort is required to provide novel interfaces that provide access to leisure to people with disabilities. The experience says that this kind of interfaces frequently provides enhanced access to other activities.

References: (SD2#13)</td><td>Specific developments:

Make social media inclusive (SD2#30)</td></tr>
<tr><td>Prerequisites

Case studies on successful use of recreational interfaces for special needs

Development of practical adaptive user interfaces (SD2#05).

Research aiming at avoiding cognitive barriers in the design of Human Machine Interfaces (SD2#02).</td><td>Accompanying policies:

Legal requirement on minimal load on information systems</td></tr>
<tr><td>Existing resources

Text phones

VoIP or Videoconference systems (e.g. Skype)</td><td rowspan="2"><u>Research action 5.5:</u> Accessible telecommunications technologies for people with little or no speech

People experiencing complex communication needs have limited possibilities in using telecommunications technologies, such as the mobile phone. This term principally refers to people with no or little speech that have a combination of disabilities (e.g. cerebral palsy combined with a laryngectomy, an acquired brain injury or a stroke). It is the combination of physical impairments that present challenges in finding ways for them to seamlessly link telecommunications with their alternative and augmentative communication devices.

References: (SD2#44)</td><td>Specific developments:

Development of new devices for accessible telecommunication</td></tr>
<tr><td>Prerequisites

Repositories of accessibility characteristics of existing technology for telecommunication purposes, including user evaluation

Promote methodologies to include the human diversity in user interface design (SD2#40)

Development of new haptic interfaces and methods for haptic usability (SD2#03)</td><td>Accompanying policies:

Economical support to the extra charges when special telecommunication systems are required.</td></tr>
</table>

Existing resources Diverse European Projects have developed a number of adaptive user interfaces (AVANTI, GUIDE, VICON, MyUI, VERITAS, etc.) Knowledge about user modelling. Growing knowledge about Artificial Intelligence.	**Research action 5.6:** ***Practical adaptive user interfaces*** The user interfaces need to be adapted to the user characteristics and preferences. In addition, they have to dynamically adapt to changing user needs (e.g. due to highly dynamic impairments); physical context (e.g. indoors, outdoors); task constraints, etc. Adaptive interfaces that consider the characteristics and needs of people with disabilities are highly required. The standard interactions with systems and applications are designed to address as many people as possible with a single interface. The concept of average user is normally used. For a large (and growing) number of users this approach causes accessibility or usability problems. A possible approach is on individualizing the interactions (adaptive user interfaces), based on user profiles. This is meant to allow users to benefit much more of available systems, services and applications. In particular, the emerging Ambient Intelligent environments the need for increased usability and adaptation of interactions will increase, due to their potentially growing complexity. Knowledge about user needs, requirements and preferences must be collected and made available to designers of new systems and applications. Moreover, this knowledge must be integrated in reasoning components that systems and applications can use to adapt themselves to meet user abilities and preferences. **References:** (SD2#05), (SD3#73)	***Specific developments:*** Create adaptive user interfaces based on models of the user, the context and the task. (Automatic) procedures for collecting end-user needs, requirements and preferences. Procedures for constructing user models and refine them (e.g. during interaction). Reasoning components able to match (automatically) interaction features and functionalities of services with abilities of users.
Prerequisites Understanding of the environment and other context factors, and smoothly adaptable to the needs of each senior individual (EAP#201) Agreement on a common taxonomy of user, context and task models Support research that looks how to reduce the complexity of user interaction whilst retaining functionality (SD2#32). Use reasoning (AI) techniques for personalization (SD2#41). Design for All approach.		***Accompanying policies:*** Measures to prevent the impact over the privacy of user modelling techniques. Legislation about accessibility.
Existing resources Knowledge about usability of	**Research action 5.7:** **Research on multi-modal interaction methods** Multimodal interaction methods	***Specific developments:*** Development or refinement of technologies for transduction of information from one media to another.

different media and combination of them by different user groups.	and alternative input-output technologies are considered as normal features of the emerging information society. Their use is essential to ensure inclusion in the emerging ambient intelligence environment. Apart from looking at the user interface aspects, it is also important to consider that the availability of multimedia information (possibly with a redundant representation) in ICT applications and the use of multimedia communication channels in interpersonal communication services, can give the possibility of inclusion to people with activity (for example sensorial) limitations, due to their personal physical limitations or to contextual factors (e.g. places with high background noise or insufficient illumination). This asks for a careful investigation of the optimum matching of the representation of information and communication components with the abilities of the users. **References:** (SD3#23)	Investigation on optimal multimedia representations of information. Investigation of optimal combination of media in interpersonal communication services.
Prerequisites Identification of technical developments of different media and of the possibility of transductions from one media to another.		***Accompanying policies:*** Standardisation of multimedia representation of information
Existing resources Interfaces for specific application fields, such as computer games, virtual reality, augmented reality, control of machinery, etc., that can be adapted to the needs of people with disabilities.	**Research action 5.8: Means for customization of UI and Open Interfaces, Principles for adaptable user interfaces including: Principles for adaptable end-user interfaces.** Rigid interfaces require that the users adapt themselves to the interface. Since people with disabilities can have difficulties to adjust their way of interacting to a different modality, procedure, or device, they are frequently excluded by non-adaptable systems. Therefore, adaptable interfaces are required to enhance the accessibility. Customization is usually done by the user or an assistant before the interaction to fine tune the interface parameters to the user characteristics and abilities.	***Specific developments:*** Principles for adaptable end-user interfaces and open interfaces. Means for customization of end-user interfaces, usable by the disabled end-users.
Prerequisites Knowledge about user modelling. Understanding of the environment and other context factors.		***Accompanying policies:*** Request the implementation of technical interfaces in Assistive ICT products to mainstream ICT products according to existing standards. Support and request open interfaces in all funded mainstream ICT projects that

	Adaptation is usually an automatic dynamic process that tailors the interface, taking into account the knowledge about the end-user stored in a user-model. Both techniques need to be enhanced to become broadly used by the designers. Moreover, progress in methods and tools for customizationand adaptation are required to enhance end-user tailored interface design, facilitating the accessibility. **References:** (SD1#25) (SD1#21)	develop user interfaces.
Existing resources More understandable accessibility design guidelines for web designers (EEX#116). Web Accessibility Automatic Evaluation tools Methodologies for web accessibility inspection by experts and evaluation by users Web Accessibility Accreditation and Certification Methods	**Research action 5.9: Enhance and universalize web accessibility** The number of human-computer interaction instances that are carried out through the Web is constantly increasing. CARDIAC has identified some research objectives in web accessibility shared with the WAI-ACT European project. They are classified into the following needs: Expanded cooperation in Web accessibility, Authoritative guidance on implementation; Harmonized evaluation methodologies; Coordinated research and development. **References:** (EAP#210-217)	***Specific developments:*** Make social media inclusive, including Guidelines for designing and evaluating ubiquitous social media (EEX#104). Accessible Rich Internet Applications compatible with Assistive Technologies Browsers that support Accessible Rich Internet Application Better automated software evaluation tools for web accessibility Methods for collaborative accessibility tagging Accessible Maps compatible with Assistive Technologies and mobile devices
Prerequisites Repositories of Web Pages intended to sampling for evaluation, work benching for quality assurance, and conformance verification Further research into why web sites aren't accessible, where & why they regress (EAP#220)		***Accompanying policies:*** More effective automated tools for publicly monitoring national government web site accessibility (EEX#108). National guidelines need to harmonize with WAI guidelines (EEX#109).

Existing resources	**Research action 5.10: Extension of Web accessibility knowledge to general HCI**	***Specific developments:***
Accessibility design guidelines for web designers Web Accessibility Automatic Evaluation tools Methodologies for web accessibility inspection by experts and evaluation by users	The Web Accessibility Initiative has developed an extremely interesting experience in practical accessibility support that includes the provision of diverse sets of accessibility guidelines to be used by designers and evaluators; an open work methodology that attracted users as well as people from the industry, academia and public administration; and a strategy to increase awareness about accessibility barriers among the designers, the policy makers and the general public. An interesting question is whether this experience can be extrapolated to other fields in the HCI area. And, if this is possible, what are the requirements for research and development needed to advance in that line. **References:** (EAP#218)	To extend accessibility guidelines to specific application and to general purpose interfaces To study the development of User Interface Description Languages, that allows the evaluation of some accessibility issues by analyzing the code. To adapt and formalize evaluation methodologies to be applied to the field of general accessibility
Prerequisites		***Accompanying policies:***
Adaptation of current User Interface Description Languages and model-based UI generation systems in order to deal with accessibility matters		To extend the awareness of accessibility to general purpose applications as a civil right and to develop suitable standards and regulations (EAP#219). To impulse the creation of repositories of shared tools, methodologies and accessibility knowledge in general.

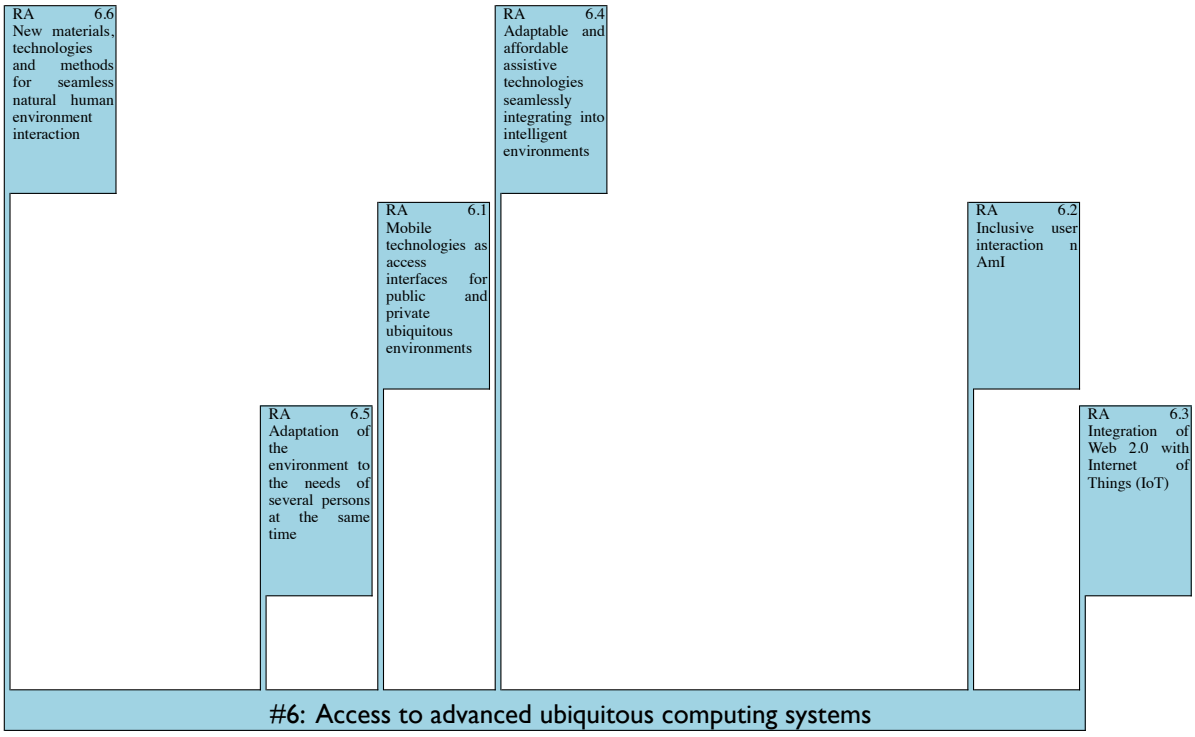

Figure 14: Graphic representation of research line 6

Table 7: Research line 6, Access to advanced ubiquitous computing environments

<table>
<tr><td colspan="3">Research line # 6: Access to advanced ubiquitous computing environments

Advancements in ubiquitous computing allowed the design of Ambient Intelligence and Ambient Assisted Living environments that provide ad-hoc local services. People with disabilities can very much profit from these services if barriers to Assistive Technology are removed and dynamically adapted user interfaces are provided.</td></tr>
<tr><td>Existing resources

Advanced mobile devices (smartphones)

Advanced mobile interaction methods and tools.

Standard middleware (URC/UCH)</td><td rowspan="2">Research action 6.1: Mobile technologies as access interfaces for public and private ubiquitous environments

Adequately adapted mobile devices, such as smartphones, can be used to access local services provided by intelligent machines, such ATMs, by means of ubiquitous computing techniques. Accessibility to these services requires dynamically created adaptive user interfaces based on user profiles that may be provided by the own user mobile device or may be available in the cloud.

References: (SD2#27)</td><td>Specific developments:

Design tools for mobile apps to ensure accessibility (EEX#105).

Basic access methods built into mobile device operating systems (EEX#110)

Programming tools for ubiquitous computing (SD2#39).</td></tr>
<tr><td>Prerequisites

Empirical research on how people with disabilities use mobile devices (EEX#103).

Better understanding of minimum physical dimensions of mobile devices (EEX#124)

Research of the use of context awareness to adapt user interfaces (SD2#06).</td><td>Accompanying policies:

Guidelines for accessible mobile interfaces (EEX#117) including the design of accessible Adds (EAP#212).

Adopt standard open middleware

Standards for physical characteristics (including minimum dimensions) of mobile devices</td></tr>
<tr><td>Existing resources

Home based AAL advanced systems</td><td rowspan="2">Research action 6.2: Inclusive user interaction in out-of-home ambient intelligence environments

Although a great deal of research is already dealing with “smart” environments and Ambient Intelligence technologies, it is important not to shift the focus away from the user aspects involved. In that respect, research on issues related to accessible user interaction in these so-called “Smart environments” is needed, focusing on people with disabilities and older people.

References: (SD2#19)</td><td>Specific developments:

Tools for accessible adaptive User Interface design

Methods for sharing or exportation of user models

Embedded computing accessibility (EAP#221).</td></tr>
<tr><td>Prerequisites

Identify where research is needed to obtain universal access in ambient intelligence environments (SD2#43).

Research on how to use mobile technologies as a universal middle-ware in public and</td><td>Accompanying policies:

Protect users’ privacy, security and safety, as well as consider user autonomy and other ethical issues.</td></tr>
</table>

private environments (SD2#13). Delivery of the interface to many more varied platforms (SD2#15). Promote research in methodologies and tools for HCI accessibility evaluation, including, monitoring and benchmarking (SD2#07). Support research on the implications for people with disabilities of the use of biometric systems for identification and security (SD2#52).		
Existing resources: Web 2.0 infrastructure and products Remote and local networks Sensors and actuators Advanced mobile devices (smartphones)	**Research action 6.3: Integration of web 2.0 with internet of things (IoT)** The development of Web 2.0 is increasing the possibility of people of being active in the production of information and new services, and in socialising through the network. The Internet of things is offering them the possibility of interactions with intelligent objects that populate the living places and give them useful functionalities both in their interconnected living environments and through the network. The integration of WB2.0 and the Internet of Things will give people the possibility of pooling intelligence in the environment and intelligence of people in the network, which implies possible cooperation to support independent living and to facilitate social integration. This asks for a careful planning of the integration of the two environments and of the functionalities made available by them, with the additional opportunity of being available in any physical space and even when moving. The interest and activity toward the implementation of the Semantic Web ideas, introducing the possibility that machines can reason about information available in the network, may introduce additional possibilities of support to users. **References:** (SD3#09)	***Specific developments:*** Development of support services in Web 2.0, including also mobile environments. Identification of functionalities useful for people with activity limitations, with a cooperation of human and artificial intelligence. Development of modules able to reason about activities carried out by users in the environment. Identification of aspects that characterise the mobile environment. Guidelines for the integration of different (physical and virtual) environments.
Prerequisites: Empirical knowledge of how people (including people with activity limitations) use Web 2.0, mobile devices and emerging intelligent environments (as. AAL)		***Accompanying policies:*** Guidelines for accessible mobile interfaces (including the design of accessible Apps) Standards for physical characteristics (including minimum dimensions) of mobile devices
Existing resources:	**Research action 6.4: Adaptable and**	***Specific developments:***

Home based AAL advanced systems	**affordable Assistive Technologies seamlessly integrating into intelligent environments** Inclusion and participation of people with activity limitations often depend on using additional technologies (including also Assistive Technologies – AT) supporting their interaction with systems and applications and facilitating the use of the functionalities of available systems and applications. While it is necessary that this additional technology becomes smarter, it is also crucial that the environment can be easily interfaced with any additional technology that people need or want to use. Moreover the environment must be able to integrate the new technology in its control and reasoning architecture. As an example, AmI should be able to help hearing aids to adapt to changing acoustic environments. This could include moving from one room to another with different acoustic properties and changing acoustic environment in the same room, for example if a party is taking place in the room with ten or more people talking. **References:** (SD3#11)	Modelling of people, technology and their interaction in order to integrate them in the AmI environment Definition of hardware/ software interfaces to be made available in the AmI environment in order to integrate personal technology Construction of AmI reasoning systems able to adapt the environment to the introduction of new technology and corresponding functionalities
Prerequisites: Identification of special technology and functionalities to be integrated in the AmI environment		***Accompanying policies:*** Standards and guidelines for interoperability
Existing resources: User modelling of the individuals	**Research action 6.5: Adaptation of the environment to the needs of several persons at the same time** AmI is supposed to allow proactive personalisation of the living environment and to exhibit adaptivity in real time to the activities that are carried out in it. Traditionally, user modelling, adaptability and adaptivity have been studied with the (implicit) assumption of having to accommodate a variety of people carrying out an activity individually. In AmI environments, instead, it must be given for granted that many people will be present. Therefore research is needed focusing on how to deal with multiple users. How is it possible to adapt the environment to the needs of several persons at the same time? This is important in the AmI paradigm, where the inhabitants of the environment are not using their single personal interaction device, but the entire environment is part of the interaction with the individuals in it. **References:** (SD3#28)	***Specific developments:*** User modelling techniques, able to accommodate different users Reasoning systems able to mediate among the needs, requirements and preferences of different users Architectures and methodologies able to integrate different functionalities even if with contradictory specifications (e.g. serving at the same time a blind and a deaf person)
Prerequisites: Models of the emerging environments		***Accompanying policies:*** User modelling standards

Existing resources:	**Research action 6.6: New materials, technologies and methods for seamless natural human-environment interaction**	***Specific developments:***
New sensors for general -purpose applications	The entire living environment will become the interface with information, remote people and control systems. All human interaction channels can take part in the process: voice, gesture, expression, manipulation/touch, gaze, as well as implicit channels like emotions and health/wellness status, and their physiological symptoms. A wide range of new sensors and actuators, both on-body or embedded in the environment, and of new materials will be needed for this purpose, taking into account the additional constraints posed by the fact that some people will not have the abilities considered "normal" for the members of the information society. **References:** (SD3#43)	Modelling of multimedia interactions taking into account the available abilities of people Methodologies and architectures for the seamless integration of different media addressing available modalities Modules able to reason about possible contradictory needs of different people in the same environment
Prerequisites: Identification of multimedia and multisensory interactions		***Accompanying policies:*** Sensor standards

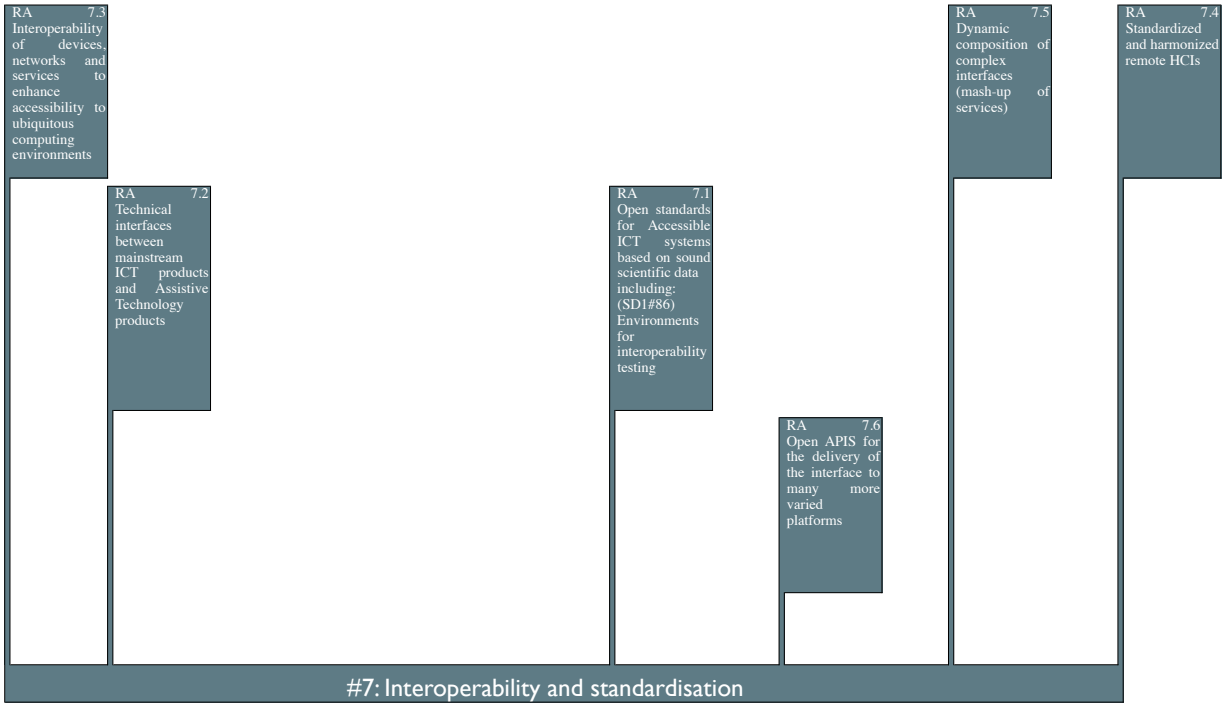

Figure 15: Graphic representation of research line 7

Table 8: Research line 7, Interoperability and standardisation

<table>
<tr><td colspan="3">Research line # 7: Interoperability and standardization

The diversity of procedures, layouts, behaviours, etc. of telecom services and applications along with of diverse interfaces required to access ICT products and remote services creates important accessibility and usability problems to people with activity limitations. Interoperability of equipment can provide a way to access to diverse services and devices using a unique interface well adapted to each user. Interoperability of different network infrastructures and protocols is also of paramount importance for ubiquitous access to services and applications of interest.</td></tr>
<tr><td>Existing resources

Working Groups already exist for international standards and guidelines on accessibility of ICT.

Guidelines for accessibility of ICT products and test tools for accessibility testing of web pages already exist.</td><td rowspan="2">Research action 7.1: Open standards for Accessible ICT systems based on sound scientific data (SD1#41)

The present set of standards is often inconsistent, fragmented and out of date (e.g. based on superseded technology). Often the accessibility aspects are superficial and do not reflect the unmet needs of the end-user population.
Assess existing standards, promoting adoption of the most promising ones, and monitor mature technological research and development results towards promoting their standardisation, in order to facilitate wider take-up, interoperability and affordability of solutions.

References: (SD1#41)</td><td>Specific developments

Open standards for Accessible ICT systems based on sound scientific and up-to-date data. The standards shall not contradict each other. (SD1#41)</td></tr>
<tr><td>Prerequisites

RA 11.6 Research on reasons why existing knowledge and standards on accessibility are not known or applied by HCI developers</td><td>Accompanying policies

Identify the need for standards in upcoming technologies and ICT systems, e.g. a new standard on “Accessibility Requirements for Mobile Devices”. (EAP#108, EAP#130)

Support the development of tools and environments for interoperability testing (SD1#86)</td></tr>
<tr><td>Existing resources

Working Groups already exist for international standards and guidelines on accessibility of ICT.

Guidelines for accessibility of ICT products and test tools for accessibility testing of web pages already exist.</td><td rowspan="2">Research action 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products (SD1#65, SD1#12, SD1#33)

An AT product aims to compensate in some way a certain disability. In this respect it is specialised; and therefore, there is no need for a “general” accessibility of this product. However, accessibility can be a relevant feature of an AT ICT product in the context of its usage in combination with a mainstream ICT product. Some AT products directly interact with mainstream ICT products or services. In this respect they can achieve an indirect accessibility of the mainstream product – at least for the end-user. It is assumed that open or standard (technical) interfaces between</td><td>Specific developments

Define open interfaces that allow ICT products and services to interact. (SD1#12, SD2#46)

Standards and guidelines to achieve the interoperability of Assistive ICT and of mainstream ICT products and services. (SD1#33, SD1#12)</td></tr>
<tr><td>Prerequisites

RA 11.6 Research on reasons why existing knowledge and standards on accessibility are not</td><td>Accompanying policies

Request the implementation of technical interfaces in Assistive ICT products to mainstream ICT products according to existing</td></tr>
</table>

known or applied by HCI developers	mainstream ICT products and Assistive ICT products would improve the situation of accessibility of mainstream products – and that it would be the main responsibility of mainstream ICT developers to provide such open interfaces. **References**: (SD1#65, SD1#12, SD1#33)	standards. (**SD1#65**) Identify the need for standards in upcoming technologies and ICT systems. (EAP#108) Support the development of tools and environments for testing the interoperability of Assistive ICT products. Increase the awareness on existing standards. (EAP#120) Demonstrate the advantage of collaborative and integrated applications and services based on using standards. (EAP#121)
Existing resources Standards on usability and accessibility, human factors, etc.	**Research action 7.3: *Interoperability among devices to enhance accessibility to ubiquitous computing environments*** Ubiquitous computing environments usually download a unique basic interface into the user device in order to provide control of each service provided. These interfaces are designed for standard mobile devices but may not be compatible with Assistive Technology equipment. To avoid accessibility barriers it is required that all the Assistive Technology is compatible and interoperable with all the ubiquitous environments. That may require promoting the definition or adoption of a common/standard middleware as accessible interoperability framework.	***Specific developments*** Study of the specifications of the different systems and identification of guidelines for guaranteeing the right interface among them. Tools to develop technology compliant with the interoperability standards, in order to allow transparent integration. Development of guidelines for interconnection of technology necessary for adaptation.
Prerequisites Awareness of accessibility to general purpose applications as a civil right and to develop suitable standards and regulations Research on reasons why existing knowledge and standards on accessibility are not known or applied by HCI developers New mechanisms for international collaborations	So far, the interconnectivity of networks, the wide availability worldwide of networks services (e.g. the telephone service) and corresponding applications, and the use of diverse equipment to access them have been made possible by the existence of standards. Presently and probably even more in the future, the proliferation of networks architectures, the increasing number of proposed services and applications, the fast developments of new technology for accessing them is reducing the possibility of aiming to a standardised worldwide system. This asks for the development of standards and/or guidelines for allowing different systems to intercommunicate (interoperability). For example, in order to	***Accompanying policies*** Reduce market fragmentation *a*dopting recommendations on UI interoperability Favour the application of recommendations on UI interoperability by enhancing international cooperation

(SD2#69). Increased awareness of the need of easy interconnectivity of networks, general access systems and specialised adaptations of them for social integration.	be accessible, services provided through networks must be accessible through a great variety of interoperable devices (including Assistive Technology). **References:** (SD2#46), (SD3#13)	
Existing resources Cloud computing services for accessibility (such as the Global Public Inclusive Infrastructure (GPII)) Cloud4All European Project's results	**Research action 7.4: *Standardized and harmonized remote HCIs*** People trying to gain access to diverse applications usually find different user interfaces based on different paradigms or using diverse procedures. This heterogeneity generates large use difficulties compromising their usability, accessibility and compatibility with assistive technology. Remote standardized and harmonized interfaces can provide homogeneous ways of interaction to facilitate the interaction and ensure the compatibility with specific Assistive Technology. Another possibility is to provide each service with a well-defined protocol that allows interoperability with each particular interface compliant with the protocol. In this way, each user gains access to every service though her or his own well-adapted interface. **References:** (SD2#14)	***Specific developments*** Tools to assist the design of standardized and harmonized remote HCIs (SD2#14). Development of workbenches to verify the functionality and quality of remote user interfaces.
Prerequisites Awareness of accessibility to general purpose applications as a civil right and to develop suitable standards and regulations Support research that looks how to reduce the complexity of user interaction whilst retaining functionality (SD2#32) Promote interoperability among devices and services to enhance accessibility (SD2#46) Basic research needs to be made on AT abandonment/adoption (SD2#64) Design clearing house for inclusive HCI (SD2#04)		***Accompanying policies*** Promotion of interoperability activities Diffusion of interoperability standards among HCI and AT designers Adopt recommendations on UI interoperability to reduce market fragmentation (EAP#208).
Existing resources Cloud computing services for accessibility (such as the Global Public Inclusive Infrastructure (GPII))	**Research action 7.5: *Dynamic composition of complex interfaces (mash-up of services)*** The dynamic composition of complex interfaces is an emerging trend that focuses on the automatic generation of personalized interfaces by using a combination of Web	***Specific developments*** Greater use of cloud and ubiquitous computing to allow devices to be automatically customized for particular environments and applications - especially for

	services. In order to provide the most suitable interface to a specific person a personalized interface can be created by making use of modelling and personalization capabilities. The required interface functionalities are obtained from diverse Web Services, such as automatic translation or screen reading services. **References:** (SD2#72)	cognitive disabilities
Prerequisites Detailed description of the technical requirements for UIs in order to be integrated into complex interfaces.		***Accompanying policies*** Promotion of interoperability among remote services Favour the application of Recommendations on UI interoperability by enhancing international cooperation (EAP#208).
Existing resources Existing open platforms	**Research action 7.6: *Open APIs for the delivery of the interface to many more varied platforms*** We are seeing a convergence of devices and the people who use them along with a divergence of the devices themselves. This means that developers must make their applications more flexible, more customizable, and more personalized – in effect more open – if they are to deliver these applications to the many different types of devices – and interfaces on those devices – without creating additional work by building an application for each individual device. Assistive technologies can, and will, take advantage of this flexibility and openness and become just another device to which flexible applications, content, and interfaces need to be delivered. By understanding that assistive technology is really just extreme adaptation we can implicitly encourage developers to create openness not previously experienced when the only platform for delivery was a closed predictable desktop environment. **References:** (SD2#15)	***Specific developments*** Open APIs to allow the use of AT within the interface
Prerequisites Provision of accessible interfaces inclusive products and services in a ubiquitous manner (SD2#17). How to enforce accessibility in consumer goods. Consumer devices need to become accessible out-of-the-box (EEX#113). Promote methodologies to include the human diversity in user interface design (SD2#40).		***Accompanying policies*** To support and enforce the creation of open platforms based on publicly available open standards to allow changes to the existing functionality of commercial products

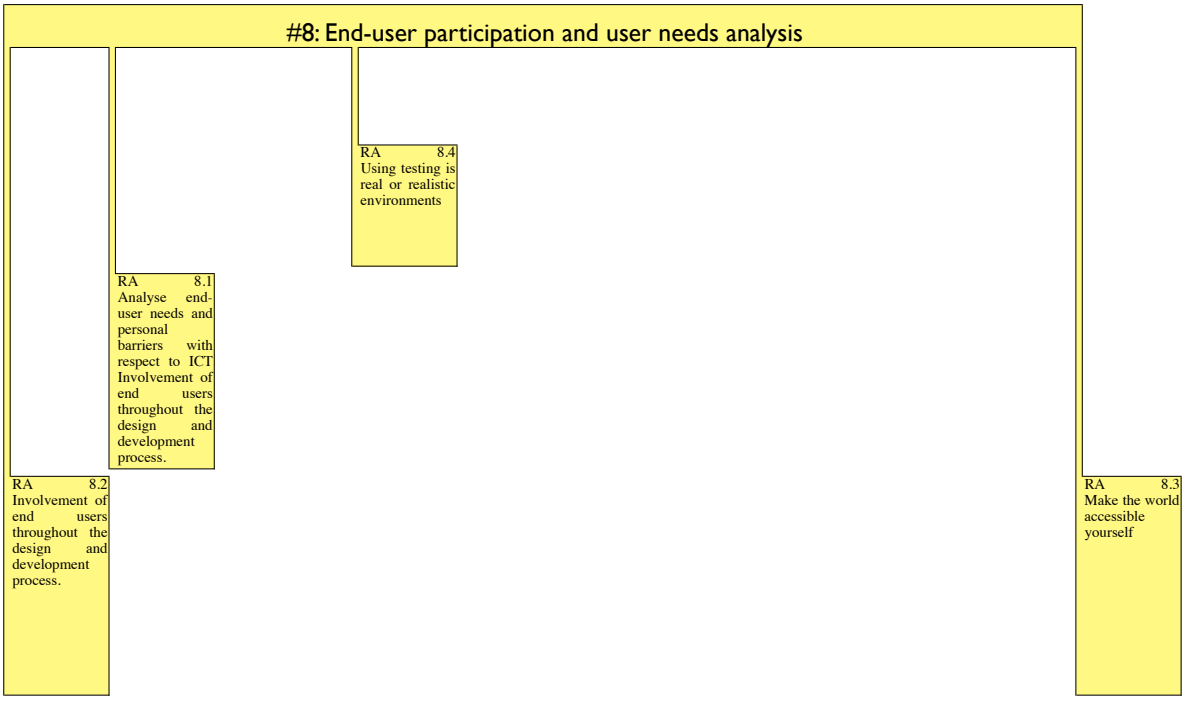

Figure 16: Graphic representation of research line 8

Table 9: Research line 8, End-user participation and user needs analysis

Research line # 8: Role of end users and their needs ICT provides great opportunities to develop assistive devices for people with disabilities and elderly people if their needs are known and respected. The 'accessibility' of a product or service is not a feature in its own. Instead it can be regarded in relation to the person who wants to use the product/service, with his/her intentions, capabilities and their assistive tools etc., and the conditions, environment and circumstances under which the persons uses the product/service. The needs of people with disabilities for technical (ICT) means, e.g. tools, devices, software, or services, that help to overcome barriers shall become well known and respected in Assistive ICT industries. End-users with disabilities shall be enabled to take part actively in technology transfer processes. The accessibility needs of end-users shall become well known and respected in mainstream ICT industries.		
Existing resources: Many studies on end-user needs (concerning people with disabilities and elderly people) have been conducted; a lot of knowledge is already there There are many end-user organisations (e.g. for people with disabilities) that can speak for their members and demand accessibility.	**Research action 8.1: Analyse end-user needs and personal barriers with respect to ICT** The knowledge of end-user needs is part of the basis for applied research and product development. **References:** (SD1#31, SD1#26, SD2#55, SD3#01, SD3#42, SD3#84)	**Specific developments:** Analyse disabled end-users' needs in a broad, systematical and comprehensive way; keep the analysis up-to-date when innovative developments are made in ICT. (SD1#26, SD3#15, SD3#42, SD3#84) Comprehensively characterise different focus groups, their needs, as well as facilitators. (EAP#102) Analyse and get a deeper understanding of problems (potential) end-users face in the usage of Assistive ICT products; identify human factors barriers to health, education and participation

		of low income groups. (**SD1#31**, SD2#55, SD3#01) Analyse the ethical, legal, and social requirements of the use of Assistive ICT. (SD3#24, SD3#40, SD3#69, SD3#89)
Prerequisites: none		**Accompanying policies:** Support end-users to effectively demand Assistive ICT and the accessibility of mainstream ICT products and services. (SD1#22) Methodologies that efficiently collect data about end-users including existing HCI quantitative tools (like needs, skills, interests, limitations). (SD2#29)
Existing resources: Usability and accessibility evaluation methods and techniques There are many end-user organisations (e.g. of people with activity limitations) that can speak for their members and demand their needs. People with activity limitations (as end-users) are usually in the direct focus of companies and organisations doing R&D in Assistive ICT.	**Research action 8.2:** **Involvement of end users throughout the design and development process** The participation of users and/or their representatives in all phases of the R&D process for Inclusive ICT is a key condition to ensure quality and adequacy and successful results. This includes not only the test with real users, but also their participation in the preliminary studies, the initial conception and the actual development. **References:** (SD1#23, SD1#44, SD3#47, EAP#203)	**Specific developments:** Methodologies and tools to facilitate user involvement in inclusive HCI research and AT design (EAP#111, EAP#131). Training courses (online and presence) for technicians how to involve people with disabilities in R&D projects Training courses (online and presence) for people with disabilities how to actively participate in R&D projects, in guidelines development, and in standardisation
Prerequisites: Developers understand the potential roles of the users in the whole R&D process End-users understand the principles of R&D processes and of their potential roles		**Accompanying policies:** Train end-users with disabilities to take actively part in technical development projects, to express their needs and visions, and to check whether their needs are respected. (SD3#68) Train end-users with disabilities to take actively part in the development of guidelines and standardisation. (SD3#25) Train product developers in effectively involving end-users (with disabilities) in the product development process.

		Require and support end-user involvement in (public funded) R&D ICT projects. Require that all technological innovations and developments be explicitly checked with respect to potential benefit for not disabled people. (**SD1#44**, SD3#47, SD3#68) Support relevant R&D projects by the gratis provision of training courses for technicians how to involve people with disabilities in R&D projects. Promote common research on end-user needs and preferences to be used by all e-inclusion projects. (SD2#60) Stimulate the establishment of national or regional "User Needs Competence Centres". Tasks of such centres could include e.g. training courses for technicians and people with disabilities, test of new ICT products/services concerning usability, advice for technical developers on end-user needs.
Existing resources: Knowledge available to end-users with activity limitations	**Research action 8.3: Make the world accessible yourself** The development of web 2.0 with emphasis on social interaction, collective intelligence, and active role of users not only in producing information but also in conceiving and setting up services and applications implies that users are supposed to acquire a role in influencing the uptake of new services, contributing to make them more accessible, usable and able to support people. First, their contributions could probably be at the level of collecting and making widely available information about needs, requirements and preferences. Then their practical knowledge and, sometimes, their specific technical expertise could give them the possibility of giving them an active role in improving accessibility and usefulness of the identified solutions. **References:** (SD3#06)	**Specific developments:** Creation of efficient communication channels between designers and end-users Development of tools to structure information Development of tools for empowering end users in modifying applications and their interfaces (EAP#111).
Prerequisites: Inclusive approach toward the acceptance of contributions from end-users		**Accompanying policies:** Support to integration of end-users in the design procedure
Existing	**Research action 8.4: User**	**Specific developments:**

resources: Usability and accessibility evaluation methods and techniques Living labs	**testing in real or realistic environments** Complex technologies, such as Ambient Intelligence, require long-term evaluations in realistic situations. Living Labs can be suitable for everyday testing of technology if they are adequately deployed and support users' privacy. **References:** (EAP#204, SD3#59)	Sound methodologies and tools to obtain knowledge from the observation of the users in Living Labs without disrupting their lives. Mechanisms to increase the potential of ICT support for "healthy living environments" (EAP#202). User testing based on living labs for fast design iterations based on user feedback in a realistic setting (EAP#204). Conduct well-controlled field studies and large randomized experimental projects (SD3#59).
Prerequisites: To form a consensus on values, ethical principles, rights, safety and privacy issues of ICT support for "living labs" (EAP#202)		**Accompanying policies:** Test new Assistive ICT products and services with respect to usability criteria and publish the results. Protection of the privacy of people behaving in Living Labs. Enforcement of rules to ensure support only to research projects where users have a significant participation

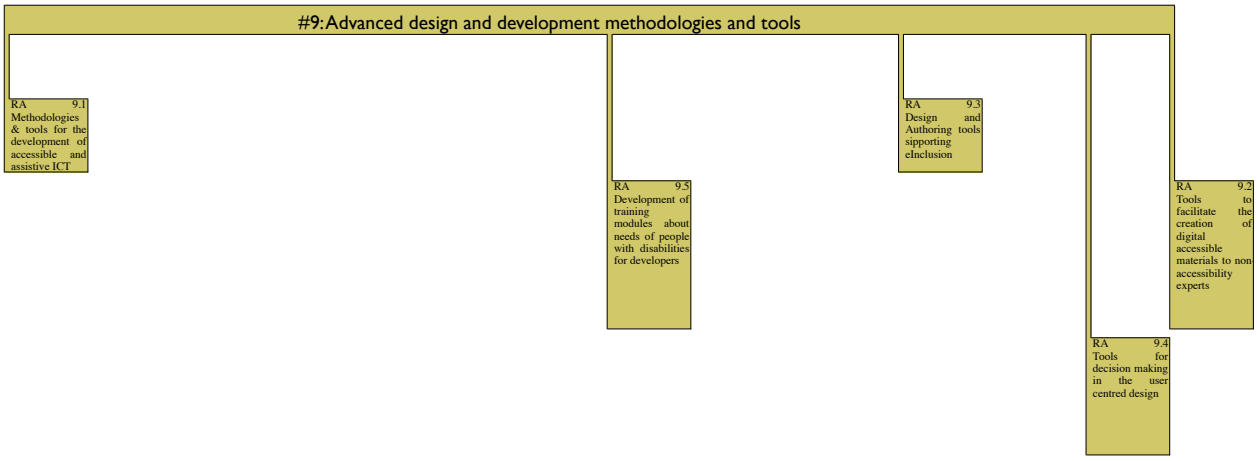

Figure 17: Graphic representation of research line 9

Table 10: Research line 9, Advanced design and developmentmethodologies and tools

Research line # 9: Design and development methodologies and tools Inclusive human-computer interaction requires methodologies and tools that facilitate the design of a) effective Assistive Technology-based user interfaces able to provide access to mainstream devices and services, and b) accessible user interfaces for mainstream devices and services, that may be handled by means of Assistive Technology devices. Most of the companies developing Assistive ICT products or services are small companies. Due to the multi-disciplinary character of Assistive Technology development and the strict technical and legal requirements for such products, it is especially hard for small companies to take care of everything. The availability of effective instruments for product development would significantly improve their ability to focus on innovation. Available technical solutions (including SW modules, technical descriptions, guidelines, technical know-how) developed and provided by accessibility experts make it easier for companies, who have no special expertise in accessibility, to achieve accessibility of their products or services. Researchers and developers of Assistive ICT or mainstream ICT need to get easy access to well elaborated and well-described technical instruments that facilitate the realisation of Assistive or accessible ICT products and services. These instruments may comprise e.g. methods, procedures, modules of software or hardware, technical descriptions, guidelines, standards, development/test tools and environments, technical experiences and evaluations.		
Existing resources Existing methodologies and tools for Web accessibility evaluation, monitoring and benchmarking. ICT development methods, tools and environments Accessibility guidelines and standards in certain areas of ICT Methodologies for end-user involvement in product development processes Concepts for Design-for-All There is technical know-how in the Assistive ICT area that is also	**Research action 9.1: Research action 9.1: Methodologies and tools for the development of accessible and assistive ICT** One of the main problems when integrating a new accessibility solution within mainstream ICT is that the guidelines and references that the developer has at his disposal to create accessible applications are very complex, very difficult to use and at a very high level. They are really explaining how to they should be used for a specific use case of the applications. It therefore takes a lot of time for the developers to create these accessible applications and very often they do not provide accessible solutions because they do not have the time to do it. Therefore, if more specific guidelines could be provided that are targeted towards what developers really do, i.e. referring to the specific tools they are using for these applications, such as for example, eclipse, Netbeans, visual studio or the Adobe tools, it would be much easier for developers to create accessible solutions thus increasing the chance of a greater number of applications being created that are accessible to mainstream ICT. A large number of methods and tools are available to guide the end-user centred design process in the early stage of the process. For example methods are	***Specific developments:*** Research on automated evaluation aids (SD2#63). User Interface Description Languages that allow the evaluation of most accessibility issues by analyzing the code Development environment for accessibility solutions (SD2#75). User / applications models that take into account disabilities of users (including reduced cognitive abilities) and application scenarios of new ICT developments Specific and clear accessibility implementation guidelines for application developers (SD2#26) Tools for decision making in the end-user centred design process (SD2#11, EAP#131) Specific methodologies and tools for the development and implementation of Accessible ICT (SD1#53) Standardized technical solutions and (software) modules for accessibility in specific domains (SD1#35) Augmentation of software development tools and environments by features that support accessibility Simulation tools for many physical conditions that can provide an insight

applicable in Accessible ICT.	available for participatory and co-design. These methods are suitable until the prototype stage. To take the step from prototypes to implementation in real life situations additional tools are necessary. There is a need for tools that facilitate the decision making process between different stakeholders in the final stages of the end-user centred design process. These tools should guarantee equality between the inputs from all stakeholders, facilitate cooperation and provide guidelines to look for alternatives and compromises when requests from stakeholders are not aligned. Even if the Web is far from being universally accessible, it is one of the environments where accessibility requirements are better known. One of the reasons is the availability of accessibility guidelines to help the designer and the evaluator. Accessibility guidelines also allowed the creation of automatic accessibility evaluation methods and tools. A similar set of clear and unambiguous accessibility guidelines would help to advance in accessible HCI evaluation. In addition this experience can be used to benefit the development of similar tools for the automatic evaluation of non-Web application interfaces. Since these tools are mostly based on finding barrier patterns in mark-up languages (such as HTLM) the definition of suitable User Interface Description Languages seem to be a good option to advance in this field. **References:** (SD1#15, SD1#35, SD1#53, SD2#26)	into what it is like to be older or disabled in today's society (EEX#121) Rapid prototyping tools that allow AT ideas to be mocked up and tested with limited technical knowledge (EEX#122)
Prerequisites Accessibility requirements, guidelines and standards for mainstream ICT Research on reasons why existing knowledge and standards on accessibility are not known or applied by HCI developers (SD2#42)		***Accompanying policies:*** Programmes to train HCI designers in the use of user centred methodologies and tools for HCI design Train the staff in knowledge of the mechanisms of TT, of the resources for information and advice and of examples of good practice as well of common fallacies and causes for failures – with respect to accessibility and design-for-all Support end-user involvement in all phases of product life cycle.
Existing resources National Center on Accessible Instructional Materials	**Research action 9.2: *Tools to facilitate the creation of digital accessible materials to non accessibility experts*** The inclusion of people with disabilities not only requires that the user interface is accessible but also that the contents are free of accessibility barriers. Content creators frequently ignore accessibility requirements or do not have appropriate tools to assist them in their application. Therefore, there is a need to create tools to help authors to produce material/ contents that are accessible to all.	***Specific developments:*** Create development environment for accessibility solutions
Prerequisites Research about the exclusion created by HCI (SD2#28).		***Accompanying policies:*** Regulations on digital accessible materials

<table>
<tr><td></td><td>References: (SD2#010)</td><td></td></tr>
<tr><td>Existing resources:
Knowledge about needs of users, problems encountered in using present applications and guidelines for their solution</td><td rowspan="2">Research action 9.3: Design- and authoring tools supporting and automating e-Inclusion
Awareness of e-Inclusion is rising. However, in practice designers and developers have problems in acquiring sufficient knowledge about the complexity and the variety of user needs and behaviours. The situation is made worse by the fact that, with the diffusion of Web 2.0, the producers of information and applications are no more information technology professionals, who can be trained about eInclusion aspects, but all users.
On the other side, due to the recent technological developments, many features of inclusive functionalities and interactions could be satisfied by mainstream developments. This opportunity could be increased if guidelines, standards, user models, profiles and simulations of the behaviour of people aging or with activity limitations, testing and checking tools would be integrated in design and development environments. This would allow developers and designers to access the necessary knowledge about eInclusion when needed and even to be guided by the design and development environments to use this knowledge.
References: (SD3#55)</td><td>Specific developments:
Formal description of foreseen eInclusion problems with emerging applications and their representation in a machine-readable code.
Integration of this knowledge in recommender systems of different complexity.
Integration of eInclusion recommender systems and/or AI reasoning systems in design and development environments.</td></tr>
<tr><td>Prerequisites:
Identification of possible problems with foreseen applications</td><td>Accompanying policies:
Public support of eInclusion guidelines</td></tr>
<tr><td>Existing resources
Current user-centred design methodologies and tools for HCI</td><td rowspan="2">Research action 9.4: Tools for decision making in the user-centred design process
A large number of methods and tools are available to guide the user centred design in the early stage of the process. For example methods are available for participatory and co-design. These methods are suitable until the prototype stage. To take the step from prototypes to implementation in real life situations additional tools are necessary. There is a need for tools that facilitate the decision making process between different stakeholders in the final stages of the user centred design process. These tools should guarantee equality between the inputs from all stakeholders, facilitate cooperation and provide guidelines to look for alternatives and compromises</td><td>Specific developments:
Simulation tools for many physical conditions that can provide an insight into what it is like to be older or disabled in today’s society (EEX#121)
Rapid prototyping tools that allow AT ideas to be mocked up and tested with limited technical knowledge (EEX#122)</td></tr>
<tr><td>Prerequisites
User-centred design process studies
Research methodologies that efficiently collect data about users</td><td>Accompanying policies:
Promote deeper understanding of how to measure the quality of ICT inclusive usage experience reported by excluded groups (EEX#115)</td></tr>
</table>

<table>
<tr><td>including existing HCI quantitative tools (SD2#29).

Research on methodologies to analyse collaborative accessibility and undertake collaborative user- and usage centred design (SD2#47).</td><td>when requests from stakeholders are not aligned.

References: (SD2#011)</td><td></td></tr>
<tr><td>Existing resources:

Knowledge about needs of people with different abilities</td><td rowspan="2">Research action 9.5:
Development of training modules about the needs of people with disabilities for developers of AmI systems

Most designers of AmI systems have a superficial idea of the needs of users, particularly of those with activity limitations.

These designers might benefit from appropriate education about the needs (e.g., the practical problems experienced by people with cognitive impairments), requirements and preferences of users. In the short time, for example for people who already are working in industry, this can be part of the lifelong education and training activities necessary for remain updated with the developments in their industrial sector.

In the long term, this knowledge should be integrated in the general education as:

Education modules made available in all the curricula of the different professional who intervene in the design process;

New post-graduate courses (e.g. at the level of master) to construct a new professional skill to support design.

References: (SD3#04)</td><td>Specific developments:

Collection of relevant information for designers

Set up of training courses for designers in industry

Design of modules for formal education

Production of syllabi for post-graduate education</td></tr>
<tr><td>Prerequisites:

Identification of main features of emerging services and applications</td><td>Accompanying policies:

European cooperation toward the introduction of formal education related to user aspects of technology.</td></tr>
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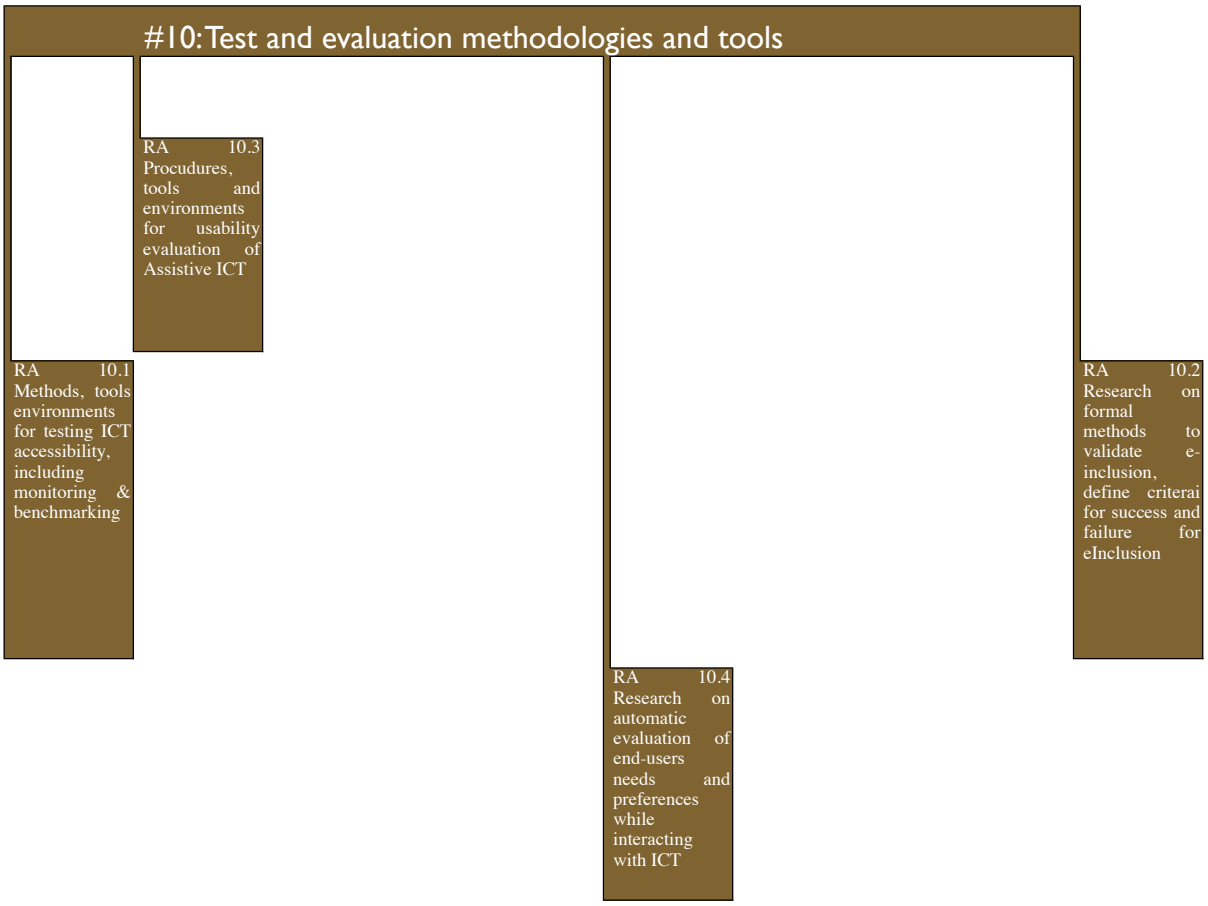


Figure 18: Graphic representation of research line 10

Table 11: Research line 10, Test and evaluation methodologies and tools

Research line # 10: Test and evaluation methodologies and tools		
While the methodologies for accessibility testing and evaluation of Web sites are almost up-to-date, this is not true for methods and tools for general accessibility and usability testing and evaluation of assistive and mainstream ICT. The Web is the most used ICT application. In addition, is one of the environments where accessibility requirements are better known? The availability of accessibility guidelines proved to be extremely helpful for designers and web accessibility evaluators. Accessibility guidelines also allowed the creation of automatic accessibility evaluation methods and tools. A similar set of clear and unambiguous accessibility and usability guidelines would help to advance in accessible HCI evaluation. In addition, this experience can be used to benefit the development of similar tools for the automatic evaluation of non-Web application interfaces and services. Since these tools are mostly based on finding barrier patterns in mark-up languages (such as HTLM), the definition of suitable User Interface Description Languages seem to be a good option to advance in this field.		
Existing resources: ICT test and evaluation methods, tools and environments Accessibility guidelines and standards in	**Research action 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking** Even if the Web is far from being universally accessible, it is one of the environments where accessibility requirements are better known. One of the reasons is the availability of accessibility guidelines to help the	**Specific developments:** Methodologies and tools for HCI accessibility evaluation, including, monitoring and benchmarking (SD2#07, EAP#141) Methodologies and tools for accessibility and usability evaluation especially taking

certain areas of ICT Existing methodologies and tools for Web accessibility evaluation, monitoring and benchmarking.	designer and the evaluator. Accessibility guidelines also allowed the creation of automatic accessibility evaluation methods and tools. A similar set of clear and unambiguous accessibility guidelines would help to advance in accessible HCI evaluation. In addition this experience can be used to benefit the development of similar tools for the automatic evaluation of non-Web application interfaces. Since these tools are mostly based on finding barrier patterns in mark-up languages (such as HTLM) the definition of suitable User Interface Description Languages seem to be a good option to advance in this field. Research is needed on the development of evaluation wizards that can be used both with and without professional evaluators to help end-users figure out what types of solutions would be best for them. Where professional evaluators are available, these wizards can help to make the evaluation process go more quickly and provide ways to try out ideas with end-users. This requires specification models that support the validation with automatic/ semi-automatic techniques in order to accomplish human needs in some specified context. **References:** (SD1#15, SD2#07, SD3#82)	reduced cognitive abilities into account Automated evaluation aids Integrated development and test environment for accessibility solutions (SD2#75).
Prerequisites: Accessibility requirements, guidelines and standards for mainstream ICT RA 10.2 Research on formal methods to validate e-Inclusion services Research on reasons why existing knowledge and standards on accessibility are not known or applied by HCI developers (SD2#42). More specific and clear accessible guidelines for application developers (SD2#26).		**Accompanying policies:** User Interface Description Languages that allow the evaluation of most accessibility issues by analysing the code Programmes to train HCI designers in the use of user centred methodologies and tools for HCI design Certification of proved accessibility
Existing resources: Knowledge about existing services and applications Knowledge about human factors Evaluation methodologies of services and applications from the perspective of different users	**Research action 10.2: Research on formal methods to validate e-Inclusion services**) Validation of services and applications from the eInclusion perspective, including their accessibility, usability and usefulness is a very difficult and time-consuming task, which is not carried out extensively for all applications and users. The development of formal methods to validate e-Inclusion services and applications and the interaction with them are instrumental for leading to automatic/semi-automatic techniques for testing extensively and efficiently eInclusion aspects of new applications during their development. This asks for the development of specification models, i.e. interactive processes, suitable to describe human interactions and needs, in order to develop applications favouring and/or supporting e-Inclusion and validate them for different users and in specified contexts of use.	**Specific developments:** Development of formal methods to describe functionalities of services and applications from an eInclusion perspective Development of formal methods for validation of functionalities of applications and services and of their interaction Integration of the methods in automatic and/or semiautomatic validation systems
Prerequisites: Identification of main features of emerging services and applications		**Accompanying policies:** Guidelines about eInclusion requirements

	References: (SD3#07, SD3#77)	
Existing resources: ICT test and usability evaluation methods, tools and environments Usability standards	**Research action 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT** This research action aims at increasing the chance of Assistive Technology adoption and reducing the risk of AT abandonment by providing means that help to evaluate the usability of assistive ICT prototypes already during the development phase. **References:** (SD1#15, SD3#48, SD3#82)	**Specific developments:** Specific and clear usability guidelines for developers of ICT applications for people with activity limitations. User models, methodologies and tools for usability evaluation especially taking activity limitations (including reduced cognitive abilities) of the end-users into account. Tools for testing that proposed AmI systems fully cater for the needs of people with activity limitations. Virtual reality environments for testing new applications of ICT for people with activity limitations
Prerequisites: RA 1.1 Basic research on Assistive Technology abandonment/adoption RA 1.2 Research on who could be excluded from using novel user interfaces RA 8.1 Analyse end-user needs and personal barriers with respect to ICT RA 8.4 User testing in real or realistic environments Accessibility requirements, guidelines and standards for ICT		**Accompanying policies:** Promote deeper understanding of how to measure the quality of ICT inclusive usage experience reported by excluded groups Programmes to train AT designers in the use of user centred methodologies and tools
Existing resources: Knowledge about user modelling User modelling infrastructures Observation	**Research action 10.4: Research on automatic evaluation of end-users needs and preferences while interacting with ICT** Currently, the provision of systems and applications adapted to the end-user needs and preferences is considered important. In order to be able to adapt them, the end-	**Specific developments:** Identification of the usage features of classes of foreseen systems and applications to be monitored. Identification of the features

methodologies	user requirements should have been gathered and stored in advance. Some solutions have been proposed: The end-user selects the most suitable persona from a set of available ones (e.g. the blind user selects a persona who activates the screen reader); The end-users specify their needs and preferences through forms (e.g. larger fonts, easier language, high contrast screens, etc.); The end-user uses games or wizards designed to carry out these evaluations (e.g. measuring the time to respond or the accuracy of the clicking in several objects). Moreover, it is considered necessary to gather the end-user behaviour during the interaction, in order to adapt the interface (adaptive interface) and the application functionalities, according to the end-user interaction. Therefore, procedures for automatic identification and evaluation of user requirements during the design phase and during direct interaction with the application, which could shorten the elicitation procedure and increase the consistency of the behaviour of the system, could be very useful. **References:** (SD3#05)	of interaction with service functionalities to be monitored Identification of methodologies for monitoring usage of applications and interaction with them. Development of models for representation of results in machine-readable formats. Development of tools for monitoring hardware and/or software. Reasoning methodologies for organising raw data in machine-readable format.
Prerequisites: Identification of main functionalities of foreseen applications Identification of the possible different interactions with the functionalities		**Accompanying policies:** Regulations about control by the user of procedures meant to characterize their behaviour

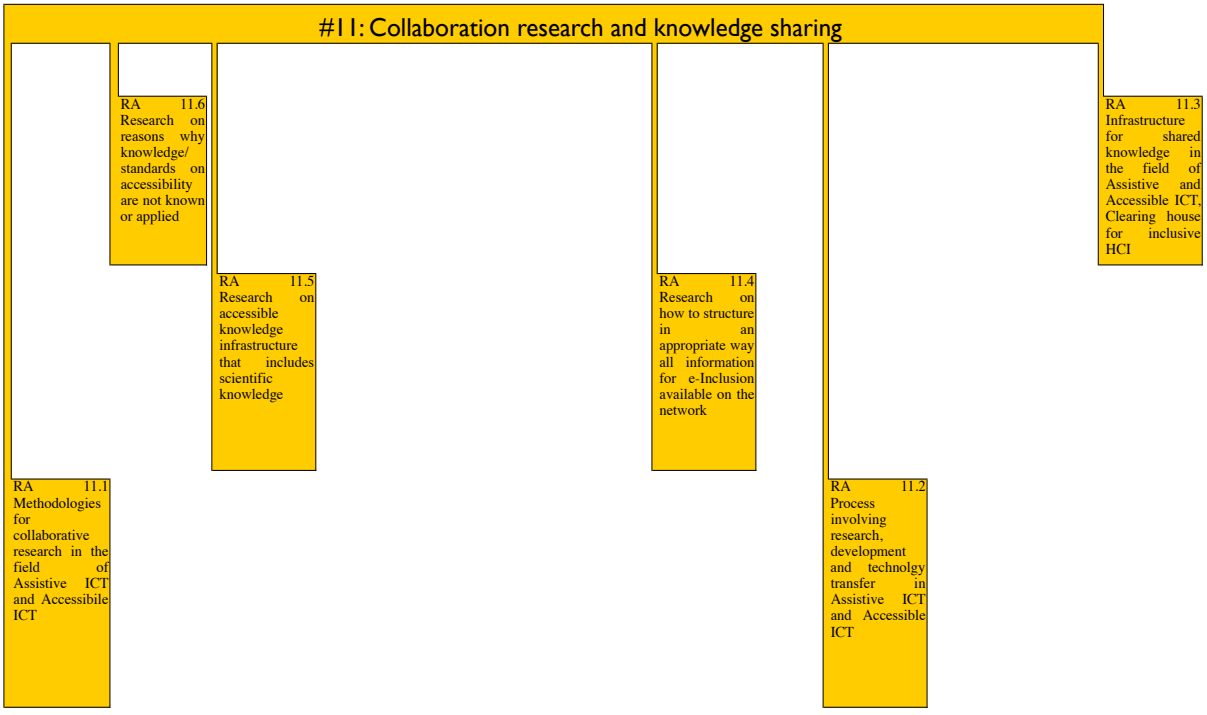


Figure 19: Graphic representation of research line 11

Table 12: Research line 11, Collaboration research and knowledge sharing

<table>
<tr><td colspan="3">Research line # 11: Collaborative research and knowledge sharing

Cooperation and knowledge sharing are essential success factors in research and technology transfer. Typically the producers, the distributors/ multiplies, and the users of ICT knowhow are different entities. Advancement towards full accessibility, usability and support services also require that the knowledge be spread among all the possible stakeholders. Progress to the full availability of resource materials is seen as a basic need.

Sharing knowledge and resources and collaborating in R&D can broaden the reachable population, increase the size of the markets and lower the prices of Assistive Technology. In developed countries Universal Accessibility is defined with a narrow focus. Availability of resources, infrastructures and education means is taken for granted. Nevertheless, disfavoured populations both in developed and developing countries are excluded from this focus because they do not have access to the basic requirements.</td></tr>
<tr><td>Existing resources

Tools for collaborative work in science and industry</td><td rowspan="2">Research action 11.1:
Methodologies to analyze collaborative accessibility and undertake collaborative user- and usage-centred design including New mechanisms for international collaborations

Social/sociological approaches to better collecting end users' requirements and opinions, as well as evaluating prototyped UI solutions, (for example, using Web 2.0 facilities) have to be taken into account. Collaborative approaches to Web accessibility start by identifying barriers by disabled people themselves and raising the social pressure for example on Website administrators. Best practice examples of such collaborative approaches are Web sites (e.g. IBM's work, or the FixTheWeb initiative) used for "fast and easy" reporting accessibility issues of online services and content but also detailed information about how to fix problems. Similarly, a geographical information system for mobility-impaired people may allow active collaboration by identifying wheelchair accessible/non accessible locations. A system may allow a correction of speech recognition captioning of audio recording for educational purposes, and where caption editing could be provided voluntarily by hearing classmates when funding for professional captioning is not available. All these are good existing examples for Web 2.0 services improving accessibility through "crowd sourcing". It is unclear if such approaches are to be scaled up to the extent and quality of commercial</td><td>Specific developments:

Methodologies and tools for collaborative accessibility and collaborative centred design

Tools for sharing accessibility knowledge and activities

Instigate a mechanism to support the transfer of technology from other areas of research, e.g. aerospace industry or military industry (SD1#88)

Open and "creative" development environments for accessibility solutions (as a platform for co-operation and sharing of tools and software code). (SD2#75, EAP#106, EAP#143)

Methodologies to analyze collaborative accessibility and to undertake collaborative end-user- and usage centred design (SD2#47)

New mechanisms for international collaborations (SD2#69), including the developing countries (SD2#71)</td></tr>
<tr><td>Prerequisites

Repositories for sharing and consulting R&D projects and results

Basic consensus on a set of research objectives that can be tackled in</td><td>Accompanying policies:

Regulation of systems for knowledge and experience sharing, preserving existing copyrights

Improve the level of technological research in inclusion by supporting projects that produce real technological innovations and produce significant advantages for end-users. (SD1#37)

Create awareness of the application</td></tr>
</table>

a collaborative way Basic consensus on collaboration and knowledge sharing Basic consensus on scientific and social goals General methods and tools for collaboration in research, development and technology transfer in the scientific and industrial world.	services like Facebook and large voluntary organizations such as Wikimedia. This requires further analysis and implementation with the involvement of end user organizations. Universal Accessibility often takes for granted that the user can be provided with adequate Assistive Technology. Even if this is true for some sectors of the population, mostly in developed countries, the real situation is that the largest sector of the population does not have the possibility of obtaining this kind of technology. This is true for poor people in developing countries, but also for sectors of the population in developed countries. A worldwide international collaboration would contribute to better face the accessibility problems of a larger population. Sharing solutions would help to lower the prices and facilitate the provision. There are many different stakeholders involved the field of assistive ICT and accessible mainstream ICT, including the quite inhomogeneous group of the end-users, i.e. people with a variety of disabilities, diversity of social and cultural backgrounds ("economical/digital divide", including people in developing countries), and age. Also the application conditions and infrastructure of ICT varies between countries, within and outside the EU. Furthermore, research in the area of "Assistive and accessible ICT" has many different aspects covered by different academic disciplines, e.g. human factors, psychology, computer science, cognitive science; and there are numerous application fields of ICT, e.g. e-shopping, e-learning, e-health, e-government. This research action aims at developing methodologies for effective and efficient collaboration of the different actors, taking account of the special characteristics of the application fields "assistive ICT and accessible ICT". – However, most of the proposed activities are not research themselves but "research supporting"; therefore the long list of "Accompanying policies". **References**: (SD2#47, SD2#69)	field of "Assistive ICT and Accessible ICT" among researchers doing basic research. (SD1#55) Define "Assistive Technology and Accessibility" as a research field on its own. (SD1#55) Develop theoretical foundation for ICT in the context of Assistive Technology and Accessibility. (EAP#109) Publish success stories on technology transfer and the development of Assistive ICT products/ services, including the success factors. (**SD1#71**) Publish "assistive" and "accessibility" aspects of R&D results and know-how generated in public funded projects. (SD1#74) Transfer know-how on accessibility and assistive functionality between the Assistive Technology field and the ICT mainstream field. (**SD1#16**) Stimulate the establishment of national or regional "Assistive and Accessible ICT Competence Centres". Tasks of such centres could include e.g. training courses for technicians and people with disabilities, test of new Assistive ICT products/services concerning usability, test of new ICT products/services concerning accessibility, advice for technical developers on end-user needs. Design clearing houses for inclusive HCI. (SD2#4) Establish broker agencies that support the technology transfer of Accessible and Assistive ICT. (**SD1#27**) Support the establishment and maintenance of a web-based European knowledge base on Assistive and Accessible ICT issues. Motivate public funded ICT projects (also in the Assistive ICT field) to use and to feed such a European knowledge base in an organized manner. (**SD1#16**) – Provide the knowledge sources in an accessible way. (SD3#34)

		Stimulate (on a political level) that the topics of "Assistive and Accessible ICT" and "Design-for-All (universal design)" are considered in curricula of universities in EU countries. Improve the education and training about inclusion and accessibility of people working in mainstream industry. (**SD1#17**) Embed the topics of "Accessibility" and "Universal design" in engineering curricula and professional education. (SD1#84, SD2#54, SD3#4) Train and inform potential stakeholders to achieve a better understanding of the process involving research, development and technology transfer in Assistive and Accessible ICT. (**SD1#56**) Adopt of the paradigm of end-user computing to involve users in the service development process. (SD3#17) Personally meet with the different stakeholders of TT in Assistive and Accessible ICT, including people from academia and industry as well as end-users. Get to know each others interests (**SD1#44**, SD1#68, QTT#12, QTT#13) Provide incentives to bring academia, industry and end-users together (**SD1#44**) Support the information exchange between researchers and developers from different technological areas (which are typically not related or are not used to cooperate among each other) in order to identify potential synergies and to avoid redundancy. (**SD1#44, SD1#88**) Support the information exchange and collaboration of researchers from the technical as well as from the human sciences. (SD3#21, EAP#110) Closely cooperate with mainstream ICT industries to transfer knowhow and to ensure interconnectivity of technology. (SD1#43, SD1#64) Bring basic research researchers

		together with people of the application field of Assistive ICT. (SD1#55) Cooperate with other initiatives to improve technology transfer processes in related application fields, e.g. the innovation partnership on active and healthy aging. (SD1#30) Cooperate with stakeholders of developing applications fields of ICT, e.g. the e-health, e government, e-learning. (SD1#48) Require the involvement of Assistive Technology experts in funded European ICT projects that are of high interest for people with disabilities, e.g. in e-health, e-government or e-learning.
Existing resources: Corporate social responsibility policies are an important part of companies' public relation (SD1#83). **Prerequisites:** none	**Research action 11.2: Process involving research, development and technology transfer in Assistive ICT and Accessible ICT** Innovation in Assistive Technology, as a field of applied science and technology, lives from the transfer of innovative technology from other technical fields and from the end-user-oriented and application-oriented (innovative) combination of various technologies. It is necessary to pay much attention to transition phases between research, development, product design and other aspects of technology transfer which are in many cases critical issues, sometimes not observed by the same perspective by all people involved. A better description of the process is needed in order to identify critical issues and to support research organisations and smaller companies to practice a more efficient style of technology transfer. For mainstream ICT companies it is essential to apply Universal Design principles in the whole product design process and to incorporate "accessibility" as an integral aspect of their product philosophy. If they organise their work and business accordingly then the realisation of accessibility of an ICT product or service requires no significant extra effort **References: (SD1#56)**	**Specific developments:** Methods and tools to formally measure and monitor the success/ failure of technology transfer w.r.t. Assistive ICT and Accessible ICT, both, inside an organisation and between organisations (QTT#10). Mechanisms to systematically support technology transfer from other areas of research, e.g. aerospace industry or military industry (SD1#88). **Accompanying policies:** Demonstrate to industrial companies that "assistive/ accessibility" functions in their products would be a positive feature, that customers could benefit from it, and that it could be a competitive advantage (SD1#72). Regard "accessibility and universal design" as an integral part of companies philosophy of product and service design. (SD1#09) Offer only ICT products and services to end-users that are well elaborated, i.e. are well operational and meet the end-users' needs so that the TT process has reached its final goal. (SD1#11) Train the staff in knowledge of the mechanisms of TT, of the resources for information and advice and of

		examples of good practice as well of common fallacies and causes for failures – with respect to Assistive ICT. (SD1#1/79, SD1#56) Take know-how and innovation in the field of mainstream ICT into account when developing new Assistive ICT. (SD1#43, **SD1#07**) Take know-how and innovation in the field of Assistive ICT into account when developing new "accessible" mainstream ICT. This means TT from Assistive ICT to Accessible ICT. (SD1#43, **SD1#07**, SD3#41, SD3#53) Convert designs of Assistive ICT products and services to solutions "designed-for-all". (**SD1#28**) Apply international guidelines and standards as a kind of "accessibility filter" firstly to understand accessibility and secondly to get guidance in R&D processes. (**SD1#03**)
Existing resources: Public repositories of accessibility materials	**Research action 11.3:** **Infrastructure for shared knowledge in the field of Assistive ICT and Accessible ICT including Clearing house for inclusive HCI and Research on sharing accessibility knowledge in the field of Assistive ICT and Accessible ICT** There are so many new technological developments and continuous change in the ICT field. Therefore, there is no established knowledge. The dynamic knowledge on assistive ICT and accessibility of ICT needs to be updated frequently. Awareness and efficient means for the provision/exchange of knowledge are basic preconditions for this. A clearing house is an online information transaction process for bringing together a wide cross-section of design methods, relevant standards and existing products as well as on-going research. A design clearing house for inclusive HCI will draw together valuable information online so that companies can quickly and clearly understand inclusive HCI. Commercial companies have limited time to develop interfaces and to encourage them to use	**Specific developments:** Repositories of Web Pages intended to sampling for evaluation, work benchmarking for quality assurance, and conformance verification Methods to verify and preserve the quality and reliability of the materials accessible through the clearing house Mechanisms to help relevant stakeholders to obtain and share appropriate information and tools about Inclusive ICT (EAP#143) Concept for the establishment of public available sources of knowledge on accessibility and Universal Design in ICT, e.g. online-databases, training courses, advice centres. (SD1#57, QTT#6, QTT#7, SD3#8, EAP#106) Training courses (online and presence) for technicians on necessity, requirements, know-how, and existing tools concerning accessible and assistive ICT. (**SD1#17**) Research on sharing accessibility knowledge with developing

	inclusive design practices, a central place online with impartial information would be valuable. Broker agencies for assistive and accessible ICT products would specifically provide support to companies/ organisations engaged in technology transfer of accessible and assistive ICT. These specialist agencies could bring stakeholders together, identify guides, markets, customers, etc. Another aspect of the sharing of accessibility knowledge refers to the developing countries. Few researchers in developing countries are investigating accessibility in their culture, using their own language and develop an understanding of the processes involved in creating a sustainable impact. Often the economics is much more demanding for low budget solutions. In the past, the development of eScience has shown an approach to create distributed research groups. An infrastructure for knowledge sharing that is open to researchers in developing countries would help with the exchange of knowledge in relation to needs and solutions of/for people with disabilities in developing countries. This would also help to strengthen corresponding research and to highlight market opportunities outside the EU. **References**: (SD1#27, SD2#04, **SD1#17**, **SD2#71**)	countries (**SD2#71**) Methods to verify and preserve the quality and reliability of the shared materials
Prerequisites: Ample agreements to classify the shared materials New mechanisms for international collaborations (SD2#69). Design clearing house for inclusive HCI (SD2#04). Basic research needs to be made on AT abandonment/ adoption (SD2#64)		**Accompanying policies:** Regulation of systems for knowledge and experience sharing, preserving existing copyrights. Support relevant R&D projects by the gratis provision of training courses for technicians on necessity, requirements, know-how, and existing tools concerning Assistive ICT. Share the special knowledge of the "inclusion community" with people outside this community. (SD1#57) Foster the idea of a global public inclusive infrastructure. (**SD1#29**) Regulation of systems for knowledge and experience sharing, preserving existing copyrights Stimulate and fund the establishment of "broker agencies" that support the technology transfer of accessible and Assistive ICT. (**SD1#27**) Stimulate the establishment of "Assistive Technology Competence Centres" that give advice on accessible and assistive ICT for users.
Existing resources: Unstructured information about eInclusion problems and solutions Tools for collaborative work	**Research action 11.4: Research on how to structure in an appropriate way all information for e-Inclusion available on the network** In the field of e-inclusion a lot of information is available from different sources and in different formats. Traditionally, a limited number of channels have been used (specific web site, specific mailing list) in order to exchange and extract information, which can help people to solve their inclusion problem or to improve their situation. Very often this information is available in an unstructured form, mainly in natural language. It could be useful to have it in a structured form, to allow an easy compilation of documents and the access	**Specific developments:** Study of the possible impact of the semantic web concepts in tagging information Development of tools for using tagged information to facilitate organisation and presentation of information Development of AI tools for extracting information from natural language text
Prerequisites: Inventory of available information and its formats		**Accompanying policies:** Standards for presentation of information relevant for eInclusion

	by intelligent agents. The study of different mechanisms (such as semantic web), which automatically give a structure to this information, can provide a way to make most of this information reusable by other people and by machines in different context. **References:** (SD3#30)	
Existing resources: Vast availability in the research literature of information of potential interest in the eInclusion field	**Research action 11.5: Research on accessible knowledge infrastructure that includes scientific knowledge** e-Inclusion is a process that is supported by active participation of many stakeholders who have different abilities and requirements. Access to scientific knowledge is crucial to take part in the process, but sometimes scientists ignore accessibility of their own ideas. People at large must make decisions based on accurate information and data hopefully supported by clearly described evidence. Therefore, it is crucial to address the special importance of making scientific knowledge accessible to all stakeholders, in particular to people with activity limitations. This would be useful for them to understand how already existing knowledge and technology can help, but also more useful to be able to understand what is going on in research and development and give them the possibility of influencing the future. Sometimes, a scientist with an activity limitation may become the best interpreter of scientific knowledge in each scientific field, but this is not enough. This need must be recognized and taken care of. **References:** (SD3#34)	**Specific developments:** Clear identification of the type of scientific information that could be useful in the eInclusion field Collection and structuring of the information Definition of guidelines for its dissemination to the general public
Prerequisites: Acknowledgment of the fundamental need of making scientific knowledge available to all		**Accompanying policies:** Actions to incentivize dissemination activities in the scientific communities.
Existing resources: Guidelines and standards on accessibility and usability of ICT products	**Research action 11.6: Research on reasons why knowledge / standards on accessibility are not known or applied** Much research on accessibility has been done, much knowledge has been gained, many guidelines or standards were elaborated, and many technical solutions have been developed. But it seems that in the user interfaces of many ICT products and services these findings are not applied or have not been implemented.	**Specific developments:** Research on reasons why existing knowledge and standards on accessibility are not known or applied by HCI developer. Inclusion of appropriate guidelines and standards in commercial methodologies and tools to facilitate and ensure they are known and applied. Further research into why web sites aren't accessible, where & why they

	Were the research results not useful, did knowledge and technology transfer fail, are guidelines and standards not applicable, are there commercial or market reasons? (Applied) research needs to be effective on the long run – otherwise it is in vain. **References:** (SD2#42, SD3#16)	regress (EAP#133) Studies of the application of accessibility recommendations in the mainstream HCI industry
Prerequisites Formal studies of the application of accessibility recommendations in the mainstream UI industry		**Accompanying policies:** Require the active participation of technicians in gratis training courses on Accessible ICT in funded R&D projects, which develop ICT for end-users. Support relevant R&D projects by the gratis provision of training courses for technicians on necessity, requirements, know-how, and existing tools concerning Accessible ICT. Fund the development and maintenance of training courses (online and presence) for technicians on necessity, requirements, know-how, and existing tools concerning Accessible ICT ("Accessibility Competence Centres" could do the running/ maintenance of such courses.) Require the use of commercial methodologies and tools that include appropriate accessibility guidelines and standards

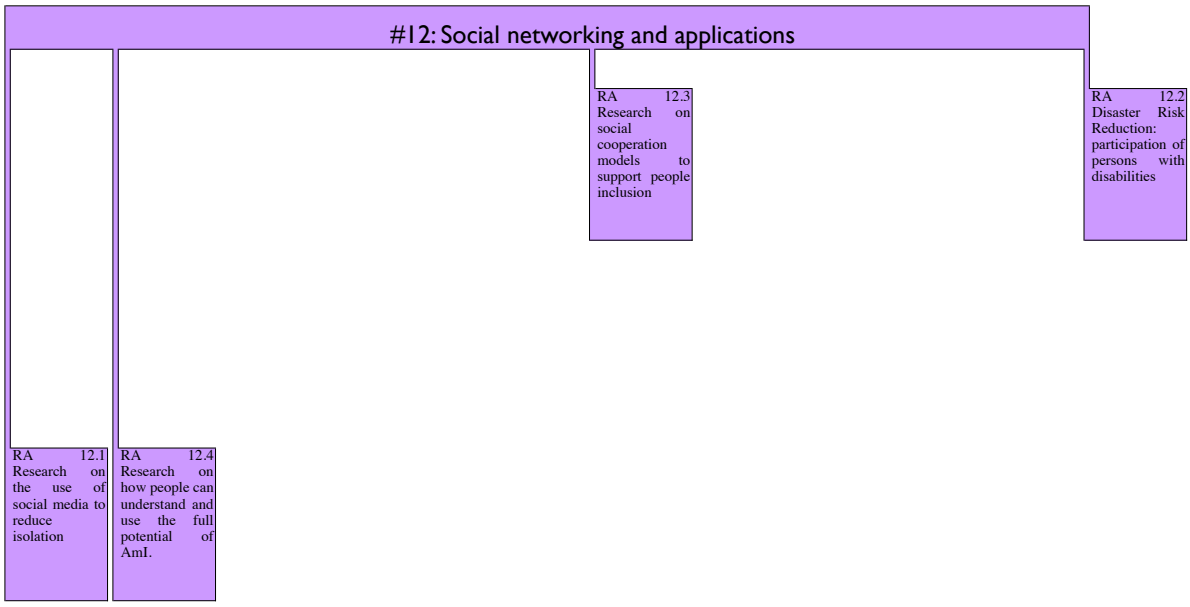


Figure 20: Graphic representation of research line 12

Table 13: Research line 12, Social networking and applications

<table>
<tr><td colspan="3">Research line # 12: Social Networking and applications

The Web from a repository of information has become a virtual space where people can meet, discuss and cooperatively produce information. Moreover it is also developing toward a Web of services, where service providers of users themselves can make available services and applications addressing different aspects of access to information and interpersonal (group) communications. This can be very important to favour eInclusion. In addition to living in an intelligent environment, people can be immersed in a virtual space where human intelligence may be available to help them. A carefully planned cooperation of machine intelligence in the environment and human intelligence in the network can be an invaluable support for inclusion of people.</td></tr>
<tr><td>Existing resources:

Emerging experience of services available in the Web 2.0 environment

Knowledge about human relations mediated by technology</td><td rowspan="2">Research action 12.1: Research on the use of social media to reduce isolation

Assuming that all accessibility and usability issues of network applications have been resolved, it is necessary to investigate on how they can reduce exclusion, e.g.:

By offering a virtual space where people can share multimedia information (i.e. text, images, video) that can be modified by users, thus giving them the possibility of discussing and cooperatively producing multimedia materials;

By offering a virtual space, where people can meet, chat and discuss about problems of common interest;

By giving the possibility to service providers of producing support services using which machines and/or human beings can support people in everyday occupations.

References: (SD3#32)</td><td>Specific developments:

Careful identification of the new possibilities given by social media.

Tools for the easy and fast production of support services. Tools for the easy and fast production of support services</td></tr>
<tr><td>Prerequisites:

Accessibility and usability of social media environments</td><td>Accompanying policies:

Support to the use of Web 2.0 as an assistive environment</td></tr>
<tr><td>Existing resources:

Skills in dealing with technology and, particularly, with alarm technology, of people with activity limitations</td><td rowspan="2">Research action 12.2: Disaster Risk Reduction (DDR): Participation of people with disabilities

Participation of people with activity limitations in networks dealing with critical societal problems is becoming increasingly critical. DDR is an important example. World trends in the problems related to disaster risk reductions are more and more toward a "whole community" approach. "Whole community" means that all citizens must make themselves a DRR asset. In other words, e.g. according to the experiences of mass casualty disasters such as March 11th 2011 earthquake in Japan, it may be not convenient that people rely on rescue specialist outside of the community. Rescue operations, which come later than 30 minutes of disaster incidents, may not effectively save lives. Whole community approach is a combination of self-help and community based mutual support. If a person is hit by a tsunami or buried by debris, it is too difficult to survive more than half an hour. Successful first</td><td>Specific developments:

Identification of specific communication needs of people with activity limitations, taking into account the stress and time constraints imposed by a disaster

Planning of special support to be offered to people with activity limitations in emergency

Identification of possible support that people with activity limitations can offer in an emergency</td></tr>
<tr><td>Prerequisites:

Recognition of the peculiar problems of people with</td><td>Accompanying policies:

Legislation that takes into accounts problems of people with activity limitations in an</td></tr>
</table>

activity limitations in an alarm situation Acceptance of their contributions	response needs to be done by neighbours. Mobilizing all assets in the community requires sharing of scientific knowledge on disasters, participation in DRR planning, participation in evacuation drills, and development of personal scenarios for DRR. This must include people with activity limitations including dementia, Parkinson Disease, sensory or physical impairments, intellectual or cognitive impairments, psychosocial or intellectual impairments, and persons who do not understand the language of the community **References:** (SD3#74)	alarm situation
Existing resources: Emerging knowledge about social cooperation ***Prerequisites:*** Increased interest on the integration of people with activity limitations in social networks	**Research action 12.3: Research on social cooperation models to support people inclusion** Cooperation of people mediated by a network is supposed to be useful to support inclusion. However, several questions are now open in this environment, as: · Are the present models of social networking suitable for supporting eInclusion of people? · How is it possible to start cooperation of people in the eInclusion environment? · How is it possible to sustain it? · Is it possible to rely only on voluntary activities or an organised control is mandatory? **References:** (SD3#70)	***Specific developments:*** Models for social inclusion based on social cooperation Models for introduction of people with activity limitations in social cooperation schemes ***Accompanying policies:*** Support actions for encouraging and sustaining integration of people with activity limitations in social cooperation schemes
Existing resources: Development scenarios and partial implementations ***Prerequisites:*** Availability of information about on-going research and development activities	**Research action 12.4: Research on how people can understand and use the full potential of AmI** The degree of awareness, understanding and adoption of any emerging technology or service to support people is partly dependent on the degree to which end-users and their carers (both formal and informal) are able to understand the potential benefits. While it is clear how to show and test existing technology so that people, including people with activity limitations, can appreciate their usefulness or point out limitations and, therefore, necessary adaptations, the problem is more complex when technology, as in the case of ambient intelligence, is under development and intelligent environment where to run test do not yet exist. Therefore it is very important that activity is devoted to allow users to become aware of what is under development and of the full benefits and possibilities of the ambient	***Specific developments:*** Analysis of the development scenarios from the perspective of people with activities Exposition of the scenarios to people Collection of information and feed-back to the designers ***Accompanying policies:*** User control of the development of new technology

	intelligent environments, especially when there are possibilities for users themselves to intervene directly in the design and setting up of applications. **References:** (SD3#62)	

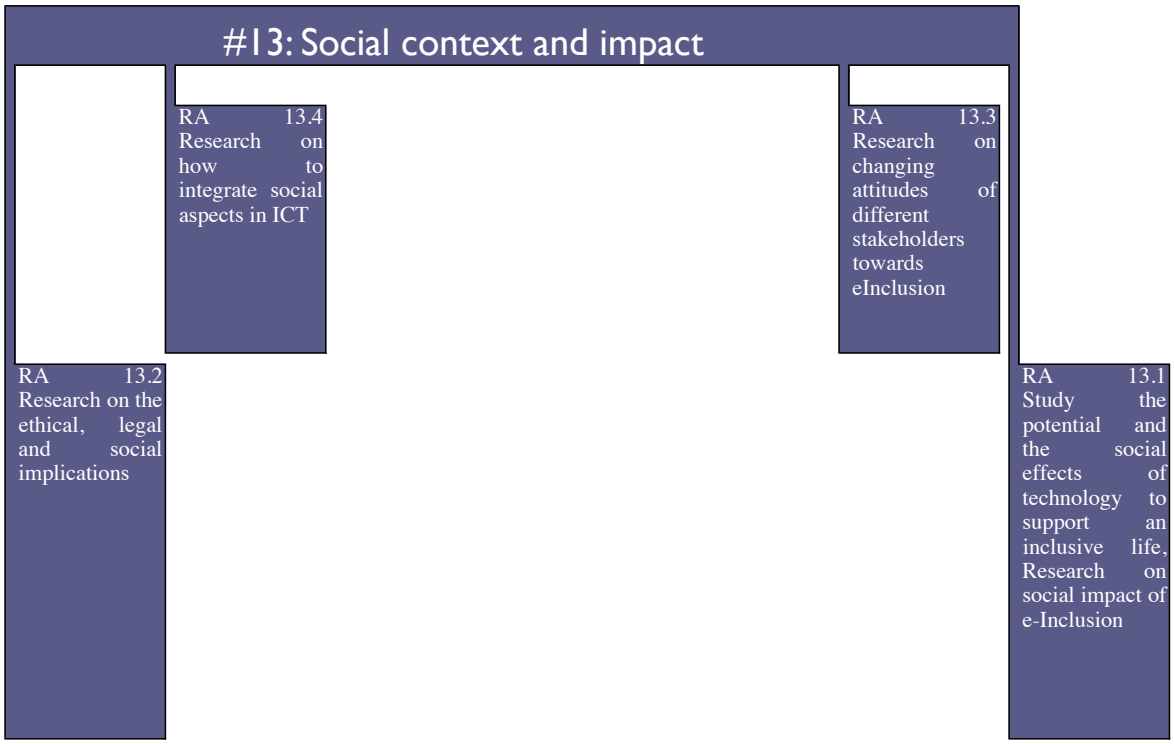


Figure 21: Graphic representation of research line 13

Table 14: Research line 13, Ethics, social context and impact

Research line # 13: Social context and impact		
Inclusion of people can be supported by a careful use of technology, particularly in activities connected to access to information and interpersonal communications. Sometimes, difficulties in using technology are caused by an insufficient care given to the problems of adaptation of it to people, especially if they have some activity limitations. Other times, this is due to an insufficient knowledge of all the important stakeholders of the problems encountered by some people in using systems, services and applications and of the solutions available to solve or reduce the problems.		
***Existing resources*:** General studies on the impact of existing technology on social relationships Knowledge about effects of exclusion from society	**Research action 13.1: Knowledge of the potential and the social effects of ICT to support an inclusive life** Stakeholders in Assistive or Accessible ICT often don't know the answer to the question: What is in it for me? Enterprises don't have clear answers on the business models that they must develop: they don't know the future development and perspectives of the area. Thus, more studies are needed that contribute to the potential of using	***Specific developments:*** Study on the use of ICT applications and, therefore of the impact of new technology on people's social contacts Study of new social interactions facilitated and made possible by ICT (e.g. in a ambient intelligence environment) Study the economical and social effects of successfully implemented and of potential Assistive ICT solutions. (SD1#10, SD3#15,

	assistive ICT and shift decision making from educated guesses to evidence based. The studies should deliver proofs of positive contributions of using Assistive and Accessible ICT for users regarding the increase of self-determinism and independence, entrepreneurs regarding economic advantages in order to reduce the risk of market failure and encompass investigations on the reliability/robustness of the ICT based solutions. Two aspects are of interest from a sociological and/or psychological perspective: · The analysis of the foreseeable impact of new technology and its deployment (e.g. ambient intelligence) in ICT services and applications in favouring or impeding inclusion in the society; · The study of the possible impact of exclusion from the use of ICT services and applications on e.g. family relationship, social interactions and contacts, personal care, social dominance and leadership. **References:** (SD1#36, SD1#10, SD3#15)	EAP#101) Study the economical and social effects of successfully implemented and of potential Accessible ICT solutions. (SD1#10, SD3#15, EAP#101) Analyse the chances, challenges, potential, limitations, and threats of upcoming ICT for Assistive Technology as well as for accessibility of mainstream ICT. (**SD1#36**) Study potential application fields of Assistive ICT, e.g. in vocational environments, leisure activities, networking of people, or disaster risk reduction. (SD3#32, SD3#46, SD3#74) Study potential application fields of Accessible ICT, e.g. in vocational environments, leisure activities, networking of people, or disaster risk reduction. (SD3#32, SD3#46, SD3#74).
Prerequisites: Identification of type(s) and likely implementation of foreseen functionalities in new ICT		***Accompanying policies:*** Create awareness of technology potential to support an inclusive life. (**SD1#36**) Embed the topics of "Accessibility" and "Assistive Technology" in engineering curricula. (SD1#84, SD3#04) Make mainstream industry aware of the market potential and the end-user base of Assistive and Accessible ICT products and services. (from SD1#18) Create awareness of end-user needs, technical requirements, and solutions concerning Assistive ICT and accessibility in mainstream industry. (SD1#24, SD1#54, EAP#142) Publish success stories on technology transfer and the development of Assistive ICT and of well Accessible ICT products/ services, including the success factors. (**SD1#71**, SD3#60) Require that all technological innovations and developments of Assistive ICT in funded R&D

		projects be explicitly checked whether they could contribute also to a more general accessibility in ICT. Require that all technological innovations and developments in funded Accessible ICT projects be explicitly checked with respect to their potential for Assistive Technology and vice versa. (**SD1#16**) Require that all technological innovations and developments are explicitly checked with respect to accessibility in general ICT projects; require that accessibility is considered in market-oriented analyses, plans, forecasts etc. Stimulate and support outstanding projects to publish success stories on technology transfer and the development of Assistive and Accessible ICT products/ services, including the success factors. (**SD1#71**) Select best practice examples of Assistive and Accessible ICT products/services on the market; describe their assistive features both, for technical developers and for end-users, and describe how end-users benefit from those features. Require from public funded Assistive ICT projects/studies to publish (as far as possible) the assistive functionality aspects of their R&D results and related know-how. Policies for favouring wide deployment of technological developments and their application to favour positive impact on social relationships Build a global public inclusive infrastructure. (**SD1#29**)
Existing resources: Presently available legislation and regulations about network-based	**Research action 13.2: Research on the ethical and legal requirements and consequences** The emergence of the information society and particularly of its instantiation as an AmI environment poses many	**Specific developments:** Quantification of the level of "intelligence" in an AmI environment Identification of level of autonomy to afford to intelligence agents

<table>
<tr><td>applications</td><td rowspan="2">problems from the ethical and legal perspectives.
Example of ethical and legal aspects are:
· Privacy of data. It is necessary to avoid that other people or systems get to know the user's intention and behaviour without their explicit authorisation;
· Security and reliability. This has some not technical aspects: for example it is important to decide who is responsible when the system acts on behalf of the user;
· Identification of the activities that people are free to carry out using ICT applications and of the information they are authorised to access;
· Dependence / independence of the user. For example, it is necessary to decide how far the AmI system is allowed to guide/ lead/ manipulate the user by making decisions for a person. In addition how "intention detection" and "intention suggestion" are related.
References: (SD3#89, SD3#24)</td><td>Identification of the person(s) responsible of the activities of the intelligent agents
Identification of the likely impact of ethical, legal and social implications of foreseen applications on the eInclusion opportunities (EAP#101).
Study the ethical implications of ICT and disability/aging in all life settings and devise practical mechanisms to enforce the adherence to ethical principles. (EAP#114)</td></tr>
<tr><td>Prerequisites:
Identification of emerging characteristics of AmI environment</td><td>Accompanying policies:
Legislation initiatives to protect all interested parties</td></tr>
<tr><td>Existing resources:
Extensive knowledge about eInclusion problems and solutions</td><td rowspan="2">Research action 13.3: Research on changing attitudes of different stakeholders towards eInclusion
Today there is already a lot of information, processes and work done to facilitate e-inclusion. But the dissemination and the implementation are far behind, most due to attitudes of the different actors.
Two sets of problems should be considered:
· The first is to understand why difficulties exist for the diffusions of the right information to all the stakeholders involved in the solution of eInclusion problems: users themselves, political representatives, researchers, designers, etc.
· The second is to investigate how the emerging network infrastructures and services could be used to change the attitudes of: all interested parties toward the acquisition and use of the available information.
References: (SD3#18, SD3#89, SD3#24)</td><td>Specific developments:
Collection and organisation of existing information
Socio-economic analyses of the eInclusion sector
Set up of services for dissemination of information adapted to the needs of the different stakeholders</td></tr>
<tr><td>Prerequisites:
Increased interest of the society for the problems of excluded people</td><td>Accompanying policies:
Political support of eInclusion
Raise ICT awareness and skills in the related fields of health and care (EAP#103)</td></tr>
<tr><td>Existing</td><td>Research action 13.4: Research</td><td>Specific developments:</td></tr>
</table>

<table>
<tr><td>resources:
Statistics of people with potential eInclusion problems
Knowledge about problems and possible solutions</td><td rowspan="2">on how to integrate social objectives in ICT
Even if, in principle, ICT is being developed for all human beings, in reality it cannot be forgotten that ICT is an industry driven area, therefore focused on getting the most profit to pay for necessary investments, e.g. in research and development. Unfortunately, specific groups of the population are often “forgotten”, namely those with more severe activity limitations.
There are groups of persons who experience severe problems in using ICT products, e.g. persons with complex communication needs and some other people who may not be able to communicate face-to-face or at distance, or other disfavoured people beyond disability and aging, such as illiteracy, cultural diversity and poverty.
It is crucial that ICT developers are convinced to take into account in their developments these potential users, too. This can be done with a combination of business-based consideration, i.e. showing that the number of persons that have these “communication” problems are increasing (especially older persons that become more and more isolated), so taking into account their needs could be important to increase the market of the problems and of regulatory and legislative actions.
References: (SD3#19)</td><td>Socio-economic studies of the potential market of eInclusion
Training of designers in industry
Education at the University level</td></tr>
<tr><td>Prerequisites:
Increased awareness about problems and solutions</td><td>Accompanying policies
Legislation about eInclusion</td></tr>
</table>

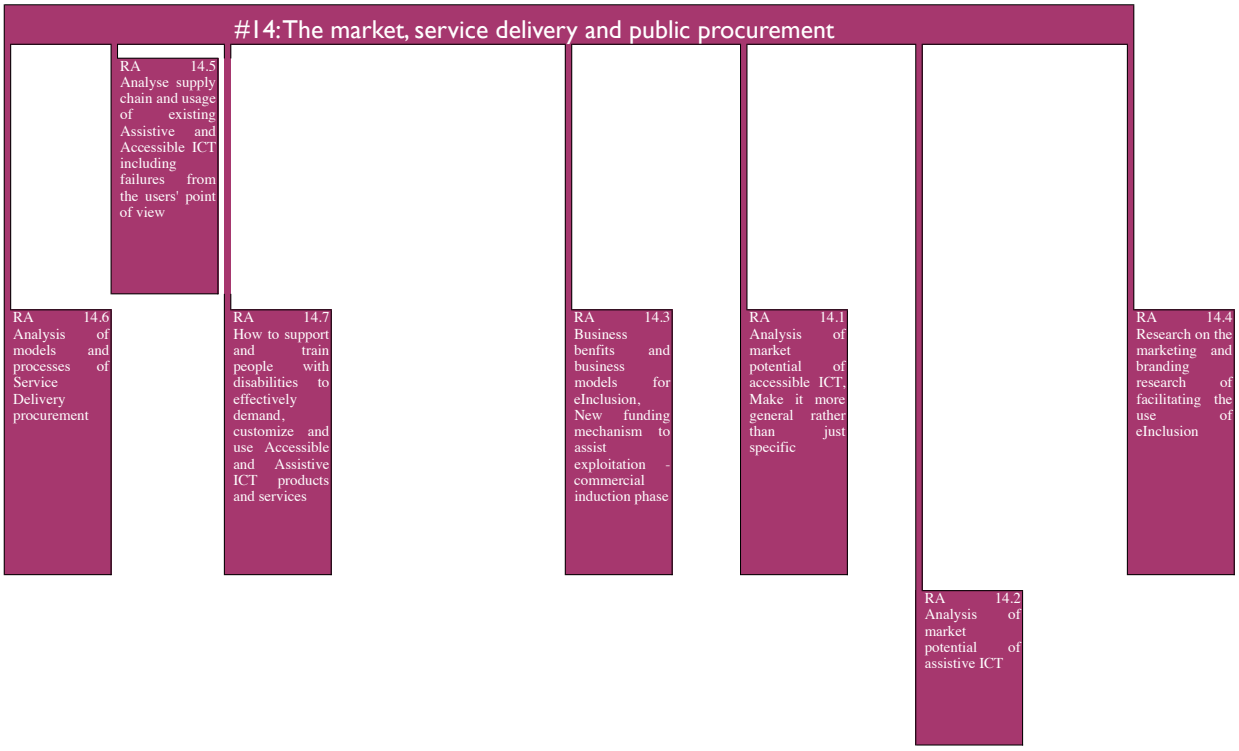


Figure 22: Graphic representation of research line 14

Table 15: Research line 14, The market, service delivery and public procurement

Research line # 14: Market, service delivery and public procurement Although market, business issues, and service delivery are not regarded as being part of the technology transfer process itself, they have significant influence on technology transfer, which is often guided by commercial considerations. A strong market demand for "accessibility of ICT products" or for "accessible ICT products" as well as for new and innovative "assistive ICT products and services" can stimulate and direct technology transfer and finally contributes to the financing of technology transfer. The improved accessibility of ICT products and significant innovation in Assistive ICT products can stimulate the market by addressing and reaching a greater number of potential customers. At the moment, the market for Assistive ICT in Europe is rather a local than a global one. It is highly fragmented. Service delivery models vary significantly between the EU member states. Often, different models are applied in parallel in a state. – This is even truer for countries outside the EU, especially developing countries.		
Existing resources: National and European funding programmes exist to support technology transfer to the market.	**Research action 14.1: Analysis of market potential of accessible ICT** Activities in eInclusion in recent years have shown that the "design for all" approach and the development of solutions for favouring people to access ICT systems, services and applications will not become a common practice if the advantage for industry from a business perspective is not proved. Demographic projections showing the impressive increase of older people in the near future do not appear to have the impact that many people working in the field hoped.	**Specific developments:** Provide accurate potential end-user data, including end-user needs, potential size of market demand, marketing requirements, service provision requirements, public procurement etc. in EU member states to developers (**SD1#46, SD1#61**, QTT#18, QTT#19) Analyse the market potential by increased/ improved

	References: (SD1#46, SD1#28, QTT#18, QTT#19, SD2#55, SD2#61)	accessibility of mainstream ICT products and services. (**SD1#28**) Identify human factors barriers to demand accessible ICT products and services. (SD2#55) Explore ways to move from purchase to lease or renting accessibility technology. (SD2#61) Consider also countries outside the EU, e.g. developing countries, which could have a big market potential.
Prerequisites: Analysis of user needs Analysis of public procurement methods in member states		**Accompanying policies:** Harmonization of accessibility requirements in public procurement of ICT products and services among EU member states. Improve links to growing markets with strong ICT involvement, e.g. the e-health market (SD1#48). Create a EU market place for ICT accessibility: products and services including technological knowhow and advice, training, information, technical solutions, development & test environments etc. New funding mechanism to assist in exploitation – commercial introduction phase (SD1#49).
Existing resources: Demographic studies	**Research action 14.2: Analysis of market potential of assistive ICT** Apparently, demographic data and some single examples, are not considered sufficient evidence of possible economic advantages for industry. Due to the demographic change and the growing lack of qualified caring personnel, it can be expected that the consumers' demand for AT products will increase in the next decade. There are many SMEs active in the field of assistive ICT. Their typical strength is that they work close to the end-users, that they are flexible and innovative. A typical weakness is their only small budget	**Specific developments:** Collect and analyse market data, consumers, resellers and providers of Assistive technologies. (QTT#15, SD2#55) Explore ways to move from purchase to lease or renting accessibility technology. (SD2#61) Analyse the chances and potential barriers in bringing new Assistive ICT to the market. (SD1#50) Consider also countries

	for market research and, as a consequence, an only limited knowledge about the market potential of their product ideas, which can be a high risk for small companies. This research action aims at providing data about the assistive ICT market and knowledge about ways for the market introduction of innovative ICT developments. **References:** (QTT#15, SD2#61)	outside the EU, e.g. developing countries, which could have a big market potential.
Prerequisites: Analysis of user needs		**Accompanying policies:** Analysis of service delivery and public procurement methods in member states (**SD1#61**) Foster the harmonization of procurement and service delivery of Assistive Technology products and services among EU member states. Work towards a global, at least European, market for Assistive ICT. (SD1#50) Simplify and harmonise certification requirements and procedures for new ICT-based technical aids and services. Improve links to growing markets with strong ICT involvement, e.g. the e-health market. (SD1#48) Progressively financially support the product development of innovative Assistive ICT until marketing. (SD1#8, SD1#13) Fund or support the commercial introduction of innovative Assistive ICT products, especially if they come from funded development projects. (SD1#8, **SD1#49**) Require and monitor business plans of funded development projects in Assistive ICT. Create an EU market place for Assistive ICT: products and services including technological knowhow and advice, training, information, technical solutions, development & test environments etc.
Existing resources: National and European funding programmes	**Research action 14.3: Business benefits and business models for eInclusion** e-Accessibility and e-Inclusion experts argue	**Specific developments:** Elaborate business models for e-inclusion and the commercial introduction of innovative accessible mainstream ICT

exist to support technology transfer to the market.	not only for ethical, social and social-economic benefits of investments in the area, but also for their business benefit for mainstream providers of systems, services and applications. Therefore, in addition to studies on on-going social and social-economic benefits, it is necessary to carry out activities able to provide data and generate business models able to show return of investments, sufficient to motivate them in the eInclusion environment. **References:** (SD3#33, **SD1#49**)	products. (**SD1#49**, SD3#33, EAP#105, EAP#114) Models of market developments Explore ways to move from purchase to lease or renting accessible ICT; research on how to make accessibility simpler to deliver, apply, configure, support and use (SD2#61, SD2#70) Case studies (successful eInclusion products) Study of increased quality and acceptability of new technology by all users, when incorporating feature of interest in the eInclusion area Study where and how to effectively support companies in the commercial introduction phase of assistive and accessible ICT products (**SD1#49**).
Prerequisites: Increased emphasis on the social dimension of industry RA 14.1 Analysis of market potential of accessible ICT RA 14.2 Analysis of market potential of assistive ICT		**Accompanying policies:** Legislation about eInclusion Description Offer incentives to suppliers who offer effective accessible products and services to the public (SD1#20). Require in business plans of funded development projects on ICT to declare how "accessibility" will be marketed.
Existing resources: Knowledge about problems and solutions Market strategies Publicity	**Research action 14.4: Research on the marketing and branding for facilitating the use of eInclusion** Some industrial companies do not want to appear as working in the eInclusion sector or to have products that can be classified in this area for several reasons, e.g. because they fear to be classified not sufficiently "mainstream" to produce elegant and up-to-date products, or they think that people may think that their products, due to investment for special feature, are more expensive and so on. They also want to avoid the image of sickness and disability and this is also a concern of some	**Specific developments:** Socio-economic studies Development of strategies for presenting features useful for eInclusion, for example adaptability and adaptivity, as useful for all Publicity strategies to make the above features fashionable Ways of marketing the "accessibility" of a mainstream ICT product as a quality feature (SD1#75, QTT#14).

Prerequisites: Increased emphasis on the social dimension of industry	people with activity limitations who would like to appear as using the same technology that all other people use. Therefore, it is necessary to develop strategies of branding and marketing the technology as useful for independent living and access to society for everyone, showing the advantages of using systems, for example able of adaptations, for everybody from children to aged people. **References:** (SD3#85, SD1#75)	**Accompanying policies:** Create a certified quality label for "certified accessibility", including the necessary infrastructure. Inform customers or end-users on the accessibility of mainstream ICT products and services. (QTT#2) Publicity campaigns to show usefulness for all of eInclusion features Train end-users to use innovative ICT products. (QTT#20) Ensure that the installation and configuration of ICT products and services is well done with respect to accessibility; provide special briefing, training and instruction materials. (QTT#16, QTT#17)
Existing resources: Only few studies on Assistive Technology abandonment Statistical data on the provision of technical aids (from insurance companies and financing organisations)	**Research action 14.5: Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view** There is a lack of understanding where and why ideas fall over or go wrong in the supply chain and service delivery, why assistive and accessible products and services are not used as originally intended. This research action aims at analysing the end-users' acceptance and usage of provided assistive and accessible ICT systems, including the extent to which accessibility features of public and private e-services are really used, and the factors that do or may lead to failures in the provision and use of assistive and accessible ICT systems and services. **References:** (SD1#01, SD2#64, SD3#81)	**Specific developments:** Explore the user acceptance and real usage of delivered ICT-based technical aids & services. Explore whether available / delivered technical aids meet the intended purpose for the user or the user's expectations, respectively. Develop mechanisms to assess customer satisfaction with the service delivery process. How to achieve the "well-informed" customer. Explore effective ways of customer information and advice. Explore the user acceptance and real usage of accessible ICT-based mainstream products & services.
Prerequisites: Explore user needs for ICT-based technical aids & services Standard		**Accompanying policies:** Emphasize ethical considerations in service delivery. (QSD#14) Emphasize holistic research and establishment of

classification of AT systems and list of AT abandonment motivations to allow worldwide studies Case studies of successful use of AT in workplaces (EEX#102).		frameworks that are impacting the entire value-delivery chain. (EAP#132)
Existing resources: Comparative studies on service delivery of assistive technology Progress studies of accessibility of ICT systems in the EU countries Current experiences in leasing or renting AT products AAATE / EASTIN workshop "Service Delivery Systems on Assistive Technology in Europe Analysing and federating the European assistive technology ICT industry. European Commission [Stack 2009]	**Research action 14.6: Analysis of models and processes of Service Delivery and procurement** This research action aims at developing ways of improvement with respect to effectiveness, efficiency and quality of service delivery and procurement, based on the analysis of current practices and frameworks in the EU member states. **References:** (SD1#61, QTT#16, QTT#17, SD2#61, SD2#70)	**Specific developments:** Analysis of procurement methods of assistive ICT in the member states. (SD1#61, QSD#06, QSD#10) • Analyse the impact of different service delivery and funding models. • Research for chances to improve the service delivery and the service infrastructure. • Explore alternative ways of service delivery of Assistive ICT products and services, e.g. in the context of cloud computing and mobile computing. (QSD#03) Explore alternative ways of financing service delivery of assistive ICT; e.g. Explore ways to move from purchase to lease or renting Assistive ICT. (SD2#61, SD2#70) • Explore alternative ways of financing the provision of Assistive ICT products. • Provide efficient overviews on market supply and market development of ICT-based technical aids and services for the financing organisations. Explore ways of effective quality assurance in service delivery of assistive ICT. (QTT#16, QTT#17, QSD#05, QSD#16) • Assure the quality of service delivery. Provide quality standards and

		quality measurements. • Research for efficient assessment and evaluation methods of service delivery. • Assess the outcome of service delivery, e.g. wrt.: more autonomy, reduced needs for personal care, improved user activity and participation in society, sustainability of provision, product development. • Research on the involvement of the users/customers in the service delivery process, e.g. user information and advice, user needs and satisfaction assessment, and ways to improve it, and user-driven approaches. (QSD#01, QSD#02) Mechanisms and procedures to improve the provision and configuration of Assistive ICT products and services; provide special briefing, training and instruction materials for suppliers and end-users. (QTT#16, QTT#17) Ensure that (harmonized) accessibility criteria are well applied in public procurement policy (SD1#42)
Prerequisites: None		**Accompanying policies:** Simplify and harmonize regulations for the provision of ICT-based technical aids and services. (QSD#04) Develop a regulatory framework (EAP#104) Design of AT products that can be accommodated to a wide range of user needs to allow their reuse
Existing resources: Public database systems on technical aids Advice centres	**Research action 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services** Often end-users find themselves in a passive	**Specific developments:** Mechanisms and methods – as integral part of the service delivery / procurement process – to:

for technical aids	role in the service delivery process or in the usage of assistive or accessible ICT systems. There are a number of reasons for this; e.g. a lack of awareness of the opportunities of assistive and accessible ICT systems, an inability to express in detail the own needs and requirements, a lack of information and independent advice, the complexity of the service delivery process with its various, often not well cooperating players in the medical / therapeutical / technical / commercial / financing fields, a lack of understanding or training to adapt and effectively use assistive and accessible ICT systems. Other barriers are sometimes the burden (time) of learning new things without an obvious benefit for the person. This is especially true for elder people. This research action aims at developing methods or mechanisms to strengthen and to support end users to play a more active role in the whole service delivery process and in the usage of "potentially accessible" ICT systems. **References:** (QTT#20, SD1#39, QTT#1, SD2#70, SD3#62)	• train end-users to better understand their accessibility requirements (QTT#01, EAP#107) • to inform / give advice to end-users about the potential and availability of assistive and accessible ICT • train end-users to use innovative assistive ICT products (QTT#20, EAP#107, EAP#112) • inform / train end-users to adapt accessible ICT products
Prerequisites: RA 8.1 Analyse end-user needs and personal barriers with respect to ICT RA 14.5: Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view RA 14.6: Analysis of models and processes of Service Delivery and procurement		**Accompanying policies:** User participation in the development of new assistive and accessible ICT Define new community-based training programmes leveraging the potential of new technology-based assistive environments. (EAP#112, QSD#11)

5 The overall Research Agenda Roadmap (step 9)

The top level and overall CARDIAC Research Agenda Roadmap is formed by bringing together the 14 research lines. An overall view is shown in Figure 23, below, where the detailed descriptions of the research actions have been stripped out for reasons of legibility.

A two-page version with the descriptions of the research actions is shown in figures 24 and 25, with figure 24 showing the top half of the roadmap with the first 7 research lines and figure 25 showing the bottom half of the roadmap with research lines 8 to 14.

As already mentioned, the placement of the research actions has been guided by the results of the three SDDPs, so for example, the 14 research actions in the first three columns are located at the bottom levels of the influence trees. As a reminder, these research actions were found, through the SDDP structuring methodology, to have the most influence and potential positive impact on the other research actions, and it is for this reason that they should be undertaken as a priority and are thus located on the left hand side of the roadmap. Conversely, the longer term research actions on the right hand side of the roadmap were located at the top level or levels of the SDDP influence trees.

There is no meaning to be found in the vertical placement of the research actions. This was purely done in such a way as to fit all the research actions into the roadmap in the most space-efficient manner, whilst splitting the roadmap into two halves, each containing 7 of the research lines.

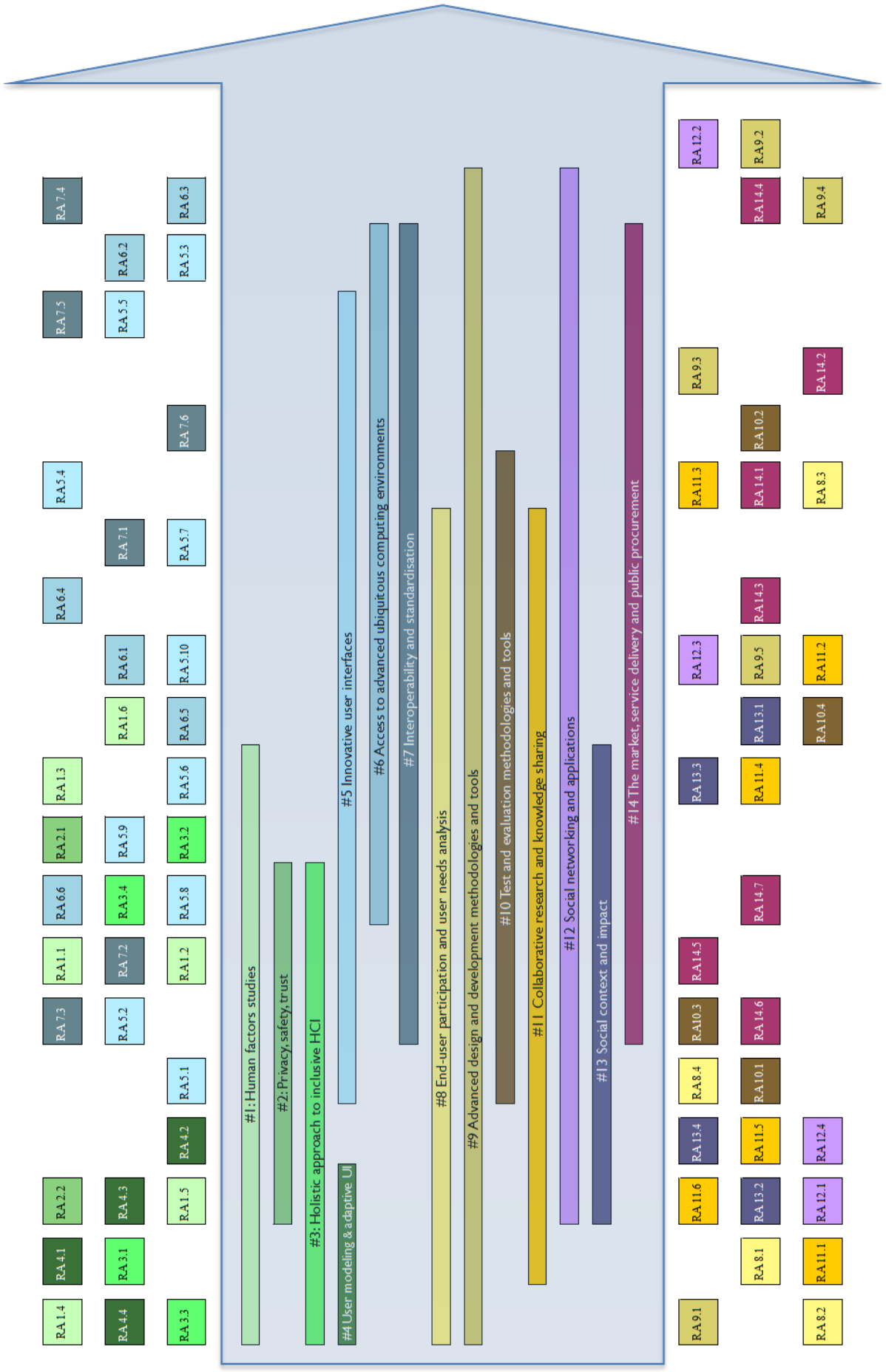


Figure 23: Overall view of CARDIAC Research Agenda Roadmap in accessible and assistive ICT

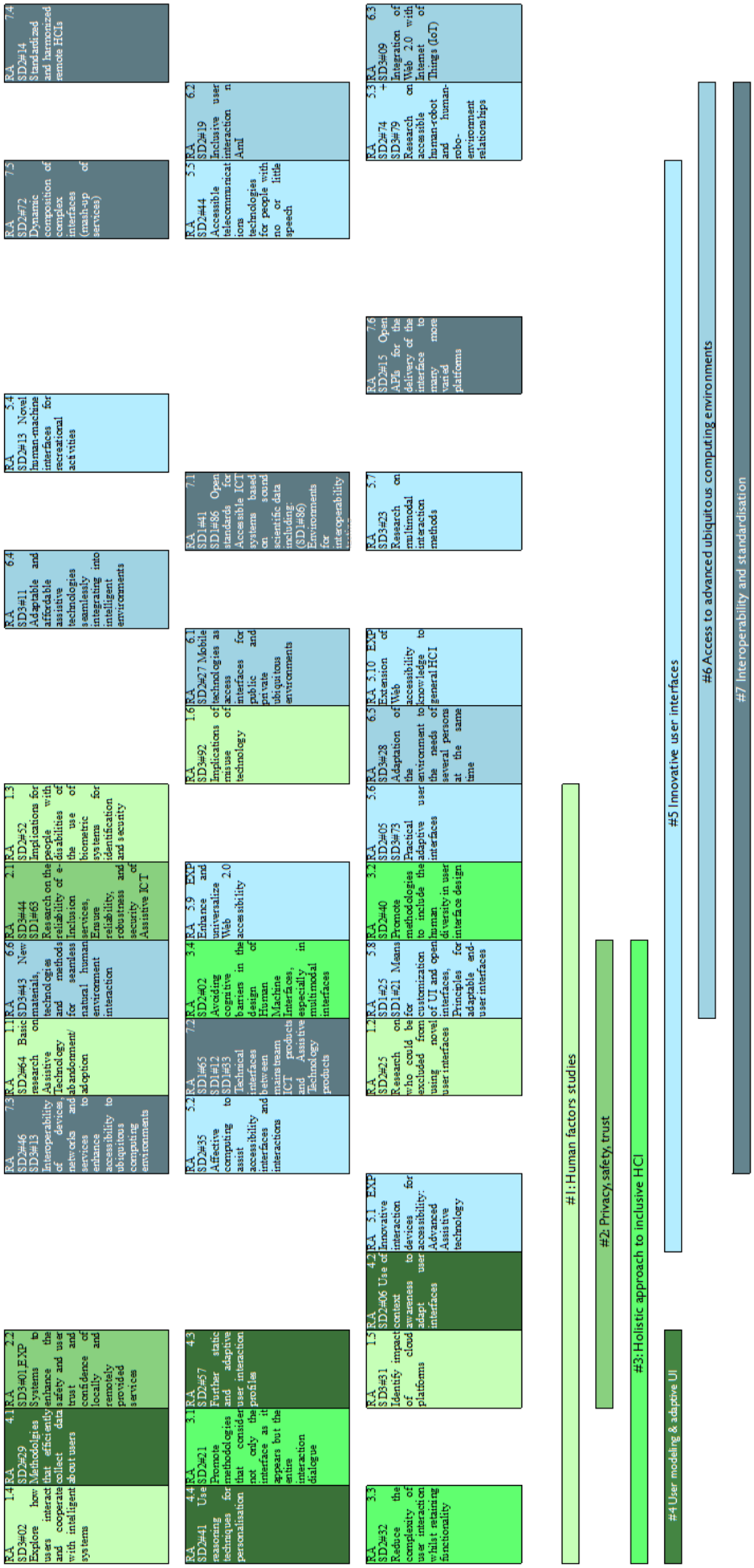


Figure 24: Top half of CARDIAC Research Agenda Roadmap, with descriptions

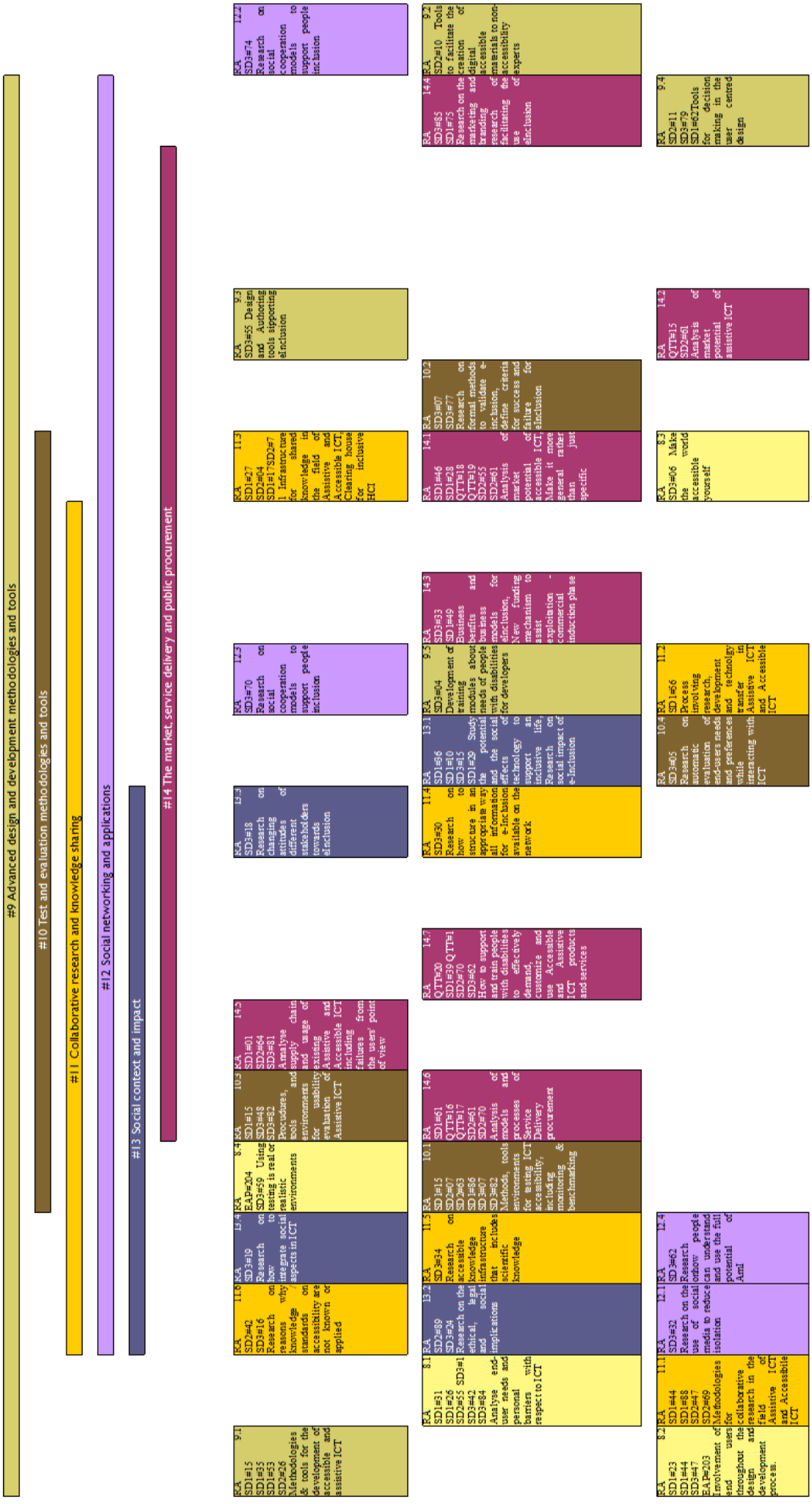


Figure 25: Bottom half of CARDIAC Research Agenda Roadmap with descriptions

6 Application of the CARDIAC Roadmap to two areas of Smart Homes and eLearning (step 10)

Two studies have been carried out, reviewing in detail the research actions of the CARDIAC Research Agenda Roadmap, with a view of assessing how relevant or not they were to their particular fields.

In the case of the eLearning study, the research actions were reviewed and filtered according to whether they were relevant or not to the field of eLearning. The detailed process has been reported on in deliverable D4.3. A simplified Research Agenda Roadmap can thus be generated for the field of eLearning and is shown in Figure 26.

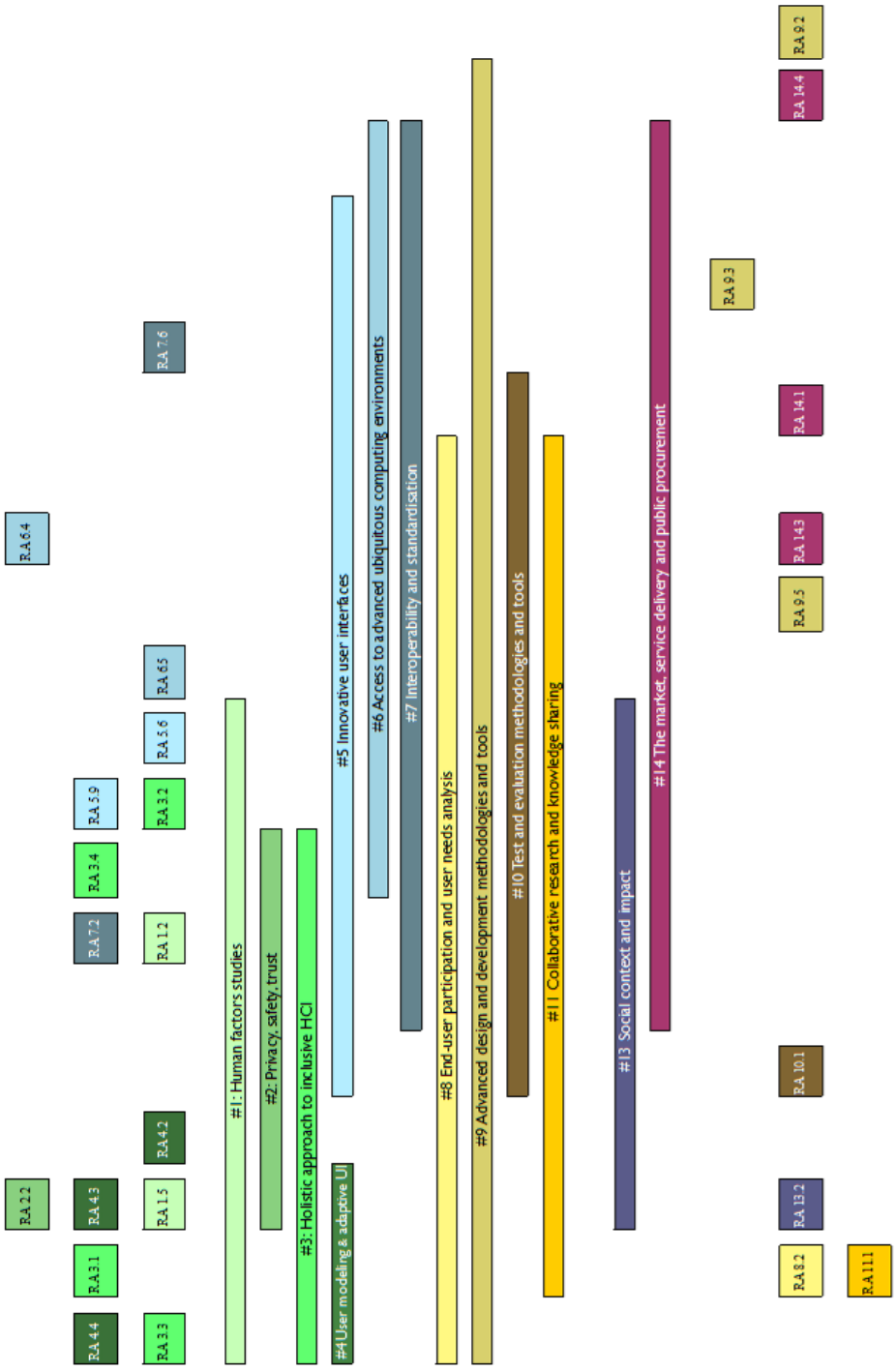


Figure 26: Simplified Research Agenda Roadmap in the field of eLearning

In the case of the Smart Homes case study, a more complex filtering process was carried out with 4 possible cases: 1) not so relevant for the area of smart home technology, 2) input from the areas described in the CARDIAC roadmap is useful input for the area of smart home technology, 3) input from the area of smart home technology is useful input for the CARDIAC roadmap and 4) areas where the two areas could 'team up' and jointly achieve results. The detailed process is reported on in deliverable D1.4.

From this filtering and analysis process, a new combined roadmap for each of the research lines was generated where any major research action in the area of smart homes, which was not mentioned in the CARDIAC roadmap, has been added. The individual roadmaps for each of the research lines were then grouped into five clusters. The roadmaps for these five clusters are shown in figures 27 to 31.

Where a research action box from the original CARDIAC Research Agenda Roadmap is removed from the smart homes roadmap, this corresponds to case 1: not so relevant for the areas of smart homes.

Where the arrows go from one of the original research action boxes from the CARDIAC research Agenda Roadmap to a red box, this corresponds to case 2: input from the areas described in the CARDIAC roadmap is useful input for the area of smart home technology

Where the arrows go from a red box to one of the research action boxes from the original Research Action Roadmap, this corresponds to case 3: input from the area of smart home technology is useful input for the CARDIAC roadmap.

Where the boxes 'piggy-back' on top of each other with a blue strip in between, this corresponds to case 4: areas where the two areas could 'team up' and jointly achieve results.

The yellow boxes are new research actions specific to the field of smart homes.

Where a research action box from the original CARDIAC Research Agenda Roadmap is left on its own this may become relevant to the smart homes are and has been left in the roadmap with no arrows (see 'Attachment 1' of deliverable D1.4 for more details).

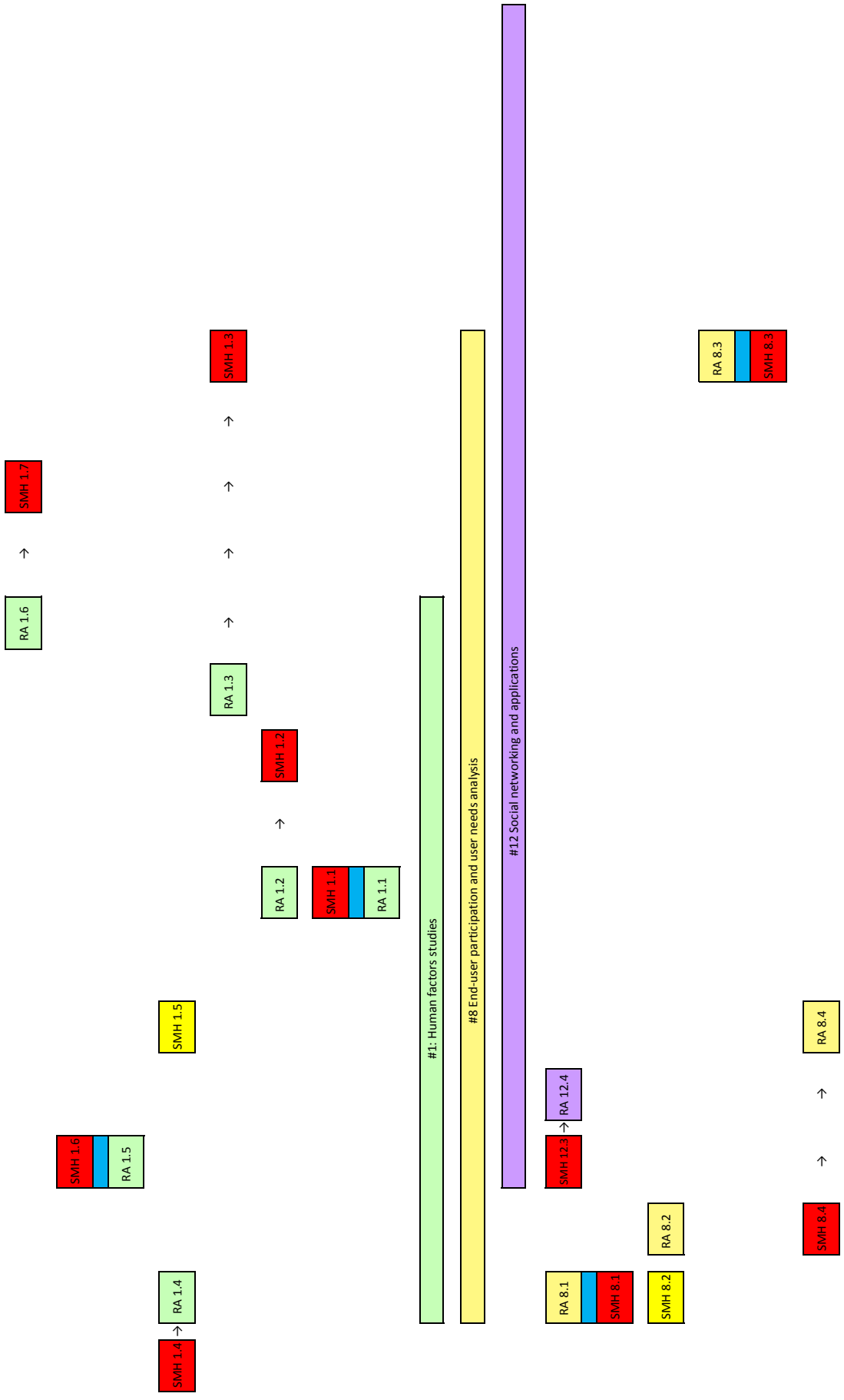


Figure 27: Smart homes roadmap for cluster on user-centred design (RL#1, RL#8 and RA#12.4)

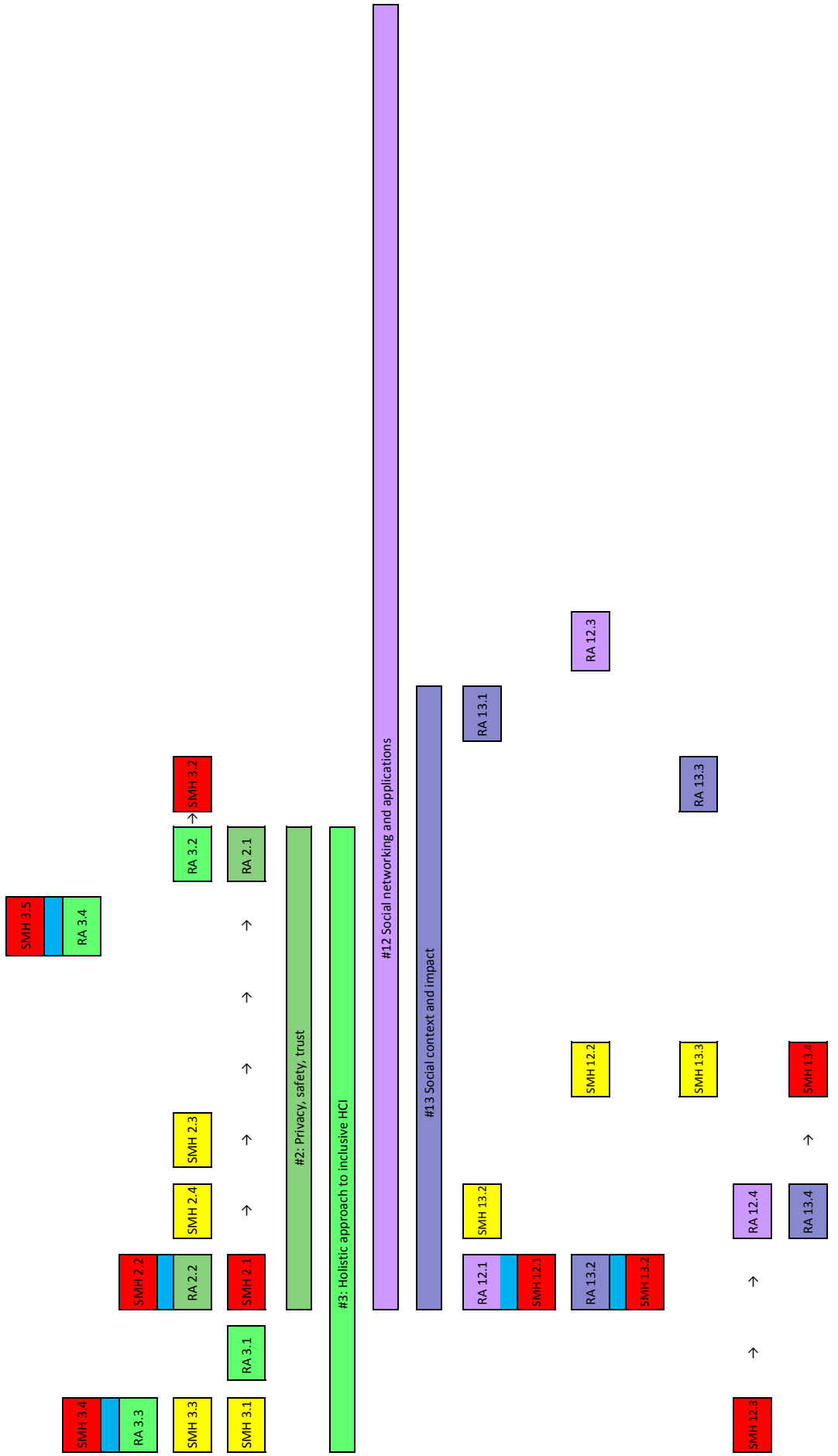


Figure 28: Smart homes roadmap for cluster on service development (RL#2, RL#3, RL#12 and RL#13)

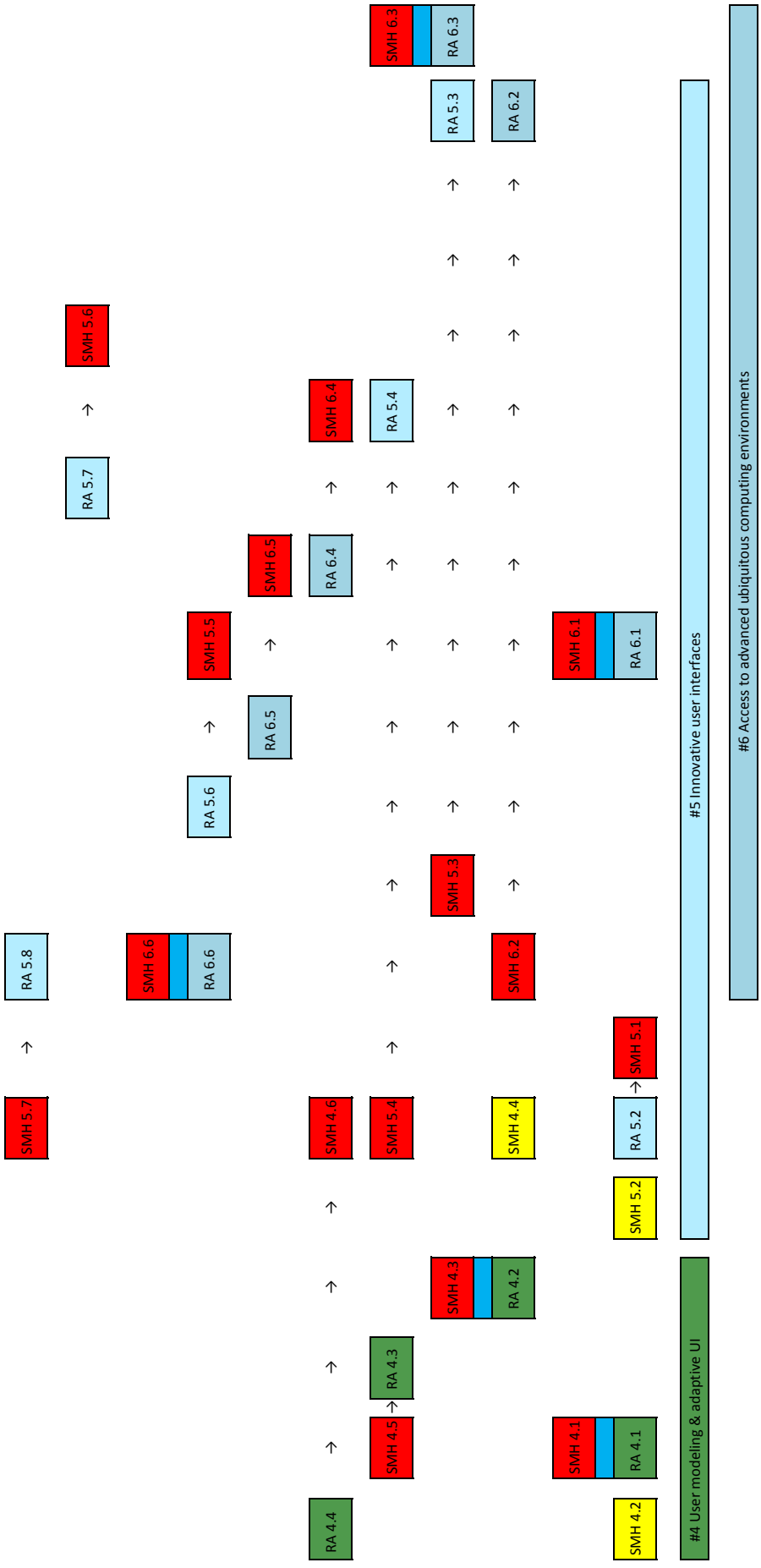


Figure 29: Smart Homes roadmap for cluster on human environment interaction (RL#4, RL#5 and RL#6)

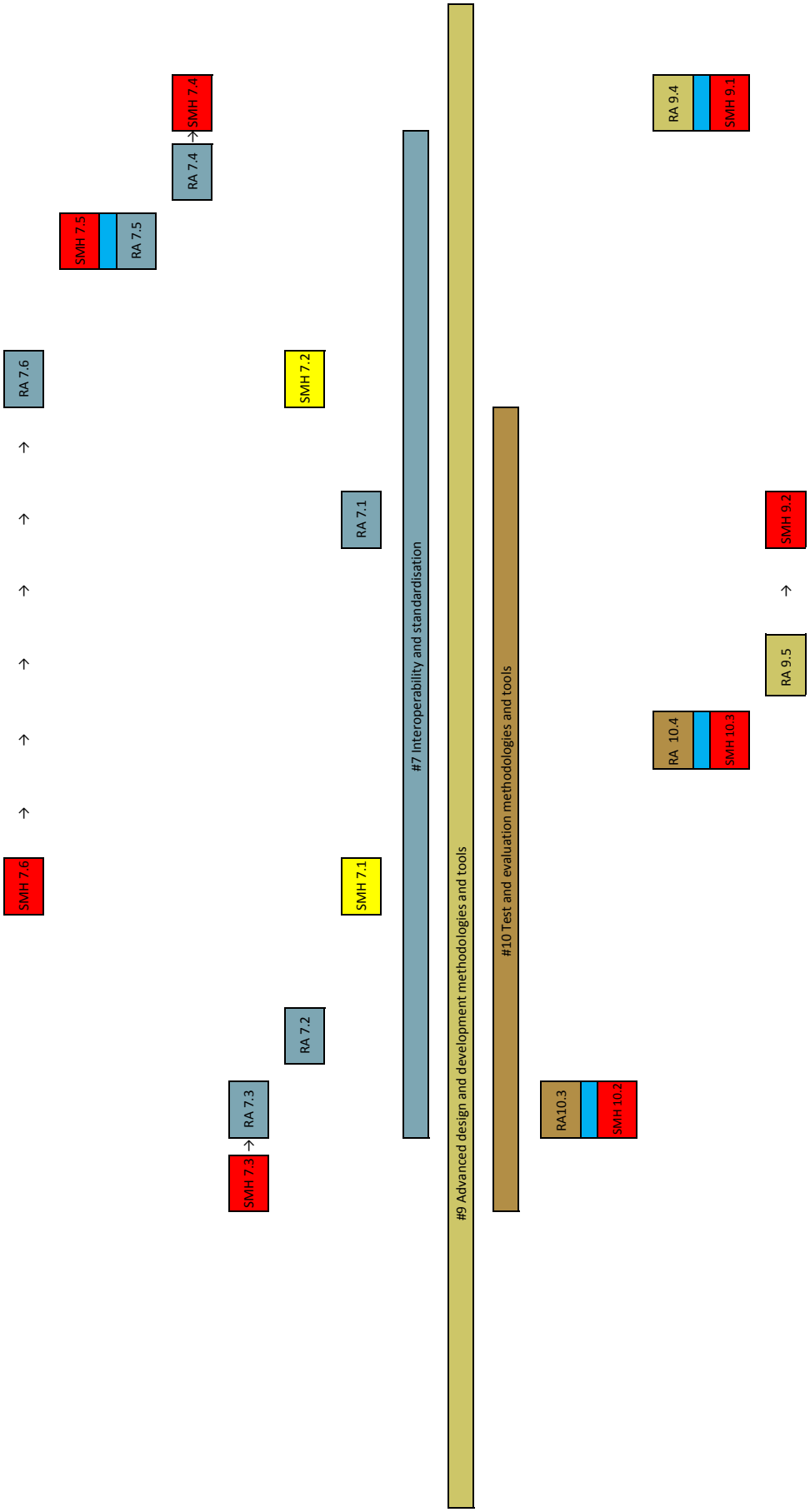


Figure 30: Smart Homes roadmap for cluster on technical requirements and testing (RL#7, RL#9 & RL#10)

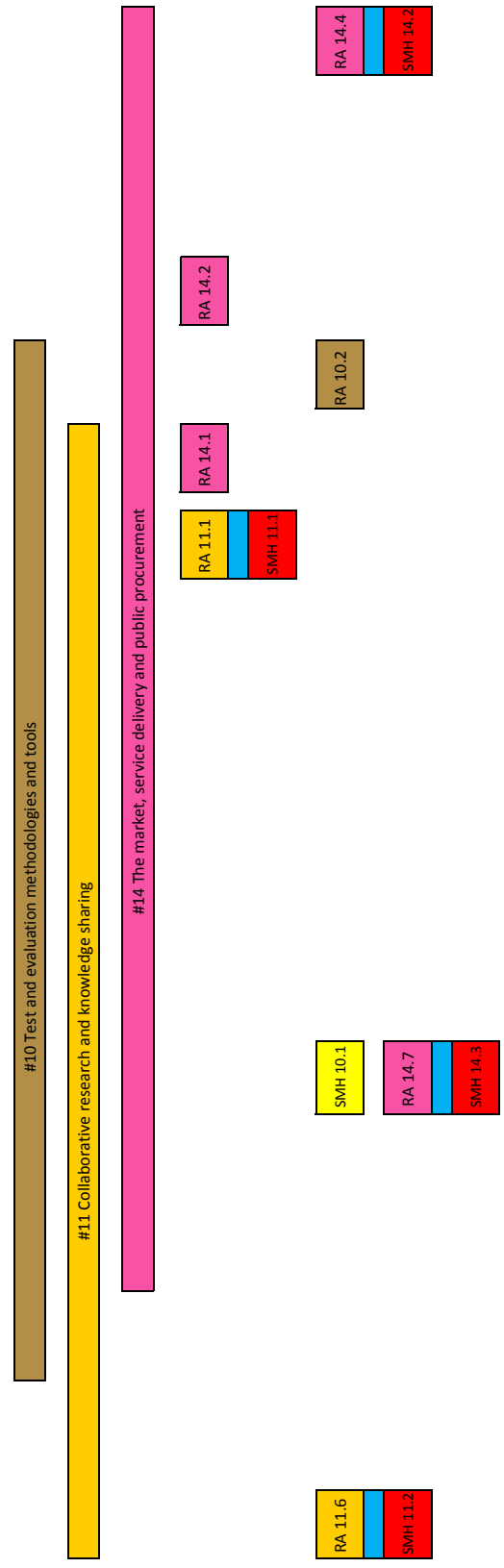


Figure 31: Smart Homes roadmap for cluster on business strategy (RA#10.2, RL#11 and RL#14)

Summary

The findings from the studies on Smart Homes and eLearning have showed that the CARDIAC Research Agenda Roadmap can be applied and extended to more specific fields even though the roadmap has been drafted with the broader perspective of accessible and assistive ICT in mind.

7 Main results from consultation on research priorities from the CARDIAC Research Agenda Roadmap (step 11)

Step 11 of the road-mapping process involved two parts: presenting the CARDIAC Research Agenda Roadmap and consulting with a wide range of stakeholders with a view of selecting priorities amongst the 14 identified research lines.

The roadmap was launched at the final conference in London on the 22nd of January 2013 and an html version was uploaded to the project website just ahead of the final conference. For the consultation part of step 11, a questionnaire was drafted and widely circulated (more than 250 copies sent out), both before, during after the final conference. A total of 53 responses were received from all 10 groups of identified stakeholders. The detailed findings and analysis of the responses to the questionnaire are reported in deliverable D2.4. Table 16 below summarises the overall rankings according to the six different aspects of impact, probability (or requiring public funding), feasibility, impact and probability (averaged), impact and inverse probability (averaged) and the Mean of Means of impact, probability and feasibility. The six graphs shown in figures 32 to 37 graphically illustrate the rankings and scores.

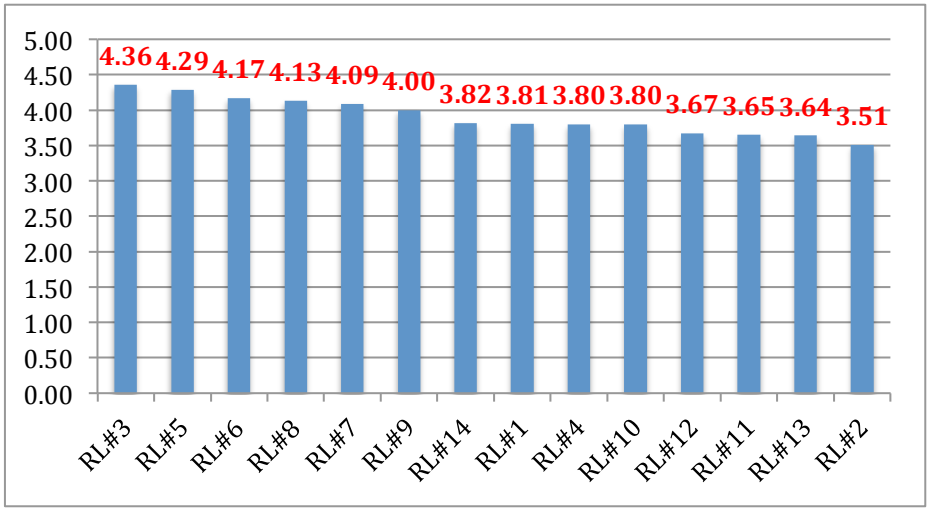


Figure 32: Overall ranking of the research lines according to impact scores at full scale

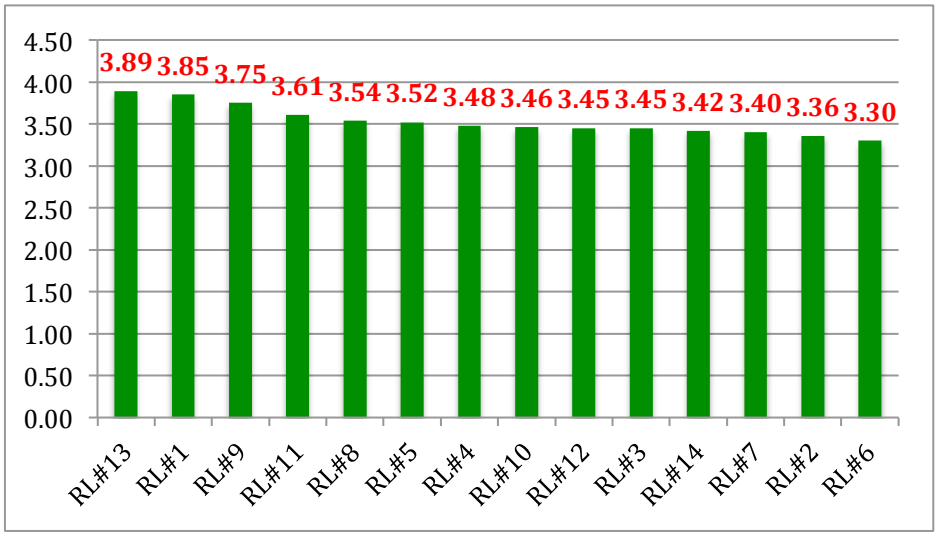


Figure 33: Overall ranking of the research lines for probability scores at full scale

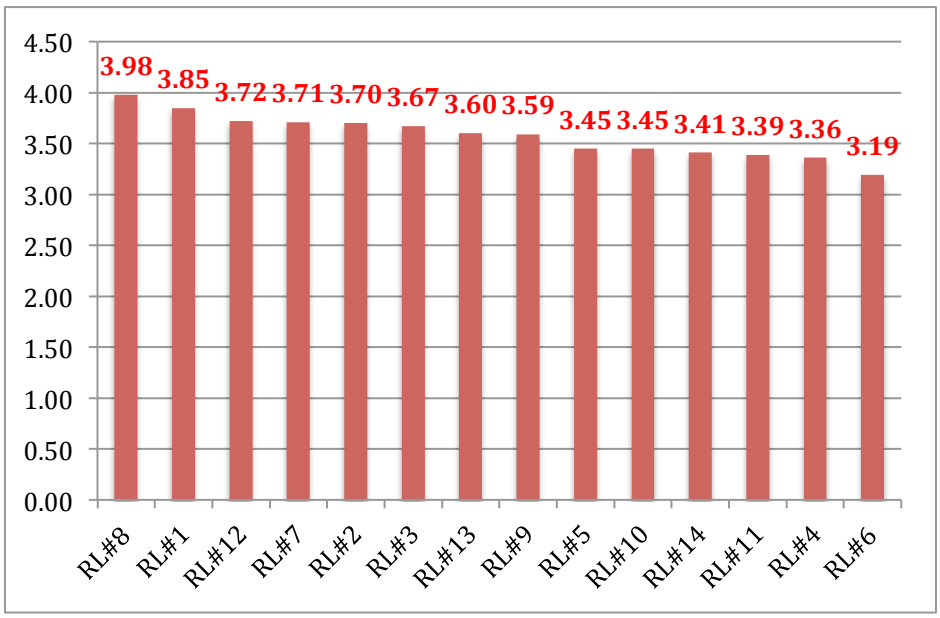


Figure 34: Overall ranking of the research lines according to feasibility scores at full scale

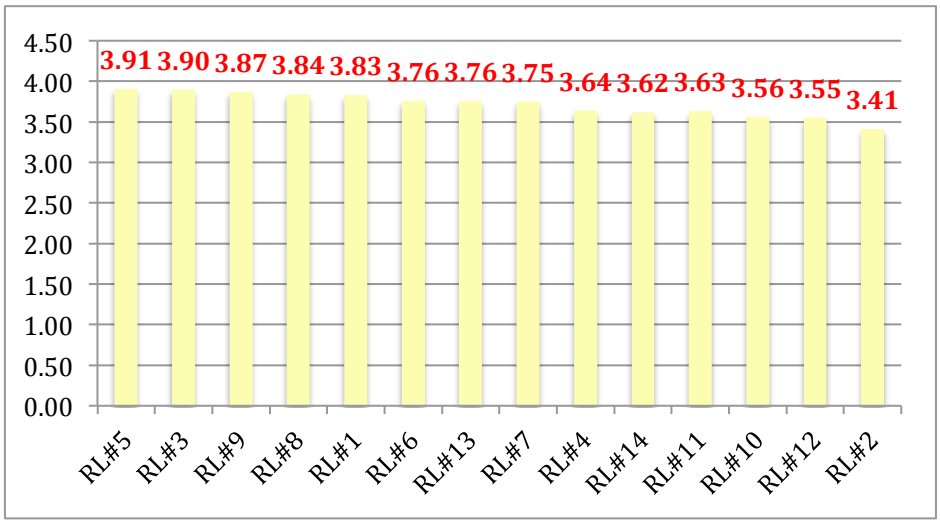


Figure 35: Overall ranking of the research lines for combined impact and probability scores at full scale

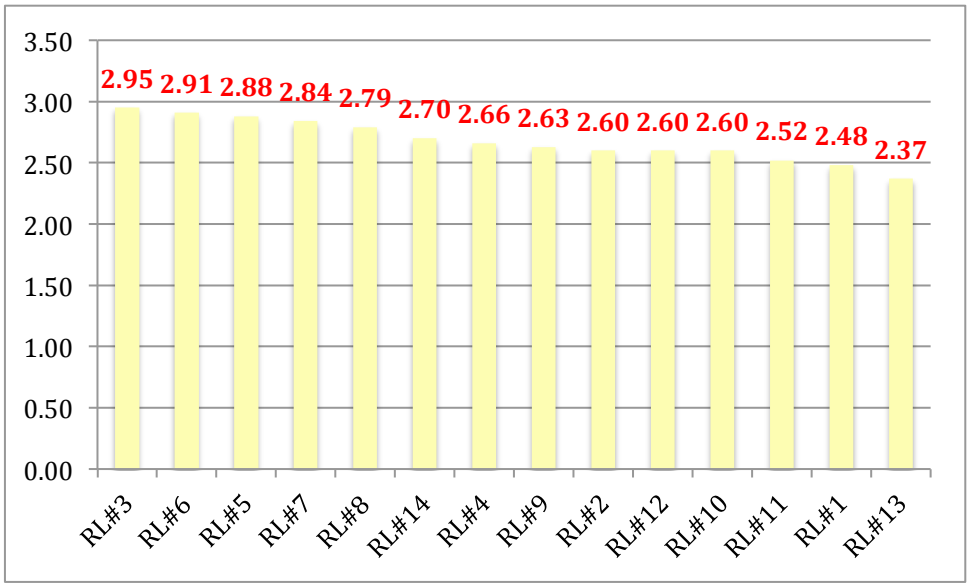


Figure 36: Overall ranking of the research lines for combined impact & inverse probability scores at full scale

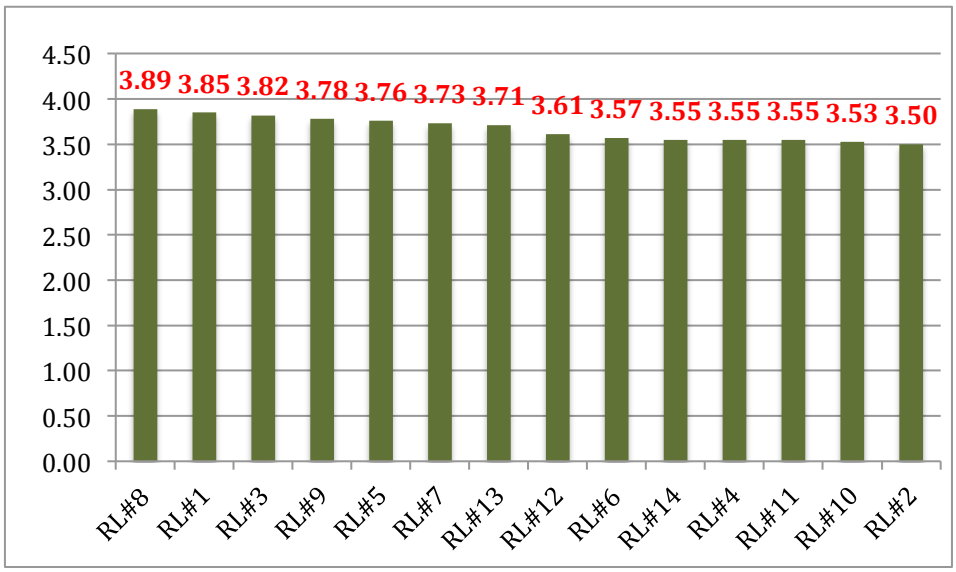


Figure 37: Overall ranking of the research lines according to Mean of Mean scores at full scale

Table 16: Overall table of rankings and scores of research lines

Ranking	Impact	Probablity	Feasibility	Impact & Probability	Impact & inverse Probability	Mean of Means
1	RL#3	RL#13	RL#8	RL#5	RL#3	RL#8
	4.36	3.89	3.98	3.91	2.95	3.89
2	RL#5	RL#1	RL#1	RL#3	RL#6	RL#1
	4.29	3.85	3.85	3.90	2.91	3.85
3	RL#6	RL#9	RL#12	RL#9	RL#5	RL#3
	4.17	3.75	3.72	3.87	2.88	3.82
4	RL#8	RL#11	RL#7	RL#8	RL#7	RL#9
	4.13	3.61	3.71	3.84	2.84	3.78
5	RL#7	RL#8	RL#2	RL#1	RL#8	RL#5
	4.09	3.54	3.70	3.83	2.79	3.76
6	RL#9	RL#5	RL#3	RL#6	RL#14	RL#7
	4.00	3.52	3.67	3.76	2.70	3.73
7	RL#14	RL#4	RL#13	RL#13	RL#4	RL#13
	3.82	3.48	3.60	3.76	2.66	3.71
8	RL#1	RL#10	RL#9	RL#7	RL#9	RL#12
	3.81	3.46	3.59	3.75	2.63	3.61
9	RL#4	RL#12	RL#5	RL#4	RL#2	RL#6
	3.80	3.45	3.45	3.64	2.60	3.57
10	RL#10	RL#3	RL#10	RL#14	RL#12	RL#14
	3.67	3.45	3.45	3.62	2.60	3.55
11	RL#12	RL#14	RL#14	RL#11	RL#10	RL#4
	3.65	3.42	3.41	3.63	2.60	3.55
12	RL#11	RL#7	RL#11	RL#10	RL#11	RL#11
	3.64	3.40	3.39	3.56	2.52	3.55
13	RL#13	RL#6	RL#4	RL#12	RL#1	RL#10
	3.63	3.36	3.36	3.55	2.48	3.53
14	RL#2	RL#2	RL#6	RL#2	RL#13	RL#2
	3.51	3.30	3.19	3.41	2.37	3.50

The main findings to emerge from the questionnaire responses are:

1. **The difference between the scores for all 6 aspects is quite small**, indicating that none of them stood out as having by far the greatest (or least) impact or being by far the most (or least) probable or feasible. As can be seen, the difference between the highest and lowest scores were: 0.85 for impact, 0.59 for probability, 0.79 for feasibility, 0.51 for impact and probability (averaged), 0.58 for impact and inverse probability and 0.39 for the Mean of Means.
2. **All research lines were considered to have a high or quite high potential impact** with even the lowest ranked research line (RL#2) scoring 3.51 for impact. This indicates that none of the research lines should be removed from the roadmap even if some priorities did emerge between the research lines from the responses received
3. **The six highest ranking research lines in terms of impact** were, in descending order: RL#3 'Holistic approach to HCI', RL#5 'Innovative user interfaces', RL#6 'Access to advanced ubiquitous computing environments', RL#8 'End-user

participation and user needs analysis', RL#7 'Interoperability and standardisation' and RL#9 'Advanced design and development methodologies and tools'. All six of these research lines received a score of 4 or above

4. The probability scores awarded are the most closely bunched together of the three individual questions asked (impact, probability and feasibility) with a difference between the highest and lowest score of only 0.59. This indicates that the respondents were of the opinion that **all research lines will, to some extent, require public funding**. The six highest ranking research lines in terms of requiring public funding were, in descending order: RL#13 'Social context and impact', RL#1 'Human factors studies', RL#9 'Advanced design and development methodologies and tools', RL#8 'End-user participation and user needs analysis', RL#11 'Collaborative research and knowledge development' and RL#5 'innovative user interfaces'. All six of these research lines received a probability score above 3.5
5. The feasibility scores are also quite closely grouped together within a range of 3.19 to 3.91, indicating that **all research lines were deemed of comparable feasibility**
6. The feasibility scores are within a range of 3.19 to 3.91, indicating that **all research lines were deemed to be quite feasible**
7. The ranking of the combined impact and probability scores are closely grouped together with a difference between the highest and lowest average scores of only 0.5. **The top eight research lines all had a score above 3.75, and are, in descending order:** RL#5 'Innovative user interfaces', RL#3 'Holistic approach to HCI', RL#9 'Advanced design and development methodologies and tools', RL#8 'End-user participation and user needs analysis', RL#1 'Human Factors studies', RL#6 'Access to advanced ubiquitous computing environments', RL#13 'Social context and impact' and RL#7 'Interoperability and standardisation'. These figures indicate that the respondents consider that **these eight research lines should be a research priority for public funding bodies**
8. The ranking of the combined impact and inverse probability scores are closely grouped together with a difference between the highest and lowest average scores of only 0.58 and closely match the previous ranking of combined impact and probability with 4 out top 6 research lines remaining the same with just RL#7 'Interoperability and standardisation' and RL#14 'The market, service delivery and public procurement making' into the top six research lines. **This seems to indicate that the research priorities for the private sector are quite similar to those of the public sector**
9. All the research lines were attributed a Mean of Means score of at least 3.50 indicating that **all fourteen of the research lines were deemed by the respondents to have high or quite high potential impact, be readily implementable and have a fairly high probability of requiring public funding**. The seven research lines selected by the respondents with the highest Mean of Mean score are, in descending order: RL#8 'End-user participation and user needs analysis', RL#1 'Human factors studies', RL#3 'Holistic approach to HCI', RL#9 Advanced design and development methodologies and tools', RL#5 'Innovative user interfaces', RL#7 'Interoperability and standardisation' and RL#13 'Social context and impact'.

The potential impact of these main findings on the Research Agenda Roadmap are discussed in the following section.

8 Complement and consolidate the CARDIAC Research Agenda Roadmap (step 12)

As mentioned in section 6, the case studies in the fields of Smart Homes and eLearning have showed that the CARDIAC Research Agenda Roadmap can be applied and extended to more specific fields even though the roadmap has been drafted with the broader perspective of accessible and assistive ICT in mind.

The intention here was to find out whether the overall roadmap could be applied to a particular field, and if not what could be changed in the roadmap structure to make this possible. The chosen structure with research lines and research actions has allowed this exploratory process and extension of the roadmap to be carried out and there has been nothing in the reports to suggest that it is necessary to modify the structure of the overall roadmap for this purpose. It has therefore been possible to complement the overall Research Agenda Roadmap with these two other roadmaps in specific fields, suggesting that this could be extended to other specific fields if required.

In regards to the content and make up of the roadmap itself, the rest of this section will review the nine main findings of the questionnaire analysis from the previous section and discuss whether any modifications need to be made to consolidate the Research Agenda Roadmap.

Finding 1: The difference between the scores for all 6 aspects for is quite small

This is a very important overall finding indicating that all the research lines were deemed by the respondents to have similar potential impact, probability of requiring public funding and levels of feasibility. The full-scale graphs shown in figures 27 to 32 illustrate this point whilst also showing that the lowest average score for impact, probability and feasibility were respectively 3.51, 3.3 and 3.19. This major finding makes it hard to argue the case for removing any of the research lines from the roadmap.

Finding 2. All research lines were considered to have a high or quite high potential impact

This finding picks up on the previous one reinforcing the case for not removing any of the research lines from the roadmap.

Finding 3. The six highest-ranking research lines in terms of impact

The first two findings have drawn attention to the similarity of scores received in general. This finding seeks to identify any small differences there may be in the research lines scores. The ranking from the responses to the questionnaire identified six research lines with high potential impact. As a cross check and comparison, the number votes cast for the most relevant ideas to the Triggering Questions in the three SDDP workshops was re-examined and a ranking was made according to research lines in which they have ended up. The second column shows the impact scores awarded by the respondents to the questionnaire and the third column indicates the average number of votes cast for each idea (research action) during the three SDDPs. The results are shown in table 17.

Table 17: Rankings of research lines according to impact scores (questionnaires) and average votes cast during SDDP's

Ranking	Impact	Relevance
	Questionnaires	SDDPs
		(average votes)
1	RL#3	RL#5
	4.36	3.85
2	RL#5	RL#3
	4.29	3.75
3	RL#6	RL#8
	4.17	3.50
4	RL#8	RL#6
	4.13	3.50
5	RL#7	RL#7
	4.09	3.15
6	RL#9	RL#9
	4.00	3.00
7	RL#14	RL#10
	3.82	3.00
8	RL#1	RL#12
	3.81	3.00
9	RL#4	RL#14
	3.80	2.70
10	RL#10	RL#2
	3.67	2.50
11	RL#12	RL#1
	3.65	2.31
12	RL#11	RL#4
	3.64	2.25
13	RL#13	RL#13
	3.63	2.25
14	RL#2	RL#11
	3.51	2.00

Whilst this comparison is not comparing like for like, it is nevertheless interesting to note that the same six research lines emerge at the top of the rankings, albeit in a different order. Whilst this comparison seems to indicate that the same issues and priorities emerge whichever way you ask the question or questions, it is also important to not loose from sight the 'erroneous priority effect' referred to in deliverables D2.1, D2.2 and D2.3 (for example on pages 15 and 37 in D2.3), which basically states that the most popular ideas do not necessarily prove to be the most influential. This means that the ideas and research actions, which received the most votes or were deemed to have the greatest potential impact by the respondents to the questionnaire, are not necessarily the most influential ones. These cross influences, illustrated in the influence graphs from the SDDPs, are at the heart of the process. The collective wisdom of all the experts harnessed during the three SDDP meetings identified the research actions with the greatest influence. These research actions were at the foot of the influence trees and are now located on the left hand side of the roadmap indicating they should be tackled as a priority. This dimension has also to be borne in mind and act as a counterbalance to the research line priorities identified by the respondents to the questionnaire. A complementary roadmap can be drawn up taking both these dimensions into account and is shown in Figure 38, where the research lines and actions not identified by as having the highest impact and being the most influential have been shaded over.

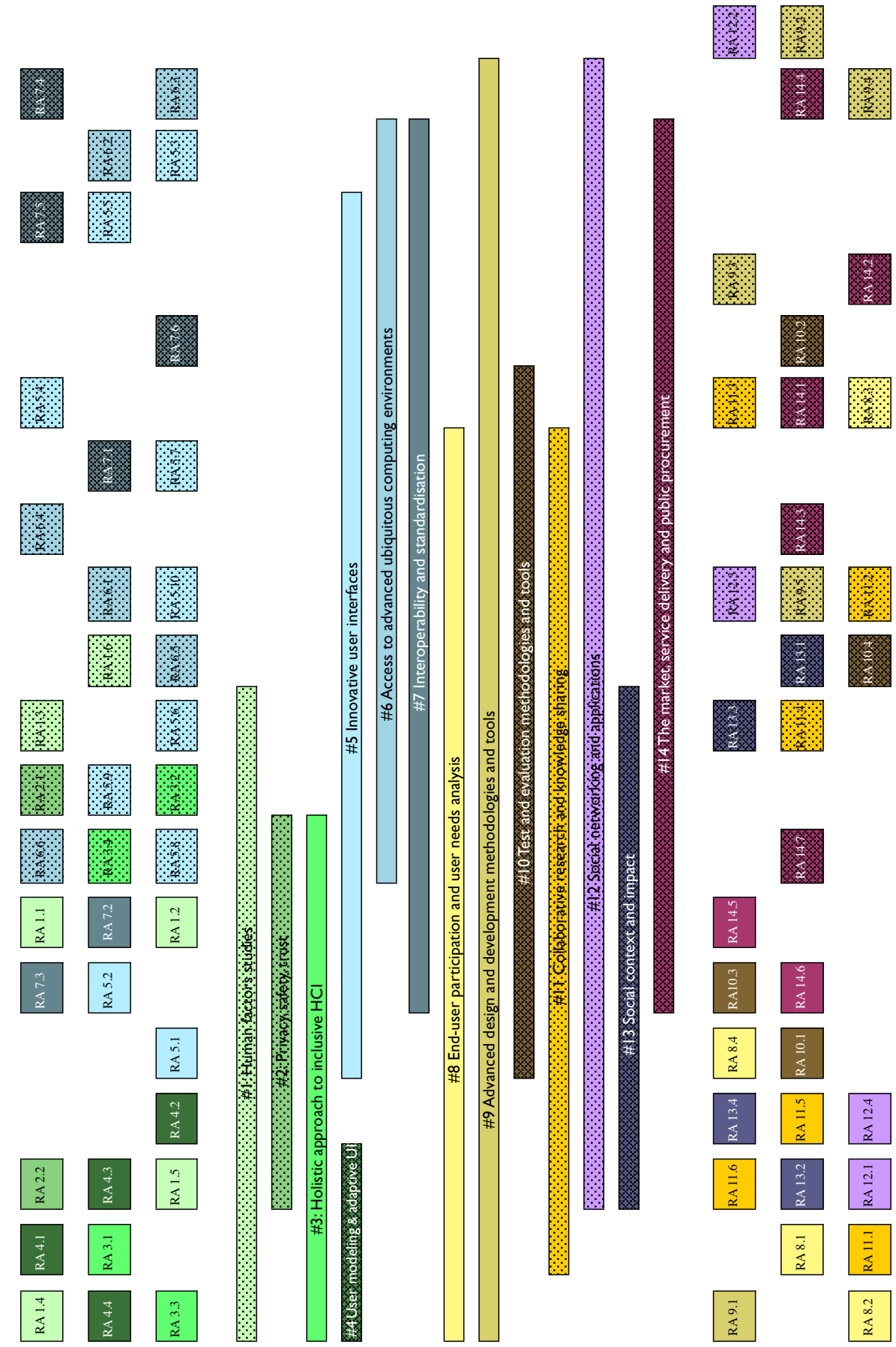


Figure 38: Complementary Research Agenda Roadmap taking both into account the impact score rankings and most influential research actions

Finding 4. All research lines will, to some extent, require public funding

This finding again reinforces the case against removing any of the research lines from the roadmap and underlines the fact that all the research lines remain relevant from the perspective of requiring public funding.

Finding 5. All research lines were deemed of comparable feasibility

This finding indicates that all the research lines can be undertaken broadly within the same time frame from a feasibility point of view, thus consolidating the overall sequential scheduling of the research lines. If we look more closely at the feasibility rankings, there is a correlation between the ranking and placement of the research lines on the horizontal axis. Except for one or two notable exceptions, the research lines with the highest feasibility rankings tend to be located towards the left-hand side of the roadmap and the ones with the lowest rankings tend to start later on and be located further towards the right. For example, six out seven of the top-ranked research lines from a feasibility point of view are amongst the first or second batch to start. The one exception is research line seven, 'Interoperability and Standardisation' which is ranked fourth but is amongst the later starters. There could be a case then for starting this research line earlier than indicated in the roadmap. As for the lower ranked research lines from a feasibility point of view, all are amongst the later starters except RL#4 and RL#9. In the case of research line #4 'User modelling and adaptive use interfaces' this may indicate that whilst it is a priority from the point of view that it contains research actions that will exert a high level of influence on the other research actions, it may pose a challenge in terms of feasibility and may require additional time and support to reach its objectives. In the case of research line #9 'Advanced design and development methodologies and tools' the lower level of feasibility is reflected by the fact that it is the longest of all the research lines. This does indicate that RL#9 will probably poses some challenges from a feasibility point of view and will need a substantial amount of support over a longer time frame.

Finding 6. All research lines were deemed to be quite feasible

This particluar finding picks up on the previous one and indicates and confirms that all research lines can be undertaken in the near to medium term with a reasonable degree of confidnce that the research actions are quite feasible.

Finding 7. The top eight ranked research lines, in terms of a combined impact and probability, all had a score above 3.75 and should be a research priority for public funding bodies

Whilst all the research lines were considered by the respondents to have a high or quite high combined impact and probability, if a further selection had to be made the following eight research lines should considered to be a priority for public funding bodies:

- RL#5 'Innovative user interfaces'
- RL#3 'Holistic approach to HCI'
- RL#9 'Advanced design and development methodologies and tools'
- RL#8 'End-user participation and user needs analysis'
- RL#1 'Human Factors studies'
- RL#6 'Access to advanced ubiquitous computing environments'
- RL#13 'Social context and impact'
- RL#7 'Interoperability and standardisation'

Finding 8. The research priorities for the private sector are quite similar to those of the public sector

The ranking in terms of combined impact and inverse probability were quite similar to the previous ranking of combined impact and probability scores with just RL#14 'The market, service delivery and public procurement' and RL#4 'User modelling and adaptive user interfaces' making into the top eight research lines and RL#1 and RL313 dropping out.

Whilst all the research lines were considered by the respondents to be quite similar in terms of combined impact and inverse probability scores, if a further selection had to be made the following eight research lines should be considered to be a priority for the private sector:

- RL#3 'Holistic approach to HCI'
- RL#6 'Access to advanced ubiquitous computing environments'
- RL#5 'Innovative user interfaces'
- RL#7 'Interoperability and standardisation'
- RL#8 'End-user participation and user needs analysis'
- RL#14 'The market, service delivery and public procurement'
- RL#4 'User modelling and adaptive user interfaces'
- RL#9 'Advanced design and development methodologies and tools'

Finding 9. All fourteen research lines were deemed by the respondents to have high or quite high potential impact, be readily implementable and have a fairly high probability of requiring public funding

This finding once again underlines and underpins the case against removing any research lines from the Research Agenda Roadmap as already mentioned under findings 1, 2 and 4. The difference between the highest ranking and lowest ranking research line according to the Mean of Means is only 0.39 (range of 3.89 to 3.50). If however, a further selection had to be made, the following seven research lines should be considered as a priority:

- RL#8 'End-user participation and user needs analysis'
- RL#1 'Human Factors studies'
- RL#3 'Holistic approach to HCI'
- RL#9 'Advanced design and development methodologies and tools'
- RL#5 'Innovative user interfaces'
- RL#7 'Interoperability and standardisation'
- RL#13 'Social context and impact'

Summary

The analysis of the responses to the questionnaire has identified some priorities amongst the research lines according the impact, probability and feasibility.

However, the main finding has been that the overall scores for all the various aspects investigated through the questionnaire have been closely grouped together. This has made a strong case for not removing any of the research lines and has been an important step in in the consolidation of the overall Research Agenda Roadmap.

Nevertheless the various rankings indicate that the three research lines to emerge as a priority are "Innovative user interfaces" (top of ranking in terms of joint impact and probability of requiring public funding) "Holistic approach to human computer interaction" (second in ranking in terms of joint impact and probability of requiring public funding top of ranking in terms of impact), and "Advanced design and development methodologies and tools" (third in ranking in terms of joint impact and probability of requiring public funding).

"Innovative user interfaces" include a wide range of aspects relating to user interaction, such as:

- Affective computing to assist accessibility interfaces and interactions
- Accessible human-robot and human-robot-environment relationships
- Novel human-machine interfaces for recreational activities
- Accessible telecommunications technologies for people with little or no speech
- Practical adaptive user interfaces and multi-modal interaction methods
- Means for customization of UI and open interfaces
- Principles for adaptable end-user interfaces
- Enhance and universalize Web 2.0 accessibility
- Extension of web accessibility knowledge to general HCI

"Holistic approach to human computer interaction" includes research actions on:

- Methodologies that consider not only the interface but the entire interaction dialogue
- Methodologies that include the human diversity in user interface design
- Reducing the complexity of user interaction whilst retaining functionality and avoiding cognitive barriers in the design of human machine interfaces, especially in multimodal interfaces.

"Advanced design and development methodologies and tools" include:

- Methodologies and tools for the development of accessible and assistive ICT
- Tools to facilitate the creation of digital accessible materials to non-accessibility experts
- Design and authoring tools supporting and automating e-inclusion
- Tools for decision making in the user-centred design process
- Translate user needs into product design
- Development of training modules about needs of people with disabilities for developers

The research agenda roadmap along with the various levels of information and tables included both in this report and on the project website (http://www.cardiac-eu.org) are meant to be used as tool. In order to help the reader digest this complex, intertwined set of tables, influence trees and roadmaps, a short 'user manual' has been included in annex 3 of this report. The concept behind this tool is that whatever the particular constraint of any given stakeholder, appropriate research actions or research lines can be selected whilst ensuring that any related research actions that may support this research can easily be identified from the information provided.

9 Conclusions

The core aim of the Coordination Action has been to generate a Research Agenda Roadmap in the field of Accessible and Assistive ICT that would be relevant to all the stakeholders involved and useful to the main stakeholder, the European Commission, in shaping future research calls and support.

For this purpose, a democratic structured dialogic process known as SDDP was selected, involving as many stakeholders as possible, so that the resulting roadmap would reflect a wide range of views and could also be partly owned by the multidisciplinary group of experts who have contributed to it.

Applying this methodology to this particular area of creating research agendas is new and it has been a ground breaking experience for all involved. It is hoped that the collected wisdom both from the structured dialogues themselves and the systematic step-by–step road-mapping process will serve as an experience for any such future endeavours.

The resulting CARDIAC Research Agenda Roadmap with its 14 research lines in different areas reflects the multidisciplinary nature of the process and people involved. The CARDIAC consortium believes that this holistic, all-encompassing approach to the problem can serve, through its implementation, to address the higher long-term aim of the project, namely to ensure that there is an increasing amount of products and services avalaible on the market in the field of Accessible and Assistive ICT.

Annex I ideas and clarifications from the three CARDIAC SDDPs

1. Ideas and clarifications from CARDIAC SDDP1 in Pafos, Cyprus, in response to Triggering Question "What mechanisms would ensure successful technology transfer in accessible and assistive ICT products and services?" (denoted SD1 + #number)

SD1#01: A **mechanism to understand where ideas fall over or go wrong in the supply chain**
A mechanism to understand where ideas fall over or go wrong in the supply chain interested in understanding why great ideas fail. I drew up a mini supply chain: is it user driven in user needs? Is there a common set or rules to apply in the supply in the chain? Procurement= User need/requirement, market pull/push it, supply chain (LE takes idea to market?), manufacture, development/prototyping, R&D. Identical to Idea #79.

SD1#03 Accessibility filter in company product R&D process
An accessibility filter based on international guidelines and standards will assist designers and product specialists to firstly understand accessibility and secondly guide them to develop more accessible products and services.

SD1#05: Focus on novel and creative designs
Stop re-inventing the wheel (as an opportunity for future generation) instead focus on identifying new, smart and creative solutions.

SD1#06: Include and monitor business models we initiate development projects
The aim is to reach a market, sometimes we show possibilities. Good ideas come to some type of prototype and stop there. Which project to finance is to already then evaluate how it can reach the market in the future so that from the beginning one can see that e.g. it's too expensive or doesn't meet the user needs. Find a model of evaluating projects in an early stage

SD1#07: Maximize potential user base for accessible products
I want to produce products that help people with disabilities. To work with developers to help look at the widest range as possible. Developers often see their potential market as defined disability groups whereas in reality there are many other 'non disabled' possible benefactors. There need to be identified and qualified.

SD1#08: Identify and put in place rewards for market placements of products
Funding mechanisms should be amended to only apply financial support to organizations or companies after they have successfully placed an accessible/assistive product on the market for a defined period of time, with defined measures of success. Similarly other incentives should be put in place, such as tax credits, etc, to support companies after they have successfully brought products to market. This is relevant particularly for SMES.

SD1#09: Companies adopting accessibility philosophy in their product and service design.

If more companies were to integrate an accessibility philosophy in their product design if there would be a greater choice of more accessible and assistive products reaching the market

SD1#10: Studies that demonstrate the positive contribution of assistive and accessible ICT

Stakeholders in assistive or accessible ICT often don't know the answer to the question: What is in it for me? Enterprises don't have clear answers on the business models that they must develop: they don't know the future development and perspectives of the area. Thus, more studies are needed that contribute to the potential of using assistive ICT and shift decision making from educated guesses to evidence based. The studies should deliver proofs of positive contributions of using assistive and accessible ICT for users regarding the increase of self-determinism and independence, entrepreneurs regarding economic advantages in order to reduce the risk of market failure and encompass investigations on the reliability/robustness of the ICT based solutions.

SD1#11: Realizing proof of concept is not a product or service

At the start of the technology transfer process often only proof of concept is available. For some people this might be the end point but it is actually a beginning. There must be a clear approach on how to move forward from the initial idea to a product/service. 'Don't stop when the baby is born'.

SD1#12: Open interfaces that allow products and services to interact

Mainstream products and services should provide interfaces that let them interact in a seamless way with other products and services including AT.

SD1#13: Progressive financial support to marketing assistive ICT

Progressive financial support to marketing assistive ICT. Put the stress on the last part. The idea is to be progressive in financial support. Emphasize on financial support. Financial support should be progressive.

SD1#15: Provision of procedures, easy to use tools and environments for accessibility testing

The provision of u, procedures, easy to use tools, and test environments, including human experts, for the purpose of testing the accessibility of ICT products and/or services would support developers of such products/services in checking for accessibility features of their developments already during the development process; users, user organizations, or public bodies (public procurement) to check whether their requirements related to the accessibility of a given product or service are met, or to proof in an objective way that the requirements are not met.

SD1#16: Increase positive contribution to fill the gap between assistive and mainstream technology

Nowadays we still have a generalized opinion that assistive technology and mainstream technology are 2 separate worlds that cannot be addressed simultaneously and be part of the solution of technology transfer and of disabled people inclusion.

SD1#17: Improve education and training about inclusion of people working in industry dealing with mainstream

SD1#18: Consistent legislation and/or mandatory regulation in the EU countries

Very often, mainstream industry does not realize the real market potential and the wide user base of accessible and assistive ICT products and services. If this is identified and communicated to the industry, it will increase their active involvement in the process of turning a concept/research prototype to a successful product/service

SD1#19: Separate the three pillars of a cost benefit analysis
Separate the three areas that are crucial before we are the launch a new product or service for the people belonging to a special interests group. Accounting - economic - social value convinces authorities in EU of the last pillar-its value could be more important after all.

SD1#20: Offer incentives to suppliers who offer effective accessible products and services tax incentives, etc. to companies who don't currently offer these products

SD1#21: Consistent adaptable user interfaces should be mandated for EU projects
Older and disabled users would benefit from consistent user interfaces, which can be personalized to meet their individual needs (which may change with time or circumstances). Implies funding for scientific research to develop the specifications for such interfaces.

SD1#22: Support users to demand accessible products and services
If user organizations are funded to train and support their users to better understand how to demand accessible products and services, companies will more likely meet the market.

SD1#23: Support user involvement in all phases of product life cycle
Usually when a product goes through an industrial production cycle a particular issue is left out (probably due to cost) that is small but vital for accessibility . Involving users in the whole procedure will eliminate the danger of losing accessibility at the final stages.

SD1#24: Create awareness and fight discrimination
As a means for increasing acceptability adoption of these technologies

SD1#25: Personalization for all and open interfaces when needed
Today the markets for assistive ICT and mainstream products and services are very separate. It is a gap between the two types of markets and these results in specific solutions even in cases when general solutions would help a number of users. Assistive ICT do not interest the large majority of people in society. If the market for mainstream products and services focus more on the possibility to personalize the settings for all end-users it will lead to more accessible solutions. For instance a businessman in a noisy environment could prefer information in text instead of audio at certain times. It is not possible to include all functionality in mainstream products and services. It would lead to much more expensive solutions. When a mainstream product or service do not offer needed functionality for all user groups it is vital that the mainstream ICT solutions include open interfaces to offer interaction with assistive ICT. For instance it should be possible for vision-impaired people to connect a Braille keyboard to a mainstream product.

SD1#26: Analyze user base by functional needs only
Situations where looking at requirements, needs have been presented by persons who have some sort of disability themselves. We need a broader application. Example: working in a group he realized that what those with disabilities need applies to many other people with similar needs.

SD1#27: Fund the development of broker agencies for accessible products
Funding should be made available to 'kick-start' an industry sector that would specifically provide support to companies/organizations engaged in technology transfer of accessible and assistive ICT. These specialist agencies could bring stakeholders together, guide marketing identify markets, customers, etc. They could be based as a similar model to the Rehabilitation Engineering resource centers in the US.

SD1#28: Make it more general rather than specific accessible and assistive
ICT products should be incorporated into e.g. smart home, therefore market will be bigger, everybody will benefit. Making it more general technology rather than specific for elderly and disabled. Make the accessible assistive ICT products and services part of general technology e.g. 'smarts home'. To increase market improve image and enhance technology transfer.

SD1#29: Build a global public inclusive infrastructure
Building such an international infrastructure could help the AT industry to reach their market this refers to the GPII initiative.

SD1#30: Implement the innovation partnership on active and healthy aging
Communication COM (2010) 546 final, published by the European Commission, presents the Europe 2020 flag- ship initiative "Innovation Union". Annex III of this communication introduces "Aims and scope of a pilot European Innovation Partnership in the field of active and healthy ageing. This innovation partnership aims to overcome deficits in the current set-up of the technology transfer process, as it will be a top-level coordination structure that the EC wants to create by beginning of next year. EC is now developing more ideas on how to identify all relevant stakeholders. The innovation partnership follows quite broad objectives, as it includes questions of funding R&D, public procurement, standardization issues and also intends to intervene in the current set-up of business models in the health area. DG Infso and Sanco together stand behind this innovative partnership.

SD1#31: Gain deeper understanding of personal barriers
Point of view to be able to personalize, quite difficult, one person might not be willing to admit he needs special device or cannot buy. It should be clear I could use technology available but to find guidance to the process. To be able to personalize ICT products and services, for example a barrier for one person could be that he is mentally not ready to admit needing help (solution could focus on community) another person might not be able to acquire a service at a local provider. Knowing the exact problem is needed to solve it, and what technology transfer is needed to focus the transfer and to know the ultimate goal.

SD1#32: Having accessibility requirements on all publicly available products and services
Legislation for requirements not enough; choose requirements whenever they are meaningful. If a private organization provides a service, it should also have accessibility requirements across all member states. The idea is to include accessibility requirements in publicly available services and especially in publicly supported services whenever this is meaningful.

SD1#33: Promote interoperability of accessible products and services
Standards and guidelines to promote interoperability; reduce the cost; existing technology could be used. Similar to Idea# 12.

SD1#34: International standards must cover the needs of everybody
Many products will be based on international standards. Therefore standards makers should clearly state whether their standards meet the accessibility needs of all people including disabled people

SD1#35: Provide standardized technical solutions or modules for accessibility in specific domains. Available technical solutions (including SW modules, technical descriptions, guidelines, technical know-how) developed and provided by accessibility experts make it easier for companies, who have no special expertise in accessibility, to achieve accessibility of their products or services.

SD1#36: To improve the knowledge of technology potential to support an inclusive life
If there is more information about how technology may contribute to participation mainstream and inclusive life styles it will be possible to have more demands concerning technology transfer serving those aims and a more positive look to the end-users, who may also support it because the accent is not on the a lack of competencies but on contribution to do / to perform better.

SD1#37: Improve the level of technological research in inclusion
Interest in technology transfer is created by the emergence of new technological solutions of relevant problems. Presently, many projects are based on incremental improvements of available technology and produce only marginal advantages for end users, which do not justify the implementation of new equipment and/or services. It is therefore necessary to aim to the selection of research project that are based of real techno- logical innovations and produce significant advantages for users.

DSD1#39: Educating people to actively use technology breakthroughs
Educating people with special needs to actively use technology breakthrough. Trying to make public to groups of people with special needs of the accessibility of technological developments in their area of interest – lobbying to EU relevant bodies.

SD1#40: Legislate in the right place
I proposed because I listened to some conversations and occurred to me that across Europe we legislate at different places at different times. We need to decide where to legislate.

SD#41: Development of open standards for accessible ICT systems based on sound scientific data
The present set of standards is often inconsistent, fragmentary and out of date (e.g. based on superseded technology). Often the accessibility aspects are superficial and do not reflect the unmet needs of the unmet user population.

SD1#42: Accessibility criteria in public procurement policy
Basically having accessibility criteria means companies are given incentives to develop accessible products. Companies are given an incentive to develop accessible products if they believe they will win government contracts.

SD1#43: Examine how guidelines for assistive technology inform best mainstream ICT products and services
The idea is to use knowledge from the development of particular and personalized assistive technology products and services, to the development of more general and mainstream

accessible ICT. Coming from the specific to the more general, that will aim to a greater number of users, not specific to particular disabilities.

SD1#44: Provide incentives to bring academia, industry and users together
Same technology designed by different groups in isolation. Robust methodologies for design should drive technology design. User at the center of design.

SD1#45: Not only accessibility but also usability
Often we use the word accessibility which has man different meanings; things can be accessible but not being used; I want to make sure we also mean we use them.

SD1#46: Provide accurate potential user data to developers
Directly aimed to marketing; what kind of marketing info; put it in that form; why should we develop this product. Organize market data into meaningful form. Make clear the potential market if the product is truly accessible.

SD1#47: Make the availability of accessible technology a human right
In line with the recently published UN convention on Human rights, I feel that this single factor would cause a 'tsunami' of new accessible ICT products onto the market immediately. It would create a new model of technology transfer- namely 'technology rush'!

SD1#48: Improve links with the e-health market
The e-healthcare services are becoming a great market worldwide. Therefore incorporating it into the healthcare sector it will improve technology transfer.

SD1#49: New funding mechanism to assist in exploitation - commercial introduction phase
The idea is how the transfer to the market of an exciting product breaks down at the end of the project when all exciting potential are demonstrated. The product dies. We need a new mechanism to look at that phase; within same instrument or innovation partnerships; auction of ideas. Cluster of projects finished and open them up for industries to come in and take them.

SD1#50: Understand the market dimension: local versus global
At the moment, the market for assistive ICT in Europe is rather a local than a global one. None of the (presumably three) enterprises with a perspective to reach out for global markets (Tunstall, Philips, Bosch) has been successful in doing so – and this is due to the fragmented market. Fragmentation occurs in regional responsibilities for health care that leads to regional regulation or regional reimbursement and business models; except the UK where the NHS is a monopoly health insurance that invested in a major roll out of Tunstall telemonitoring devices. Taking the example of telemonitoring, it can be said that technology successfully operating in the US market fails a successful introduction in Germany. Due to the fact that telemonitoring devices are not refunded by the social health insurances. The market dimension for health technologies has a crucial impact on the successful implementation, and as we do not have a sufficient understanding of all influential factors, we need to have more evidence on the market dimension; we need to analyze barriers as to understand the market.

SD1#51: Learn how to sell the technology
If you are able to see the benefit, how to use it will be easier o reach the end users. A different mindset is needed. Developing something and selling something are two different

types of expertise. Articulating the (added) value of what is available can positively influence the technology transfer

SD1#53: Specific methodologies and tools for the development of accessible ICT

One of the reasons for tech transfer is because there are not adequate methodologies and tools

SD1#54: The industry should be aware of the user needs of all

Work is going on within ISO/IEC Joint Technical Committee no. 1 (ISO/IEC JTC1) on the user needs, which have to be taken into account when specifying products and services enabling accessibility for all. The Special Working Group on Accessibility of JTC1 has specified a Technical Report stating user needs for people with some reduced functionality. The industry should consult this list when designing their products.

SD1#55: Make basic research researchers aware of the application field of accessibility

One step of TT is the step from basic research to applied research. According to our observation, basic researches have low awareness and little understanding of 'accessibility'. Basic researches could: (1) do more work in accessibility related issues of their basic research and (2) consider 'accessibility' as an application field of their research results.

SD1#56: Better understanding of the process involving research, development and technology transfer in ICT

To pay more attention to transition phases between them research development and technology transfer which are in many cases critical issues, sometimes not observed by the same perspective by all people involved. A better description of the process is needed in order to identify critical issues

SD1#57: Improve distribution of information outside the group of people working in the inclusion environment

Mechanism for knowledge accumulated in EU projects to be distributed to all interested parties. In Europe many SMEs exist, who produce equipment and services and cold take care of inclusion problems, if they would be aware of the problems themselves and could have access to the available results aimed to solve them. Therefore, mechanisms for a wide and specific distribution of information about problems and possible solutions should be envisaged.

SD1#59: Go to the kids. One student one laptop

Blue-sky idea with practical value. For all the kids in the public sector in Cyprus, over 14, we offer them for free one lap top. If this happens across all countries it will be a major breakthrough.

SD1#60: 'Green' agenda - footprint for usability

How can we use the analogous agenda we have for the environment to make it an agenda.

SD1#61: Analyze procurement methods in member states

SD1#62. Translate user needs into product design

This relates to the difficulty for industry and designers to translate a set of user needs into meaningful design specifications.

SD1#63: Ensure ICT reliability, robustness and security

SD1#64: Focus on interconnectivity of technology
Cooperation is needed. Open your mind, think out of the box, try to strengthen by working together don't think your field of expertise is more important than another. Focus on how we can benefit from each other's expertise.

SD1#65: Define technical interfaces between mainstream products and assistive technology products
Besides accessible HMIs applicable for the great majority of the users, there are some users who may be dependent on their customized assistive technology HW to operate various applications. Technical interfaces to AT products could make mainstream products and services accessible even to those who are dependent on such special HCI HW; e.g. a powered wheelchair user could operate also public terminal systems with the joystick of his wheelchair. A prerequisite would be that such technical interfaces are agreed (standard) between the mainstream ICT providers and the AT providers.

SD1#67: Actually penalize countries, organizations and companies who don't implement accessibility and use the funds for R&D

SD1#68: Insight into gaps in the role and responsibility among stakeholders
Not one single stakeholder can do it all cooperation is necessary. More complex than a blue-ray player and a disk that can be played on that. This area is far more complex, dynamic group of stakeholders with different interests.

SD1#69: Implement UN convention
Implementation of the UN convention that refers to e-accessibility and that has been signed by all the member states could be an opportunity to reinforce obligations and requirements on industry and public bodies. This could be a driver of technology transfer.

SD1#70: Consumers should not pay more for accessibility.
Regardless of development/manufacturing costs etc., accessible products and services should be priced at the same level and non accessible products, so that they can complete on the basis of fundamentally etc. rather than by price.

SD1#71: Success stories needed
We need success stories for successful technology transfer. The word will spread. Also - we could analyze success stories. What was it that made this particular transfer so successful?

SD1#72: Positive monetary aspects
For big companies it's often all about money. Are there any positive aspects of accessibility we can promote here or will assistive ICT always have to live with the prejudice that it's big expenses for only a handful of users?

SD1#73: Small projects instead of big frameworks
Start somewhere through a pilot project to monitor easy to evaluate.
Practically approached, I think a company would rather grasp a good idea for an accessibility solution and implement it themselves instead of using big unhandy frameworks. Keep it slim!

SD1#74: Access to results for a broad range of companies
Many European and national R&D projects yield results or know-how related to accessibility.

However, especially for small ICT companies it is a big problem to get an overview or even to become aware of such new findings. An open repository of findings of projects concerning accessibility, but also of technical solutions could support the TT from (EU) projects to those companies.

SD1#75: Marketing for accessible solutions
Marketing/PR is too often done in the wrong way or at the wrong place.

SD1#76: Simplify the process within the commission before funding is approved

SD1#77: Promote models of rapid, iterative development for ICT
Be prepared! The market does not wait! The time taken between concept evolution and a market ready product costs companies money. Most companies I have worked for have gained a market share by "pushing" technologies, and having the resources to facilitate rapid, iterative design during the life cyle of the product. My personal belief is that if this can work for manufacturing technology where significant market share is at stake, then it will work for accessible ICT development as well.

SD1#80: Investigate whether patents are required to implement a new standard for assistive ICT

SD1#81: Consistent legislation and/or mandatory regulation in the EU countries
At present different countries have different requirements for accessible ICT systems for public use. This means that manufacturers have to produce different countries, hence increasing their costs. Government procurement policies vary from country to country.

SD1#82: Consistency in policies for subsidies of assistive products and services

There are various mechanisms for subsidizing the cost to the end user for purchasing and running assistive devices. Even within one country, the same device may attract different levels of subsidy in different circumstances. For instance there may be a state subsidy for aids for employment, which may not be available to disabled people currently unemployed, but seeking employment. There is also inconsistency in who pays for the cost of training the disabled person in the use of the assistive device. All this variability means that marketing departments of mainstream companies are reluctant to market assistive products and services.

SD1#83: Requirement for companies to publish their corporate social responsibility policies in respect of accessibility
Currently many CPR policies reflect to what the company aspires. Making CPR policies in the public domain gives the possibility of outside organizations exerting pressure on companies to implement policies.

SD1#84: Embedding accessibility in engineering curricula
Many accessibility issues are related to lack of awareness/knowledge by the product/service design team. Embedding accessibility/DfA in the engineering curricula would improve this situation.

SD1#86: Environments for interoperability testing

SD1#87: Harnessing the green agenda and sustainability to promote the issue of accessibility

Finding a way to get leverage from the green/sustainability agenda could be a way to enforce technology transfer .

2. Research Actions and clarifications from CARDIAC SDDP2 in San Sebastian, in response to Triggering Question "What type of research is missing that could facilitate development of inclusive HCI?" (denoted SD2 + #number)

SD2#01: Research to get rid of HCI

This response is a provocative way of expressing the idea that to have development in inclusive interaction, it is necessary to go beyond the usual model of user interaction with a computer. The situation is now much more complex. In the future people will not have to interact with computers but with many types of intelligent objects and collection of objects and the situation will therefore be much more complex. It will be necessary to develop new metaphors and new ways of accommodating this complex situation in such away that people are included,

Computers get smaller and are not recognizable as computers any more. They hide in all kinds of devices and in (smart) environments. Next to this, people do not explicitly interact with these devices and environments, but are constantly living in between, and often passively or implicitly using them. Therefore, research should focus on Human Environment Engagement.

A natural corollary to the discussion on ubiquitous computing. That is the incorporation of the computer into the environment so that you don't feel like you're interacting with the computer but rather with the environment around you (and even remote environments)

SD2#02: Research aiming at avoiding cognitive barriers in the design of Human Machine Interfaces

The accessibility/ usability of ICT products and services sometimes fails because of a „mismatch" between the system functionality and the user's mental model of the system.

There are of course many possible physical barriers in human-machine interaction, which may prevent full accessibility, but there are also cognitive obstacles that may reduce the accessibility of the system. Many user interfaces just reflect the functional performance of the system on a certain level, so if the user does not fully understand the functionality of the system, leading to a mismatch between the functionality an the user's internal mental model of this functionality, or if the user is cognitively overloaded by the complexity of the system or by too many details and questions being requested by the interface, then the human-machine interaction is going to fail. Research is needed to improve this situation.

SD2#03: Development of new haptic interfaces and methods for haptic usability

Many haptic artifacts has been developed so far for instance to be used by blind people. Similar techniques should be developed for other categories of disabilities, e.g. people with cognitive and motor impairments. Furthermore haptic usability, its user centred design, evaluation and accessibility in general should be investigated.

SD2#04: Design clearing house for inclusive HCI

A clearing house is an online information transaction process for bringing together a wide cross-section of design methods, relevant standards and existing products as well as ongoing research. A design clearing house for inclusive HCI will draw together valuable information online so that companies can quickly and clearly understand inclusive HCI. Commercial companies have limited time to develop interfaces and to encourage them to use inclusive design practices, a central place online with impartial information would be valuable.

SD2#05: Development of practical adaptive user interfaces

An adaptive user interface automatically charges based on the behaviour of the user. These interfaces have worked well in the laboratory, but have sometimes been problematic for applications such as public access terminals.

SD2#06: Research of the use of context awareness to adapt user interfaces

Context awareness can greatly help to build a new adaptive user interfaces that can provide more simple and useful functionality to users. For example, for a user who is sitting in front of the TV and does not know how to use the remote control because it is too complex, context awareness can be used to provide the remote control through his touch-screen mobile device with very simple functionality (going up and down for volume control and channel selection, for instance). It thus greatly simplifies the same functionality that user experiences with other types of devices. Using this context awareness can therefore help user operate different devices in a simpler way but with the same degree of functionality.

SD2#07: Promote research in methodologies and tools for HCI accessibility evaluation, including, monitoring and benchmarking

Even if the Web is far from being universally accessible, it is one of the environments were accessibility requirements are better known. The reason is the availability of accessibility guidelines to help the designer and the evaluator. They also allowed the creation of semiautomatic accessibility evaluation methods and tools. A similar set of clear and unambiguous accessibility guidelines would help to advance in accessible HCI evaluation.

SD2#08: To do research on tangible artifacts to promote e-inclusion of people with special needs in technologically mediated environment

- [Wikipedia] Tangible user interface is a UI in which a person interacts with digital information through the physical environment (i.e. to give physical form to digital information).
- New Human Machine Interfaces to support people with special needs promoting their eInclusion and engagement in public spaces (e.g. tangible artifacts for accessing knowledge in a museum could improve informal learning).

SD2#09: To promote research that closes the gap between interfaces for inclusion

Create multimedia interfaces instead of speech technology, eye tracking tec. Etc. Having in mind or based on the multimodal human abilities /capabilities.

SD2#10: Facilitate the creation of digital accessible materials to non accessibility experts

The HCI can be accessible but if the contents produce are not the accessibility will be compromised. So there is a need to create tools to help authors to produce material/contents that are accessible to all, if they don't have the skills to do that.

SD2#11: Promote tools for decision making in the user-centred design process

A lot of methods and tools are available to guide the user centred design process in the early stage of the process. For example methods are available for participatory and co-design. These methods are suitable until the prototype stage. To take the step from prototypes to implementation in real life situations additional tools are necessary. There is a need for tools that facilitate the decision making process between different stakeholders in the final stages of the user centred design process. These tools should guarantee equality

between the inputs from all stakeholders, facilitate cooperation and provide guidelines to look for alternatives and compromises when requests from stakeholders are not aligned.

SD2#12: Promote research on the role of inclusive HCI to support self-management in health care

In the Netherlands and also in a lot of other European countries the trend in healthcare is towards a focus on self-management by clients and a active attitude towards care delivery in stead of passively consuming care services. To facilitate this trend all self-management possibilities must be inclusive. This can for example be the equipment needed to measure your own blood pressure and send the data to a doctor but also the way access to Electronic Patient Files is arranged. Research in this area is needed.

All the more so due to the fact that nursing homes are becoming more expensive and the government have caped the beds, thus blocking general hospital beds with patients who could easily be monitored from home.

SD2#13: Support research on novel human-machine interfaces for recreational activities

New modes of interaction, including for example, gesture recognition, touch, voice control, breath control, could all be explored as a means of interaction and should be explored for the whole range of recreational activities ranging from gaming, entertainment and the playing of musical instruments..

It may be best to avoid thinking about interfaces as being tied to particular activities., but it could be good to look at topics such as music and recreation in order to gather the full range of different types of interfaces we should have. We should instead be trying to come up with a very diverse set of interface techniques, which can match any tasks we try them with.

We simply don't know what all the things we want to be doing in the future will be. And we can't run around creating interfaces one and a time for tasks as we encounter them.

We ought to be looking at recreational activities because they can give us some of our most challenging interface problems. Also if you look at where education and other activities are heading, often they are looking more like recreation activities of the past.

SD2#14: Develop and enforce standardized and harmonized remote HCIs

The idea relates to the extent to which standards bodies such as DLNA can and should be encouraged to implement an infrastructure which will support the user interactions required to realise inclusive design.

One particular area of interest is the Accessible Connected Home, an area that the current convergence of connected home technology making multiple devices readily available to remote control devices, and the availability of portable personalisable hardware capable of supporting accessible remote control clients, offers a potential connectivity bonus for disabled users.

One current model of accessibility, emphasises the exposing of the functionality of the target device (the one that the user wants to be able to access) to a client device which might employ a number of user interaction options depending on the disability group for which it has been developed. This model is particularly appropriate for devices such as set top boxes, networked TV's Hi-Fi units etc.

This model can be used to service the needs of disabled users with very different requirements, e.g. a blind user with a screen reader enabled mobile phone, and a severely disabled user with movement in a single limb whose Personalised Assistive Control Terminal could support switch selection of scanned icons on a screen, offering a very different control scenario.

SD2#15: Delivery of the interface to many more varied platforms

It is my belief that we are seeing a convergence of devices and the people who use them along with a divergence of the devices themselves. This means that developers must make their applications more flexible, more customizable, and more personalized – in effect more open – if they are to deliver these applications to the many different types of devices – and interfaces on those devices – without creating additional work by building an application for each individual device. Assistive technologies can, and will, take advantage of this flexibility and openness and become just another device to which flexible applications, content, and interfaces need to be delivered. By understanding that assistive technology is really just extreme adaptation we can implicitly encourage developers to create openness not previously experienced when the only platform for delivery was a closed predictable desktop environment;

SD2#16: New interaction metaphors and paradigms for computing

There is always a need for exploring new metaphors and paradigms for improving user interaction with other users or machines. Though this area concentrated much interest and research in the 90s, nowadays it seems as if it not any more attractive. Quite wrongly, according to my opinion, as it is the one that may help us find genuinely new ways for *defining* problems and not only *'solving'* ones: we still live under the long shadow of the desktop metaphor. Even in augmented reality world assumptions, it is again a desktop metaphor that is underlying. Furthermore, and having in mind how much inter-disciplinary and cross-disciplinary approaches are praised, there is no other natural place for breeding such an approach than the research for new interface and interaction metaphors. Of course, a difficulty in defining a new metaphor or implementing it is *how literally one does this*: do we have to stick to a one-to-one mapping between the original metaphor and its implementation? Is it ok if we just pirate some ideas and concepts and put this as an add-on to dominant interface metaphors? If the aim is to start thinking out of the box, research on interface metaphors is perhaps the most obvious step to take!

SD2#17: Research and development on provision of accessible interfaces inclusive products and services in an ubiquitous manner

Today, many disabled people, elderly people, and other citizens have its personal devices (e.g. their PC or mobile) with its interfaces configured according to their needs and preferences (e.g. larger fonts, high-contrast colours etc.) and, when needed, with their preferred Assistive Technologies (ATs) installed (e.g. a screen reader). However, when trying to use another device (e.g. a PC in a library), they have to change the configuration of them and/or to install their ATs in order to be able to use them. If they do not know or cannot do it, this may prevent them from using these devices.

This research trend aims to make use of the potential of the cloud technologies to enable anyone to interact with any device by using their preferred interfaces and AT. This is one of the research lines of the GPII initiative (http://gpii.net/).

If succeed, in the future, when someone goes into any one of the libraries for the first time the staff can take them over to any available computer and activate the personalization wizard on the web. The staff can then walk away and this friendly, and actually fun, program goes through and talks (using speech, captions, and sign language) and shows the person different access features and technologies and finds out what works best for them. When that's done, it automatically stores what the person needs somewhere where they can use it anywhere, any time. Now when that person sits down to any computer, at any of the libraries, the computers automatically and instantly change into the form that they need *[Source: GPII website]*.

SD2#18: [DELETE] Research on collaborative accessibility

SD2#19: Research on inclusive user-interaction in ambient intelligence environments

Although a great deal of research is already dealing with "smart" environments and Ambient Intelligence technologies, it is important not to shift the focus away from the user aspects involved. In that respect, research on issues related to accessible user interaction in these so-called "Smart environments" is needed, focusing on people with disabilities and older people. Emphasis on the technological side could be placed for example on adaptive and adaptable User Interface design, on ubiquitous computing, and so on. Apart from the technological aspects however, other issues affecting user interaction in smart environments, including ethical issues, socio-cultural, economic and educational characteristics, user abilities and functional limitations, privacy, security and safety concerns should be further investigated. It is obvious that all such issues have a direct effect on technological development. It is crucial however, for the successful deployment of inclusive Human Computer Interaction that the development of new technologies, interaction paradigms, design methodologies and tools, all address these issues.

SD2#20: Create a paradigm that avoids the traps of either forcing all to use a single new technology or for all content to be rewritten (interesting to study the growth of the web)

Currently many proposals for universal accessibility of the web and documents in general fall into one of two traps:

- All content must be re-written to a new spec that is universally accessible by existing software.
- Any existing content can be accessed but only with **this** reader/software.

We could call these two problems the authoring and the reader problem. Any realistic solution will have components of both approaches (e.g. a standard for content and a minimum functionality requirements for software). Even when an attempt is made to skirt the two problems they will often come back into the research in a back door. This is a big problem on the level of web 2.0 and semantics vs. presentation, and it needs both clever and standards based solutions.

SD2#21: Consider not only the interface as it appears but the entire interaction dialogue

This proposal is connected to idea number 1, in the sense that the meaning of this idea is that in the complex emerging environment you can no longer think in terms of what you can implement with the interaction objects which are made available by the different interaction technologies available. It is more a question of developing new ways of interaction rather than adapting existing user interfaces. You therefore have to think back as to what is the dialogue that people have to carry out with the environment or with a machine in order to complete a given task and therefore restructure the dialogue. It will then obviously be necessary also to develop new metaphors and new objects for the implementation of the interaction with a complex new environment.

SD2#22: Support the research in detecting the behaviour, emotions and intentions of the user without the conscious control by the user

The standard paradigm of human-machine interaction includes a standard functional model of how the user perceives the system/machine to work. Usually the user gives direct input or controlled input into the system and then expects that the system acts or reacts in a certain way according to their expectations and intentions. What is suggested here is to change the paradigm and to change the roles. So far the user needed a mental model of the machine or system, what is being proposed is that the system has acquired a model of the

user and the system tries to understand the user's intentions and what he is doing within the context of where he currently may be. This model of the user would thus include the context of the current activity, maybe the usual behaviour of the user and his proposed/assumed intention for the very close future, so that the system can act as an intelligent assistant to the user. This requires, not only technological research (for example in respect to the sensors to be employed), but also and even more so, research on the human side of the model. This includes user modelling, behaviour and activity modelling and so on. This requires much research from the field of psychology and cognitive science. This paradigm could be used in assistive environments such as Ambient Assisted Living and it could possibly avoid accessibility problems in standard interfaces.

SD2#23: Development of sophisticated brain-computer interfaces for people with special needs

The ultimate aim of this research is to be able to put a hat on and communicate with the computer. This may however happen some years in the future. The research should reveal which special needs that will benefit from these kinds of interfaces. It is anticipated that it may be of special importance to persons with cognitive, sensory and motor disabilities.

SD2#24: Training programs for disability representatives to effectively participate in R & D processes

People with disabilities need to be included in the design process based on the disability movement's motto: "Nothing about us without us". To make this possible, disability representatives need to have in-depth training and support to understand how R & D processes operate so they can contribute effectively both in product design and standards committees. There have been training programs in the past but these need to be evaluated to find the most effective method for ongoing mentoring for a successful and sustainable process.

SD2#25: Research on who could be excluded from using novel user interfaces

Companies designing products with new interfaces need to know, before the product is on the market, who will find their interface difficult or impossible to use. This needs to be matched against the target market for their new product

SD2#26: To develop more specific and clear accessible guidelines for application developers

One of the main problems when integrating a new accessibility solution within mainstream ICT is that the guidelines and references that the developer has at his disposal to create accessible applications are very complex, very difficult to use and at a very high level. They are really explaining how to they should be used for a specific use case of the applications. It therefore takes a lot of time for the developers to create these accessible applications and very often they do not provide accessible solutions because they do not have the time to do it. Therefore, if more specific guidelines could be provided that are targeted towards what developers really do, i.e. referring to the specific tools they are using for these applications, such as for example, eclipse, Netbeans, visual studio or the adobe tools, it would be much easier for developers to create accessible solutions thus increasing the chance of a greater number of applications being created that are accessible to mainstream ICT.

SD2#27: To do research on how to use mobile technologies as a universal middleware in public and private environments

- [Wikipedia] Middleware is computer software that connects software components or people and their applications. That means software that provides a link between separate software applications.

- The idea is trying to make mobile devices (mobile phones, PDAs, tablet PCs, etc.) adaptable to different environments.
- People with special needs could have their user profile in the cloud, which could be used, for example: To adapt his/her mobile device to the environment in different locations, To export & import from one mobile device to another one.

SD2#28: Research about the exclusion that has been created by HCI

In what extension HCI creates exclusion? Why, when and how people are excluded by HCI? The term people include not just disabled people but everyone that may be excluded because they are not able to adapt themselves to new ways to perform an activity or a task. Changing frequently the people way of thinking or performing leads to the abandonment of technology?

SD2#29: Research methodologies that efficiently collect data about users including existing HCI quantitative tools (like needs, skills, interests, limitations)

SD2#30: Make social media inclusive

Social media has changed the way we communicate and interact with each other and has the potential to have a positive impact on the lives of a wide range of people. It is important to make it possible for everybody to experience the positive impact. However little research has been conducted on how inclusive social media is and what can be done to ensure that social media is inclusive. It is especially important at this stage since social media is still under development and at this point in time accessibility can be integrated and influence the design of social media in stead of providing accessibility afterwards.

There is a study initiated and financed by PTS that can be found at…
http://www.pts.se/upload/Rapporter/Funktionshinder/2011/2010-32-jmfr-sociala-medier-tillganglighet.pdf.

Technosite has also provided an analysis of "Accessibility of Social Networking Services". The abridged version (in English) is available at:
http://www.discapnet.es/Observatorio/Accessibility_Observatory_on_Social_Networks.pdf.

This is interesting topic with some particularly interesting challenges especially with regard to individuals with cognitive disabilities. This can be a very powerful way to allow people to have access to a wider audience. However it is also very easy way for people to misrepresent themselves and to prey on people who do not understand. Is also a very easy way for people to get let into situations where they give information that should not, respond to requests they should not, and can get abused in some very ugly ways.

On the other hand the safest thing is just to lock people up and not let them out and this is wrong too.

There is a lot of really valuable work to be done on how to make social media accessible and safe.

There's also a lot of work around ethics that needs to be done to look at whether "protecting" people with disabilities is ethical. When we protecting them and when are we taking away their freedoms.

SD2#31: Promote research into the cost of eye-tracking and tongue piercing based interfaces

Eye tracking and tongue piercing based interfaces are often very expensive and are often the only form of assistance for people with severe motor restrictions. The recommendation here is to research potential advancements and mobility enhancements whilst aiming to reduce the price.

SD2#32: Support research that looks how to reduce the complexity of user interaction whilst retaining functionality

It is no trivial task to reduce the complexity of a user interface whilst retaining its full range of functions. However, very often there is a lot of unnecessary complexity that can be removed without removing functionality.

It is also possible to layer complexity so that people who do not need all of the functions do not have to contend with them.

If we really want to have digital inclusion, we really need to focus on this topic. We can't continue to create interfaces that are only usable by the top half of the population (or the top 10% as is often true now).

SD2#33: [DELETE] Extend quantitative tools from HCI to inclusive design

Many of the HCI evaluative tools need to be adapted to specific disabilities, often by a researcher without the tie to validate the new wording/scales. These can span tools designed for users with full sets of typical sensory abilities to evaluation of effort by persons with cognitive disabilities. Careful 'porting' and evaluation of the resultant tests – in the very same way the current tests were evaluated – are necessary.

SD2#34: Research on how to enforce accessibility in consumer goods

SD2#35: Support research on how affective computing can assist accessibility interfaces

While still novel, measures of stress – based on say Galvanic Skin Response (GSR) – have been, and are becoming, increasing common measures in experiments to quantify human behaviour, particularly anxiety frustration disorientation and hesitation. However, what is the possibility of using GSR (along with predictive task models) to quantify interaction problems and automatically adapt the interface such that stress is reduced and interactivity progresses faster. Even if we are not able to adapt the interface automatically and directly we may still be able to understand the areas of frustration that are common among different user groups and change the interface such that these areas of stress are reduced.

SD2#36: Non-visual interfaces for all (mainstreaming of non visual computing)

Visual channel is powerful - we all accept this. And nowadays that we have fast internet and the ability to transfer high quality video, support sophisticated graphical interfaces and exploit as much as possible this channel, why not do it? However this is only the one side of the coin. The modern individuals who are continuously on the move depend, as expected, too much on the visual channel: while walking, in the metro or train, or driving on the motorway people send and receive messages, read emails or documents, google or browse on the internet. To do all this, they depend on visual information that is provided by some small(er) or big(ger) visual displays. Why not give a chance to some new form of mainstreaming non visual interaction? Why not have people reading their emails or their newspaper *while not - actually - reading them*? Why not have people editing a document *while not having visual access to it*? Why not have people googling for information or searching for a restaurant for tonight *while not looking at some screen* (big or small)? One supporting argument for this is to think about the super rich people who are always accompanied by custody of secretaries and aides who take care of all their stuff. Interaction there goes through them and they usually dictate their wishes or are told about the findings.

SD2#37: R&D on text normalization, simplification, personalization and evaluation

Research on technologies for text processing aimed at facilitating the information handling by both the end-users and the services based on linguistic processing:

- Text normalization and simplification: E.g. easy-reading text personalization (not only static texts but also online user-generated texts: such as for social participation in social networks).
- Text simplification to improve: multi-lingual conversion (national languages), sign language conversion, etc.

SD2#38: Research on mid to long term interaction by disabled and elderly people

Many elderly people have acquired some disability over period of 5 to 20 years. This research is about understanding the user's capabilities and the changes in their interaction over a longer period of time und order to understand the need for adaption's or applications in adaptive systems. Typically this requires to acknowledge some form change of technology, to analyze the interaction and methods to ensure persistence of the user's profile in the new technology.

SD2#39: Promote ubiquitous computing and programming tools

Research would need to focus on computers that do not appear to be computers. That is to say, the post-desktop model of Human Computer Interaction. Ubiquitous computing could overcome the prejudices and inability of any user. Technological determination is not the way to facilitate the development of inclusive HCI. Research into developing computers with appropriate programming tools could provide "machines that fit the human environment instead of forcing humans to enter theirs" (J. York and P.C. Pendharkar 2004).

This is an important question and is the future of computing. In the future we will be having things we would not think of as computers like we do now. We will have information appliances in one sense, but in a broader sense we will really have devices so much as will have services. We will simply turn to whatever objects are near us and use them to access services that will be available in the cloud, Or in the environment, or all around us.

It is actually hard for us to conceive of what it will be like. But we need to start thinking differently if we want to really begin doing serious research and get ahead of the curve.

SD2#40: Promote methodologies to include the human diversity in user interface design

Most current User Centred methodologies are not able to cope with the features of all people. Designers wanting to produce accessible Human-Machine interaction systems need sound methodologies and commercial tools to do it. Most designers are used to advanced design environments, therefore, in order to be adopted by the industry; these methodologies must be sound and usable in large scale software development projects.

SD2#41: Use reasoning (AI) techniques for personalization

We are generalizing the way in which we are considering the interaction; we say that it is no longer possible that you have interaction with predefined tasks and the system has to be able to 'think' about what is the purpose and intention of the user. The system has therefore to be able to imagine what people need and thus help the user in a practical way in reaching the desired outcome. Two examples can be mentioned: the first example is the scenario where you are cooking something in the kitchen, where the kitchen should be able to understand what your next moves should be. The second example is a multimodal interface for booking a medical examination, where the idea is that for the system to be really useful, it should be able to replicate closely the behaviour of a person whilst observing the user and knowing how to speak and interact with the user. The system should thus be able to organise a dialogue in such a way that it can help a person understand what is the environment, what are the different types of examinations you can have and guide you through the system.

SD2#42: Research on reasons why existing knowledge and standards on accessibility are not known or applied by HCI developers

SD2#43: Quite a lot of work is going on to obtain ambient intelligent services using different artifacts. Ambient services for people with special needs have however not been addressed much so far. It has to be identified where more research is needed and relevant research has to be carried out.

SD2#44: Accessible telecommunications technologies for people with no or little speech

People with no or little speech (sometimes called complex communication needs) may have cerebral palsy combined with severe physical disabilities or have had a laryngectomy, an acquired brain injury or a stroke. As a result they have limited possibilities in using telecommunications technologies, such as the mobile phone. It is the combination of physical impairments that present challenges in finding ways for them to seamlessly link telecommunications with their alternative and augmentative communication devices. As this is often an overlooked group of people with disabilities, research is needed.

SD2#45: Research on the cognitive load associated with various user interfaces

With interfaces provided in more than modality, the different interfaces may impose different cognitive demands on the user. For instance, it is easy to get 'lost' with auditory output of a complex interface which was designed for visual presentation.

SD2#46: Promote interoperability among devices and services to enhance accessibility

Many services available to people with disabilities have very different interfaces that are frequently incompatible among them. The idea behind this proposal is to make compatible and interoperable all the equipment available to each user. The ideal scenario is to provide access to all services by means of a single interface (well adapted to the user). This interface would be available in the different devices that are handled by each user (supposedly well adapted to the features and needs of the specific user). That may require promoting the definition or adoption of a common/standard middleware as accessible interoperability framework.

SD2#47: Research on methodologies to analyze collaborative accessibility and undertake collaborative user- and usage centred design

Social approach to better collecting end users' requirements and opinions, as well as evaluating prototyped UI solutions, (for example, using web 2.0 facilities).

Collaborative approaches to web accessibility start by identifying barriers by disabled people themselves and raising the social pressure for example on website administrators. Best practice examples of such collaborative approaches are web sites (e.g. IBM's work, or the FixTheWeb initiative) used for "fast and easy" reporting accessibility issues of online services and content but also detailed information about how to fix problems. Similarly, a geographical information system for mobility impaired people may allow to collaborate actively by identifying wheelchair accessible/non accessible locations. A system may allow collaborative correction of speech recognition captioning of audio recording for educational purposes, and whose editing of captions could be provided voluntarily by hearing class mates when funding for professional captioning was not available. All these are existing good examples for Web 2.0 services improving accessibility through "crowd sourcing". If such approaches will scale up to the extent and quality of commercial services like Facebook and large voluntary organizations such as Wikimedia is unclear and requires further analysis, involvement of end user organizations and implementations.

SD2#48: Create a meaningful use of HCI clearly supporting activities
Why some products and services are not been used? Why some products and services failed?

SD2#49: **Research that promotes inclusive practices of professionals responsible to develop new products or services**
It is important that we can find ways to motivate professionals to use the knowledge and inclusive practices (e.g. standards, research findings, etc.) to develop new products or services, or else the accessibility and usability will always have problems.

SD2#50: Promote research on inclusive HCI for highly dynamic impairments
Patients in hospitals who have a temporary impairment need products that support them. In a noisy environment everybody has a hearing disability. Persons with co morbidity can have a changing need for example every day, every week, every month. A person can also have a 'bad day' and corresponding different needs. Main characteristic of the examples mentioned above is that they are often highly dynamic. Research is needed to investigate how these persons could be served. In addition dynamic impairments are dependent on different situations therefore context awareness needs to be incorporated into the solution. The solution will broaden the target group for inclusive products which can be interesting for manufacturers.

SD2#51: [DELETE] Support research on emotional interaction

SD2#52: Support research on the implications for people with disabilities of the use of biometric systems for identification and security
Biometric systems could be embedded in an intelligent environment that could recognize a person and then tailor the interaction to their particular needs within a given context. Where biometrics are to be used to gain access to a given service or interface, research is required to ensure that no groups of users are being excluded from the service because of the means of biometric identification.
This is a critical area for research. We all know that some people don't have some biological systems (fingerprints, irises, etc.) so anything which depended upon one of these (and sometimes even one of two of these) would not be accessible.
The research may focus on things that everybody has such as a heart beat or their circulatory system.
The research could focus on the most compatible combination of approaches that would work together and always provide something that an individual had. Especially pre-work through of networked systems there might be a very wide range solutions.
Any use of cloud technologies such as GPII will of course need to have some type of authentication. And if we are working with people all over, codes will not work and biometrics may be the most reliable and usable.

SD2#53: Research into how AT can provide better than typical results (e.g. cyber-human)
This is in two dimensions.
1. Disabled person with prosthetics / orthotics may achieve goals that 'typically' ambled cannot (e.g. 'the blade runner' south African athlete)
2. Assistive technology may enable both typically ambled persons to perform tasks that the context at the time may make impossible to complete ordinarily (e.g. using a computer in the dark with Jaws)

This positive side of the assistive technology domain needs formal principled research, beyond what the military is doing now.

SD2#54: Research on how to increase and widen accessibility in professional education

SD2#55: Identify human factors barriers to health, education and participation of low income groups

The opportunities created by digital technologies are not enjoyed by the whole of society; indeed, there is a strong correlation between digital exclusion and social exclusion. There are significant and untapped opportunities to use technology better on behalf of citizens, communities, and digitally disenfranchised groups. However, to achieve inclusion, systems must be created seeing the human factor as a part of an integrated solution from the outset, not as an adjunct but also not as a focus. In addition, the multiplicity and ubiquity of devices and their interfaces are key to successful inclusion, and systems must be tailored to what users actually require and will use; as opposed to what organizations and government require and use. For instance, uses on low income may not be able to afford general-purpose computational facilities and therefore it may be more appropriate to deliver applications and content via other mediums such as mobile devices, games consoles, digital television, or other as yet undefined applications and devices. Only by making sure there is access to, what now seems to be compulsory digital interactivity in areas such as education and health care, can we make sure that the next generations have better chances than the current one.

SD2#56: [DELETE] User interface as a service (exploring market and technology challenges)

SD2#57: Further research on static and adaptive user interaction profiles

This research line aims to change the paradigm of the interfaces design from "one-size-fits-all" to "one-size-fits-one". Its objective is twofold:

- Adaptive interfaces. The user interfaces will not only adapt to the user needs and preferences, but also will adapt to:
    - Time changing user needs (e.g. due to highly dynamic impairments)
    - Context information (e.g. indoors, outdoors)
    - User behaviour (e.g. presenting common operations of the user or changing the interface for a simpler one when the user seems to be confused)
    - Temporal constraints (e.g. in a sunny day some Automatic Teller Machines' interfaces may use high contrast colours)
    - Etc.

- Interaction profiles. Medically based categories of disabilities do not provide useful information about the needs of the individual. Many people "fall through the cracks" or feel that their needs are stereotyped according to one classificatory category when ICT access solutions are delivered according to traditional disability groupings. A classification of being "blind" does not indicate whether they are Braille literate, have any tactile sensation in their fingers, what language they speak, whether they have good hearing, whether they have residual sight, colour or light sense. As such the category does not provide useful information for configuring an ICT system. The variety of needs that are grouped under the classification "blind" can be vast.

Recognizing that persons with disabilities are one of the most heterogeneous groups of users and that individuals with disabilities are likely to be constrained in their ability to adapt to a stereotypical characterization of their access requirements, a new approach to inclusive design was developed which enabled users to create their own individualized personal profile from an extensible list of common functional descriptors. This enables a one-size-fits-one response from a system that is able to transform, augment or choose from a pool of diverse

resources. This approach was first specified in the IMS AccessForAll standard and later in the ISO24751 multi-part standard *[Source: proposal of FP7 IP project: "Cloud4all", selected by the evaluators and currently under negotiation]*.
It is interesting to note that we are talking about interfaces and not talking about devices. The key is to separate the idea of interface from the idea of device. We need to start thinking about how to think of interfaces as services or ways to access services.
In the future we will be less about devices and more about functions.
Accessibility we need to think about interface as being separate from device or function. Mainstream products will never provide a variety of interface we need. We need to figure out how to allow swappable or pluggable user-interface is so that people can use the interface they need. This takes us back to the URC work.

SD2#58: [DELETE] Research on the methods for haptic usability

SD2#59: [DELETE] Research on inclusive interfaces for entertainment

SD2#60: To promote common research on user needs and preferences to be used by all e-inclusion projects

When most of the European projects that are dealing with accessibility start, they first carry out a study on the state-of-the art and user needs and preferences so that they can identify their limitations, their desires, their needs and their preferences. The main problem is that most of the time, this effort is done several times and we are effectively reinventing the wheel and we are wasting effort that could be more efficiently redistributed amongst the projects. So the idea is to have a common research and database where user organisations and technological partner look for the accessibility of the different ICT and assistive technologies so that they can identify these preferences, needs and limitations. This information could then be provided to all the other projects dealing with accessibility so that they can use this state-of-the-art as an input into their project.

SD2#61: Ways to move from purchase to lease or renting accessibility and assistive technology (exploring market, policy and technology challenges)

In the recent years we talk about software-as-a-service while for several decades now we are all used to the concept of leasing a car or equipment or a house. So it seems that it is high time that we make the transition towards new ways to move from purchase to lease or renting accessibility and assistive technology. Why own a communication aid if you can lease one? And why own a navigation system for blind or elderly while renting one as a service? Social insurance agencies may also have their own views on this – it may prove more cost-efficient for them both for the long run and for an immediate introduction; however there is need for exploring market, policy and technology challenges and dynamics. Finally accessibility matters here again: if you leave the ownership model to move to the leasing or renting, you need intuitive accessibility in the offered solutions as your users don't regard anymore the learning of the system as an asset. As long as you may use a system for a few days or weeks, it needs to be easy-to-use and make the life of the user easy regarding manipulation and maintenance.

SD2#62: Digital literacy stepping stones

SD2#63: Research on automated evaluation aids

Although it would be ideal if everyone had a crack team of specialists to evaluate their needs and make recommendations for accessibility solutions, we do not have anywhere near the number of such specialists as are needed to address everyone who needs special interface assessments. In addition the specials we do have trouble keeping up with everything that is available.

Research is needed on the development of evaluation wizards that can be used both with and without professional evaluators to help users figure out what types of solutions would be best for them. Where professional evaluators are available these wizards can help to make the evaluation process go more quickly and provide ways to try out ideas with users. They can also help suggest new interfaces that the evaluators may not be familiar with but that should be considered allowing evaluators to keep up-to-date in this rapidly changing area. For those who cannot afford or who live in a place where evaluators are not available, use wizards can help people become familiar with different techniques or strategies that might address their needs.
All of this is much easier to say however that to do in the evaluation process can be quite complex. So while there is great need and potential for this is also a very difficult area. This would make it a difficult but high payoff and high need area of research.

SD2#64: Basic research needs to be made on AT abandonment/adoption
There are only a handful of papers on AT abandonment, mostly form the 90's. In order to fully address the distressing level of AT abandonment (40-70%) a principled, longitudinal research agenda of this phenomenon, segmented by AT and user type and compared to similar non-AT systems needs to be set out on. The implications of the resultant body of knowledge could potentially deeply affect AT form design to marketing.

SD2#65: Interface design - knowledge of computer paradigms
Current use of technology relies on extensive knowledge of the system and this inhibits users. Examples such as radio buttons, dialogue boxes, menu windows. These are not simple terms for novice users. Context information and how that should be represented in the most user friendly way needs to be explored.

SD2#66: Interface design: input and output
More often that not, the usability of a system is a poorer cousin to accessibility when an interface is designed for disabled people. Web accessibility is a prime example as it is possible to have a more accessible website which is completely unusable. When designing an interface, consideration needs to be given to the integration of accessibility features so that the user can navigate and use the device as quickly and as efficiently as possible. The Accessibility features need to be "smart" rather than dumb. By this I mean that the importance of information needs to be considered and how and when it is delivered to the user.

SD2#67: Usable accessibility
An interface should be configurable, or at least a variety of interfaces should be available, to allow a user to choose from a range of different input and output methods without impeding on the functionality of the rest of the device. An example of this using a touch-screen paradigm could be that when the user has to input text for an SMS message the alphabet could be in a vertical list with the user scrolling up and down to the letters rather than having to input text using an onscreen keyboard. This differing input or output method could be delivered by an application.

SD2#68: [DELETE] Standards for accessibility

SD2#69: New mechanisms for international collaborations
There is tremendous need and limited funding in the area of accessibility. The European funding model has created a mechanism for international collaboration within Europe but mechanisms are needed to prevent duplication of effort and to allow closer collaboration between all nations in this area.
Pooled funding and cross jurisdiction funding are both extremely difficult. However other

mechanisms might be explored. Some of these might involve common roadmaps and research platforms. Others may indeed involve international collaborative efforts among funding agencies.
We should explore this to find better mechanisms for building on each other's research in a coordinated fashion.

SD2#70: Research on how to make accessibility simpler to deliver, apply, configure, support and use and explain to policy makers
- simpler for users to figure out what meets their needs
- simpler for companies, schools etc to apply it, and maintain it
- simpler for users to install, invoke, configure
- simpler to (re)apply across all the technology that people encounter.

SD2#71: Research on sharing accessibility knowledge with developing countries
Few researchers in developing countries such as Thailand or China are investigating accessibility in their culture, using their own language and develop an understanding of the processes involved in creating a sustainable impact. Often the economics is much more demanding low budget solutions. The development of eScience has shown in the past an approach to create distributed research groups. Developing countries may become involved in research on accessibility of training material is provided, best practice approaches described and pitfalls are expressed.

SD2#72: Dynamic composition complex interfaces (mash-up of services)
This is an emerging trend linked to the automatic generation of personalized interfaces that requires of more research. It focuses on the automatic generation of personalized interfaces by using a mash-up of Web services.

A use case is shown below: "Mario is a Spanish blind person travelling abroad. When interacting with a public eKiosk, he indicates that his preferred language is Spanish and that he requires a screen reader. The eKiosk have installed software for automatic generation of personalized interfaces enhanced with the possibility of using mash-up of services. In order to provide the most suitable interface to Mario, the eKiosk's software composes a personalized interface by making use of its personalization capabilities, and two Web Services (WS): one WS provides automatic translation among different languages, and other WS provides screen reading services".

SD2#73: Accessibility of IPv6 enabled consumer appliances
IPv6 will be the new Internet addressing protocol and we will see a large take-up of IPv6 by ISPs in the near future as the current IP addresses are being depleted. There is a potential that an increasing number of consumer appliances will have unique IP addresses, which can automatically connect to the Internet for maintenance and communications. The day of the Internet-enable fridge and washing machine may be coming. Already in Japan, rice cookers are connected to the Internet. People use rice cookers daily and if an elderly person hasn't used their rice cooker, a message is sent to their relative and/or a service centre that they may need assistance. It is an opportunity to research inclusive HCI in a wide range of IPv6-enabled consumer appliances.

SD2#74: Support research on accessible interaction with robots
A great deal of research is being carried out in the field of robotics. There are of course many different fields where the applications could be implemented, including the area of Ambient Assisted Living and daily help at home. For example, there could be a role for robots to assist older people in their daily lives. It is important to support research that

ensures that any new applications in this field take the users needs and preferences into account. It is crucial that this area should include aspects both from the technical user-interface and human factors points of view.
As noted elsewhere, this whole potential not only for more natural ways of controlling robots but also for having robots as companions.
It also raises the ethical questions around using robots instead of humans to serve as companions. Though it is not entirely clear why this would be different than using animals for companions.

SD2#75: Create development environment for accessibility solutions

We have an incredible resource in professors, students, clinicians, and consumers with ideas on how to create new or improved accessibility solutions. However it is often very difficult to do all the work needed to build them from scratch. It would be much better if these individuals had an environment where they could realize their ideas without having to write massive amounts of code. Apple has had great success in creating a myriad of new, creative, (and some not so creative) solutions by providing a development environment that made it easy to create applications in a rich set of tools to build them with. It is possible to create applications in as few as three days.
By creating open source platforms that can be easily adapted by researchers to create functional solutions we can tap this creativity more easily in the more ideas get to market.

3. Research Actions and clarifications from CARDIAC SDDP3 in Florence in response to Triggering Question: "What research actions should be supported in network infrastructures and services to facilitate eInclusion?" (denoted SD3 + #number)

SD3#01: Research on user trust and confidence issues

Research on how to ensure user trust and confidence for the new systems is needed. Trust and confidence are crucial factors that affect how users will perceive and ultimately use new technologies.

SD3#02: Explore how users interact and cooperate with intelligent systems

It is a characteristic feature of "intelligent" systems that they learn, adapt to changing conditions, and as a consequence change their behaviour. This makes it in principle hard for the user to predict the system's behaviour. How does the user become aware of the AmI system functionality, i.e. the actual support it is going to provide. How will he trust the system; is it reliable according to his expectations?

What is the relation of

- the view the user has of the system (mental model) and
- the view the system has of the user (user model)?

SD3#03: Exploitation of social network and cloud computing to support independent living

Facilitate full participation of people with disabilities through increasing availability and speed of broadband and internet access extending the availability of mobile computing and exploitation of social networking and cloud based services to support people in independent living.

SD3#04: Development of training modules about the needs of people with disabilities for developers of AmI systems

Designers of AmI systems may have a superficial idea of the needs of people with disabilities. These designers might benefit from appropriate training about these needs (e.g., the practical problems experienced by people with intellectual impairments). The development of suitable training modules will not be a trivial task.

SD3#05: Research to evaluate automatically end-users needs and preferences while interacting with ICT

Currently there is a research trend on providing user interfaces adapted to the end-user needs and preferences. In order to be able to adapt the interface, the end-user requirements should have been gathered and stored in advance, or during the interaction. The automatic evaluation addresses the question: What are the user requirements for the end-user interacting/using the ICT product/service.

Regarding the automatic evaluation of end-users in advance, in order to provide personalized interfaces, several current trends exist, e.g.:

The end-user selects the most suitable persona from a set of available ones (e.g. the blind persona activates the screen reader)

The end-users specify their needs and preferences through forms (e.g. larger fonts, easier language, high contrast screens, etc.)

The end-user uses games or wizards designed to carry out these evaluations (e.g. measuring the time to respond or the accuracy of the clicking in several objects)

An even more advance trend is gathering the end-user needs and preferences during their interaction with the service (it can start from previously gathered information or from

scratch), in order to adapt the interface (adaptive interfaces) according to the end-user interactions with the system.

SD3#06: Make the world accessible yourself

Research focusing on the contributions that users can have in terms of making the emerging networks and services accessible themselves. Linking in to the development around web 2.0 where the emphasis is on social interaction and collective intelligence. Going a step beyond asking what users would like and what problems they face by giving them an active role in shaping solutions. Making use of the fact that a large group can be reached that can speed up the process. Focus on the best way to use the practical knowledge that the end-users have and their capabilities to develop.

SD3#07: Research on formal methods to validate e-Inclusion services

Formal methods to validate e-Inclusion services
Research on specification models, i.e. interactive processes, suitable to describe human interactions and needs in order to develop interactive services for e-Inclusion.
Interactive systems so specified must be validated with automatic/semi-automatic techniques in order to accomplish human needs in some specified context

SD3#08: Research on mechanism of collective intelligence technology-mediated in and for e-Inclusion

Collective intelligence is a phenomenon which is studied in several different fields of application, with good results, as the way to obtain great results with many small contributions and with the help of technology. This mechanism could provide results also in e-Inclusion filed, if studied.

SD3#09: Integration of web 2.0 with internet of things (IoT)

Augmenting the interaction with people through the Wb2.0 with the possibility of interacting with objects in the environment or in remote places can give people additional possibilities.
A trivial example could be a person interacting in a social network about recipes with the selected recipe transmitted to the fridge that controls the availability of all ingredients and, when necessary, buys them in the supermarket.

SD3#10: DELETE] Research on training end-users and carers SEE 62

SD3#11: Adaptable and affordable Assistive Technologies seamlessly integrating into AmIs

Inclusion and participation of people with disabilities often depends on using personal Assistive Technologies (AT) supporting the interaction with systems and services. These ATs have to become more intelligent („micro AmIs“) and all other systems and services („macro AmIs“) have to respect and implement requirements for these ATs. In this way standard accessibility issues have to be brought into Web2.0 and AmI environments.

TEXT FROM idea SD3#88 (deleted)
The idea here is research how the emerging network infrastructure and Ami could be exploited to help hearing aids adapt to changing acoustic environments. This could include, for example, either moving from one room to another with different acoustic properties, or changing acoustic environment within the same room, for example, changing from a situation where there are two people in the room to a party situation with 10 more people talking.
This idea is a subset of #11: Adaptable and affordable assistive technologies seamlessly integrating into intelligent environments.

SD3#12: Research and process to balance intellectual properties right and the right of access to knowledge

IPR was originally established to promote cultural, scientific and technological originality and development of the society. I respect the original idea. However, current IPR situation, such as Submarine patent and DRM, is sometimes negatively impact on the rights of access to knowledge. E-Inclusion must solve this issue by scientific analysis so that a society may find the balancing point through open discussion process supported by scientific analysis. Scientists, not only engaged lawyers, need to work on open and scientific analysis of the situation.

SD3#13: Interoperability of devices networks and services

In order to be accessible, services provided through networks must be accessible through a great variety of interoperable devices (including Assistive Technology).

SD3#14: Content generated by web 2.0 users should be controlled to be accessible

Web2.0 is characterized by user content generation. The accessibility of this content should be controlled.

SD3#15: Research on social impact of e-Inclusion

Involve sociologists and psychologists in research teams to understand better the needs and constrains of users with new technology and the possible impact of e-inclusion on society such as family relationship, social interactions and contact, personal care, social dominance and leadership,

SD3#16: Getting the details right supporting creators with the micro-issues

Many systems and services become inaccessible to users not because of the intention of the creator or designer but due to their lack of knowledge. This lack of knowledge can include not knowing that design information is available to help them and not knowing where to look for the information. This lack of knowledge can result in design decisions, which negatively impact the lives of older and disabled people whilst the decisions made may have no positive effect on other aspects of the system. Minor decision decisions can effectively result in systems becoming totally inaccessible for some users. The knowledge the creators require is partly codified in standards. Training is also required for the creators.
(Links to 4 and 60)

SD3#17: Adoption of the paradigm of end-user computing to involve users in the service development process

End user computing helps users become builders and co-builders of their own applications and services. So what best than enabling all different categories of users with varying degrees of access capabilities to become co-creators of the services they will eventually use? So the idea here is to accommodate end user computing principles in the future service development environments.

SD3#18: Research on changing attitudes

Today there is already a lot of information, processes and work done to facilitate e-inclusion. But the dissemination and the implementation are far behind, most due to attitudes of the different actors. How could we use the emerging network infrastructures and services to change the attitudes of: stakeholders, users, political, researchers, designers, etc.

SD3#19. Research on how to integrate social objectives in ICT

Although we all probably agree that ICT has been developed for all human beings, the truth is that we can´t forget that this is a Industry driven area, focusing on getting the most profit to pay their research and development, so specific groups of the population are often "forgotten", namely those with more severe activity limitations. There are groups of persons, e.g. persons with complex communication needs and some order people that many times are not able to communicate face-to-face or at distance. It is crucial that ICT developers take into account in their developments the number of persons that have these "communication" problems are increasing (specially older persons that become more and more isolated) so their social objectives must be taken into account.

SD3#20: Research to predict the impact on the decision making process of the end-user

To predict the impact of emerging technologies in the decision making process of activities and services. Emerging technology changes the way of thinking and to analyse a concept, a task an activity or a service creating or changing reasoning steps that may conflict with people traditional way to establish their decision – making process leading to technology rejection. This has a particularity importance in relation to the elderly and carers organizations.

SD3#21: Merge research on society and on education with technological R&D

If we look at the three-tiers structure of ICT/AmI related EU funding programs (FP7-ICT, AAL, CIP ICT-PSP), it appears that they are potentially effective on Independent Living and Healthy Living, two life settings where technological drivers play a strong role. On the contrary, such programs, as they have been until today, are intrinsically unfit to address life settings like recreational and (from a certain perspective) occupational activities, which are affected more by economic, social and organizational drivers. New actions should be promoted, integrating Technological R&D+I with other instruments, e.g. with lifelong learning and empowerment.

SD3#22: Research on data use and data protection related to the information society

Explore methodologies, practices and legislations, both at European and national levels, related to the use of data and its protection in the Information Society

SD3#23: Research on multi-modal interaction methods

Multimodal interaction methods and alternative input-output technologies are essential to ensure participation in the emerging ambient intelligence environment. Apart from looking at the user interface aspects, it is also important to ensure that they are seamlessly integrated within the emerging systems and services.

SD3#24: Research on the ethical and legal requirements and consequences

Ethical aspects may refer to

- Privacy of data (Do other people or systems get to know the user's intention and behavior?)
- Security and reliability (Who is reliable when the system acts on behalf of the user?)
- Legal issues (Who may do what and get to know what?)
- Dependence / independence of the user (How far does the AmI system guide/ lead/ manipulate the user by making decisions for him?) How is "intention detection" and "intention suggestion" related?

SD3#25: Research into educating standards committees on accessibility issues

Awareness is a big issue for standards committee and users need to be involved at all stages. Many emerging technologies for people with disabilities depend on the use of open standards so we need to address how standards committees can be further educated about accessibility issues. Awareness campaigns and involve users at all times.

SD3#26: Research on the optimum structure and content of data storage to accommodate the need of people with disabilities

If the structure of a data storage system does not allow for data of particular relevance to people with disabilities, then it may be impossible for the service to meet their needs. For instance, an indoor navigation system may need to contain more specific information for a blind pedestrian than for a fully sighted person. Also a blind person might benefit from knowing which buses stop at a particular bus-stop and when the next bus will arrive (and the data will need to be stored such that it can be presented verbally as well as visually).

SD3#27: Research on assistance-on-demand systems

Despite advocating for the need of making all Internet content accessible for all sorts of people with special needs, this idea addresses the exploitation of the potential of the Web Services to provide automatic assistance-on-demand, and Web 2.0 in order to provide human assistance-on-demand to overcome existing accessibility barriers.

This may help disabled people when surfing in Internet and dealing with non-accessible content. For example, a deaf user trying to access a non-accessible video would be able to invoke an automatic assistance on demand system that provides automatic captions. Another example, a blind user surfing through a website without alternative text in their images would be able to ask for human assistance on demand to the system to obtain an interpretation of the image.

SD3#28: Adaptation of the environment to the needs of several persons at the same time

To be able to personalize the environment, adaptation the environment and a proactive environment are some of the key selling points of AmI. However a lot of cases in that environment more people will be present. How to make that a reality? Therefore research is needed focusing on how to deal with multiple users in the AmI environment. How to adapt the environment to the needs of several persons at the same time? Especially important when there isn't one single interaction device but the entire environment is part of the interaction. If this is possible possibilities for personalization are available which will enhance e-Inclusion.

SD3#29: Research on simplification of services and infrastructures observing human interactions needs

To simplify the interactions between human and IC services we need to analyse and model human interaction needs. We could drop out many things that are not useful and can simplify our effort to create environments that include all people.

30: Research on how to structure in an appropriate way all information for e-Inclusion available on the network

Nowadays a lot of information is provided by different sources also in the field of e-inclusion. Up to now a limited number of traditional channels have been used (specific web site, specific mailing list) in order to exchange and extract information, which can help people to solve their problem or to improve their situation. The study of different mechanisms (such as semantic web), which automatically give a structure to this information, can provide a way to make most of this information reusable by other people

and by machines in different context.

SD3#31: Identify impact of cloud platforms
Are cloud platforms only an interesting commercial new idea? Are there service as and applications that cannot exist without being made available on a cloud? Are networks so available and reliable to allow a continuous and seamless use of cloud applications?

SD3#32: Research on the use of social media to reduce isolation
It is assumed that all access and usability issues have been resolved, so the idea here is more to look at how social media networks could play a role I reducing isolation from a sociological point a view rather than a technological point of view.

SD3#33: Business benefits and business models for e-Inclusion
e-Accessibility and e-Inclusion argue not only for their ethical, social and social-economic benefit, but also for their business benefit for mainstream product, system and service providers. When asked, „where is the evidence" we are still, besides demographic data and some single examples, short of evidence. Providing such data and generating business models leading to investment and return of investment.
Of course this should be embedded into on-going social and social-economic benefit studies where there is also still a lack.

SD3#34: Research on accessible knowledge infrastructure that includes scientific knowledge
E-Inclusion is a process that is supported by active participation of all stakeholders who have different abilities and requirements. Access to scientific knowledge is crucial to take part in the process but sometimes scientists ignore accessibility of their own ideas.
People at large must make decisions based on accurate information and data hopefully with evidence. A scientist with a disability may become the best interpreter of scientific knowledge in each scientific field. Therefore it is crucial to address the special importance to make scientific knowledge accessible to all stakeholders in particular to those with special needs.

SD3#35: Safe methods for sharing user models
Study safe and privacy aware methods to share or export the user models/profiles to allow user adaptation.

SD3#36: Promotion of Open Data apps to improve the implementation of accessible front-end Apps
It is interesting to promote Open Data app implementations or extensions to non-accessible apps. That would improve the implementation of accessible front-end apps.
Some extra explanations:
Open data is the idea that certain data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control. Open data is often focused on non-textual material such as maps, genomes, connectomes, chemical compounds, mathematical and scientific formulae, medical data and practice, bioscience and biodiversity. Problems often arise because these are commercially valuable or can be aggregated into works of value. Access to, or re-use of, the data is controlled by organizations, both public and private. Control may be through access restrictions, licenses, copyright, patents and charges for access or re-use. The concept of open data is not new; but a formalized definition is relatively new. The goals of the open data movement are similar to those of other "Open" movements such as open source, open content, and open access. (From Wikipedia: http://en.wikipedia.org/wiki/Open_data)

SD3#37: Research and design for the intermediate period
Study design strategies for the intermediate period between technologies, and how to influence people to use the new technology, how to "rap up" it in a familiar appearance (interface).

38: Adaptable and adaptive systems that support the individual
The abilities of people change over time (in both the short and long term). As their abilities change they want systems and services to support their life, not the life of some theoretical older and disabled person. This research must adopt a user-centered approach to take into account the non-homogenous nature of older and disabled people.
(links to 11 and 13)

SD3#39: Explore methodologies for value co-creation in service development environments
Value affects not only the look and feel of a service or an application but also the functionality it supports, the interface and the overall experience that the user or service consumer receives. Here, the aim is to define methodologies that follow this co-creation path and take care so that value is generated for all involved parties. The idea of value is relative and may vary from context to context. Also aspects of intellectual property of the value created need to be properly addressed.
(See also idea 12)

SD3#40: Research on privacy issues from the en-users point of view
It is important to research how to assure privacy issues in the infrastructures and services of all users. Also important to research the best ways how to educate the users to also protect their privacy (including ethical and security issues).

SD3#41: Better inclusion of assistive technology in mainstream industry
Mainstream industry often "does not care" too much about making their products accessible to everyone, although they usually state that they follow accessibility rules. They are experts in technology not in accessibility. One possible solution for this problem could be for mainstream technology to follow standards or rules of engagement that allow assistive technology industry to "interface" with their products and make them really accessible. The knowledge on e-accessibility is mainly in the hands of the AT Industry not in mainstream Industry.

SD3#42: Research to predict the new user-needs created by new ways to perform activities
New requirements appear with emerging networks infra structures and services leading to new user performance needs and careers acceptance. An ongoing process to fulfill the gap between requirements and needs helping the system / users to adapt and to incorporate new activities created by those new environments is necessary to be implemented at different levels (mean fullness: answering to the user life styles, cultural, attitudinal, performance).

SD3#43: New materials, technologies and methods for seamless natural human-environment interaction
The living environment must become THE INTERFACE. All human interaction channels can take part in the process: voice, gesture, expression, manipulation/touch, gaze, as well as implicit channels like emotions and health/wellness status, and their physiological symptoms. A wide range of new sensors and actuators, both on-body or embedded in the environment, and of new materials will be needed for this purpose

SD3#44: Research on the reliability of e-Inclusion services

Analyse the reliability of products and services for e-Inclusion, the reliability of their interoperability, to check the systems in place for coping with eventual failures and to explore the issue of reliability especially from the user perspective

SD3#45: Research on the emerging dimensions of Security and user privacy issues in AmI applications and services

Security is an increasing concern in the AmI environment and crucial in facilitating Inclusion because of its characteristics related to:

- Size (millions of subjects and objects);
- Mobility (more vulnerability than in a static world);
- Heterogeneity (open system architectures);
- Complexity (regarding both hardware and software);
- Distribution of knowledge coupled with co-operation (individuals & groups interconnected and working together).

Therefore, these new dimensions of Security in the context of AmI infrastructures is have to address:

The reliability of critical infrastructures,

- Their resilience (systems must continue to operate despite threats and despite actual, successful, attacks) and, ultimately,
- Ethics, as AmI environments must be able to provide secure and resilient systems which at the same time are unobtrusive for their users, can identify the goals of users and find out ways to satisfy them with available resources, while inspiring trust and confidence and being easily controllable by ordinary people.

SD3#46: Explore how the work conditions of older people can be improved by AmI systems

AmI systems need to be implemented in complex environments or application contexts.

A context worthwhile to analyze in detail is the work place or work conditions of older employees who need to sustain their work capability in a more and more complex getting vocational world – coping with a decrease of cognitive abilities of the older employees. – How could AmI help?

SD3#47: Research to determine at what stages users should be involved in e-Inclusion projects

Traditionally designers do not involve users at development stages research into at what stages in the project do users need to be involved in e-Inlcusion projects and what are the perceptions of manufacturers of user involvement in emerging infrastructures and services. What has been the experience of users to date?

SD3#48: Development of tools for testing that proposed AmI systems fully cater for the needs of people with disabilities

The developers of AmI systems need tools, which are easy to use which identify potential problems for various groups of people with disabilities. This testing needs to be done while the proposed system is still at concept stage.

SD3#49. Research on matchmaking systems for identifying the best match of available configurations or additional ATs according to the user needs

Most mainstream ICTs have several configuration modes for their user interface, and some of them even embedded Assistive Technologies (ATs). However many end-users does not know how to activate them or even their existence.

The automatic identification of the most suitable configuration of the user interface of the mainstream ICT or the invocation of the required AT (either embedded or external to the system) according the end-user needs and preferences may be obtained by algorithms (rule-based, statistic-based, hybrids, etc.) that must be further researched.

SD3#50: Problems and possibilities of the AmI environment for e-Inclusion

Research targeted at the balance between the additional problems the AmI environment can create in relation to e-Inclusion and the additional possibilities for e-Inclusion that are available as a result of the AmI environment. By looking at problems and possibilities of the AmI environment better insight will be gained in the relationship between AmI and e-Inclusion.

SD3#51: Research on social interaction design to develop new social inclusion tools

Research on social interaction design to develop new social inclusion tools. Social tools such as web social networks have much potential to allow people collectively participate to a communication; to better exploit such a potential we have to focus on this new kind of interaction design, the social one.

SD3#52: Research on dynamics of social networks

Research on dynamics of social network: social networks are a current phenomenon which is giving good results in several different fields of application. The study of the specific dynamics can represent a new way to activate interaction between people for a better quality of life

SD3#53: Mainstream knowledge developed in the rehabilitation environment

Users do not have only needs, but many times they and their carers are also able to develop solutions. It is sometimes written that solutions developed for people with activity limitations are often useful for all. Is it true and to what extent? Is it possible to construct mechanisms for transfer? Example – impact of studies on language difficulties on text interfaces.

SD3#54: Research on how to exploit the emerging network infrastructures to enable people to vote securely

The issue of confidentiality, security and trust would be key in setting up any remote voting systems. The idea here is to investigate whether the new possibilities by the emerging technological infrastructures could be exploited to proved a secure means of voting for all members of the public including people with disabilities.

SD3#55: Design- and authoring tools ("e-Inclusion Suite") supporting and automating e-Inclusion

Awareness for e-Inclusion is rising, also legal and political demand. But in practice designers and developers are struggling with the complexity of a divers set of users and according needs. We are handing over a huge bunch of requests to mainstream. Guidelines, standards, user models, profiles and simulations of aging and people with disabilities, ATs, testing and checking tools, methods, gadgets, tools, user models, examples (code snippets) … should be integrated in design and development environments allowing developers and designers access to the know-how when needed and even being forced to implement it. Such support should be integrated or invoke able into design and development environments which mainstream is used to.

SD3#56: Assessment of the impact of electronic publishing including digital rights management

E-publishing may give better opportunity to people with disabilities if we successfully develop standards, applications and social systems. However, we have great concern on preservation and accessibility of current electronic publications in the future. Compared with publications on paper which may last hundreds years, it is not easy to guarantee that people may have access to current electronic publications in 2112 or later for example. When we say accessibility, it is not just for current generation but also for future generations.

SD3#57: Cloud computing for service ubiquity

Network services that need to be deployed in a medium or large-scale scenario can benefit from cloud computing. In this regard, providing interoperability among different cloud computing platforms is important.

SD3#58: Research on Responsive Design based on HTML 5 standards to improve access from all kind of devices

Responsive design is being successfully implemented, based on HTML5 standards, for improving access from all kind of mobile devices. That should be also explored for devices configured for accessibility. It is the fifth revision of the HTML standard and, as of May 2012, is still under development. Its core aims have been to improve the language with support for the latest multimedia while keeping it easily readable by humans and consistently understood by computers and devices (web browsers, parsers, etc.). These features are designed to make it easy to include and handle multimedia and graphical content on the web without having to resort to proprietary plug-ins and APIs. Other new elements are designed to enrich the semantic content of documents. HTML5 also defines in some detail the required processing for invalid documents so that syntax errors will be treated uniformly by all conforming browsers and other user agents.
(From Wikipedia: http://en.wikipedia.org/wiki/HTML5)

Responsive Web Design (RWD) essentially indicates that a web site is crafted to be able to adapt the layout to the viewing environment. As a result, users across a broad range of devices and browsers will have access to a single source of content, laid out so as to be easy to read and navigate with a minimum of resizing, panning, and scrolling.
(From wikipedia: http://en.wikipedia.org/wiki/Responsive_Web_Design)

SD3#59: Well-controlled field studies and large randomized experimental projects

Perform field studies (e.g. "living laboratories") to let people check the technology at home at real conditions.

SD3#60: Research into methods to promote best practice in inclusive design to mainstream designers

This research must investigate how we can ensure that best practice information on designing technology for older and disabled people is passed on. The information must be passed on in a format, which can be used at the time it is required (or just before). Research is also needed into how we can maximize the chance of audience being receptive to that knowledge.
(links to 16 and 4)

SD3#61: Incremental and evolutionary learning algorithms (machine learning) for users, systems and machines when dealing with web content and complex environments

Systems, machines and humans need to accommodate their individual learning needs when interacting with any new content or system. Improvement of the access to service and content experience can not only happen after training but also as a result of a planned evolutionary learning process.

SD3#62: Research on how people can understand and use the full potential of AmI

For example, most people that I know to produce a table of contents in word processor do it by hand. There is a gap between what technologies can do and what users really use it. So it is important besides develop the technological solutions to assure that the most excluded persons will use it in particular.

TEXT FROM idea SD3#10 (deleted):
The degree of awareness, understanding and adoption of any emerging technology or service is partly dependent on the degree to which end-users and their carers (both formal and informal) are able to use the system and understand the potential benefits. The basic idea here is one of empowerment of the users in ensuring that they are aware of the full benefits and possibilities of Web2.0 and the ambient intelligent environment, especially where there are possibilities for users themselves to intervene directly in the design and setting up of applications. Research should be supported into how this could be best achieved through the development of training courses.

SD3#63: Research on more intelligent interface that allow persons with progressive limitations of activities to interact in AmI

Persons with progressive limitations of activities (e.g. with neurological progressive diseases) that rely a lot on AT products mostly based in ICT products to be able to communicate, need to have interfaces (hardware and software) that in a "intelligent" form, adapts to the progression of their limitations in all the contexts (changes in the environment and/or change in the activity).

SD3#64: AmI that acts: unifying research ion AmI and robotics, starting from interoperability standards

Interaction between service robots and smart environments has been addressed in recent EU programs. If a smart environment must be capable of physical actions (e.g., to provide physical support when needed, or to perform an activity on behalf of the user), full and standardized interoperability must be granted between the different logical and physical modules dedicated to sensing, reasoning and acting.

SD3#65: Explore personal and collective health issues related to the use and misuse of technology

What are the implications and consequences on the health of users when using ICT? And what are they when ICT is not correctly used? E.g. studies demonstrate that the constant zapping from one program or application to another, receiving constant pop-ups, etc. hinder our concentration, our learning abilities, our knowledge management, etc. Studies around health issues on both individual and societal level could therefore be a further subject of research, especially in the long-term perspective.

SD3#66: Research on human – environment relationship

It is crucial to ensure that the emerging technological environment is actually able to accommodate users needs and requirements according to their personal profile (e.g. culture, technical knowledge, possible impairments), the different contexts of use, and their emotional situation in order to find a compromise between privacy and possible security aspects. The idea here is that users are in a constant dialogue with the emerging

technological environment that surrounds them and which is constantly changing / evolving. As such, user needs and requirements are also constantly evolving. Research on this constantly changing relationship between the human and their surrounding technical environment is thus needed.

SD3#67: Explore how complexity of operation and application can be reduced by AmI systems

Modern ICT systems often claim to make "life" easier. This may be true to a certain extent. But often the opposite is true: people do not understand how to operate/ use the system and get frustrated. How can AmI improve this situation?
Researchers should develop models of complexity for system operation, including measurement of complexity, as well as cognitive models of the user.

SD3#68: Research on the experience of end-users in e-Inclusion projects

Traditionally, designers do not involve users until the product is developed. What are the perceptions of users before moving to exploit emerging network infrastructures and services for e-Inclusion. What has been the experience of users to date in e-Inclusion projects?

SD3#69. Research on the ethical and security issues arising due to the storage or sharing of end-user profiles

Recently, we have seen security leaking of users' information in several web services. If the emerging networks are going to be used to store and share sensitive information (e.g., from the information on the interface preferences of their users, an external party may infer information, for example, on the users disabilities), the ethical and security issues involved must be carefully analysed and new systems should be researched.

SD3#70: Research on social cooperation models to support people inclusion

In many situations society naturally expresses cooperative models to help people with disabilities.
My question is: how can we facilitate and make more sustainable and replicable with technology/new services such cooperation models?

SD3#71: New perspectives for privacy and security in AmI

If privacy and security can represent an obstacle to a more and more adaptive services an appropriate study on these aspects (especially during the design phases of the product or of the service) can give a contribution to e-Inclusion.

SD3#72: Ambient user interactions

Interactions in AmI environments can be multimedia, complex and changing in time. They are not forced by the metaphor and/or dialogue built in the interface, but must adapt to the complexity of tasks and variability of the situations. The interaction system can be distributed in different objects. The resulting interaction dialogue must be harmonized as a function of the task, the situation and the user abilities.

SD3#73: Adaptive User Interfaces

The standard user interface (UI) intends to address as many people as possible. For a big (and growing) number of users these UIs cause accessibility or usability problems.
Individualizing the interface, based on profiles, users could benefit much more from available systems, services and AmIs. In particular with AmIs the need for increased usability and adaptation of UIs will increase. But it still can be based on the standard usability/accessibility criteria.

SD3#74: Disaster Risk Reduction: Participation of people with disabilities
World trends of the, DRR in short, becomes more and more "whole community" approach. "Whole community" means that everybody must make them selves a DRR asset, in other words people may not rely on rescue specialist outside of the community. The trends based on human experiences of mass casualty disasters such as March 11th 2011 earthquake in Japan. Rescue operation, which comes later than 30 minutes of disaster incidents, may not effectively save lives of those victims. Whole community approach is a combination of self-help and community based mutual support. If a person is hit by a tsunami or buried by debris it is too difficult to survive more than half an hour. Successful first response needs to be done by neighbors. Mobilizing all assets in the community requires sharing of scientific knowledge on disasters, participation in DRR planning, participation of evacuation drills, and development of personal scenarios for DRR. So far persons with disabilities including dementia, Parkinson Disease, sensory or physical disabilities, intellectual or cognitive disabilities, psycho-social disabilities, intellectual disabilities and persons who do not understand the main language of the community.

SD3#75: Research on economically affordable infrastructures and services
The economy is a factor that may have influence in the acceptation/rejection of a network infrastructure or service. Therefore, the research of quite expensive network infrastructures and services must be deprecated. The cost includes installation, operation and maintaining the whole infrastructure and service.

SD3#76: Promoting automatic content transformation
Contents transformation that can be done automatically could increase the accessibility level. Includes also different languages of devices and cognitive adaptations to languages.

SD3#77: Define criteria for success and failure of e-Inclusion
Develop and define multidisciplinary criteria for a success or failure of e-inclusion projects (economical, technical, sociological, satisfaction, long-term effects, side effects, spill over, etc

SD3#78: Fun, sustainable and accessible support systems
The use of electronic targeted support systems can be of benefit to the end users and to the society in which they live. These systems can also be sustainable. To ensure the long term use and initial take up of these systems they should also be fun to use.

SD3#79: Research on human-robot and human-robot-environment relationships
How will humans communicate with robots? Will there be natural language? Will there be an instruction-based (command and control) style? Will there be any room for emotions? And how should the service robots behave? Are they to be considered as extensions of the machines? Some type of maids with human-like attributes and characteristics? So, there is a lot to explore here and come up with innovative ideas...

SD3#80: New methods and tools for the design and implementation of ICT-enabled, person-centric service networks (and networks of networks)

e-Inclusion service networks should rely "natural" support networks (made of relatives, neighbours, friends and other formal/informal carers); so their logical and operational structure should mimic the existing one; the typical "star-shaped" topology, with a service center as a concentrator, should be overcome, and small proximity networks should be implemented, taking into account shared components as well (networks of networks)

SD3#81: User relationship with public and private e-services

Study how users are affected/ how users user public e-services, such as e-banking, e-voting, e-governing, and private e-services, such as e-commerce, in order to focus and act on the bottlenecks and concerns and find the way to improve those products and services.

SD3#82: Virtual reality for testing new applications

Virtual reality software have been used by people with disabilities for socialization, learning and business. Finding new ways to utilize virtual reality to test new applications with people with disabilities in a distributed environment could be beneficed in large-scale research projects in different locations. Also, Self-modelling foe people with cognitive impairments and psychiatric disabilities can be used as a technique for disaster management.

SD3#83: Privacy and security controls in pervasive sensing technologies (e.g., RFID ,WSN)

Pervasive sensor presents opportunities but challenges for privacy and security. For example, revisiting RFID row that the costs have decreased for tags and readers can be used as part of mobile phones should offer new applications. Privacy and security is centered to any new work.

SD3#84: Cultural diversity research

Have in line a research about adaptation to local culture and cultural diversity, including gender differences

SD3#85: Marketing and branding research for facilitating the use of the e-Inclusion

Avoid the image of sickness and disability. Develop research strategies of branding and marketing the technology as future living for everyone. Show the advantages for everybody from children to the aged.

SD3#86: Invisible technology

Research how to make the networks and services invisible and not different from normal current ones. Whenever you enter a home, you want to see that technology is embedded. If using RFID should look like normal and fashionable like a wristwatch or T Shirt. It shod be part of the environment.

SD3#87: Personalization of content and user interface

In order to promote e-Inclusion a higher level of personalization in term of content and user interface design should be supported in social nets and web 2.0 platforms. Content personalization that selects the contents in the appropriate format taking into account the user preferences and context, is critical

SD3#88: [DELETE]Link between AmI and hearing aids

Merged to 11

SD3#89: Legal and social implications

The opportunities offered by the information society considerably affect the lives of all consumers. However, we also need to remember the enormous impact it can have on the consumer, and this is why ANEC believes the ethical, legal and social implications (ELSI) should be carefully considered, as well as potential privacy and security issues.

SD3#90: TV and Broadband Networks

SD3#91: Predict the negative impact on the user life styles produce by the activities changes created by the new environments

As we change the way of working, of interacting with people and carrying out leisure activities, this changes our lifestyle. For example, end-users may be spending more time sitting down and less time carrying out physical exercise. We need therefore to understand the potential impact of these changes on our health.

SD3#92: Implications of misuse of technology

What might be the implications if people use technologies in the 'wrong way'. Could it cause injuries or damage to both the user and the environment?

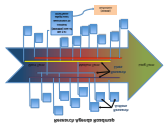
SD3#93: Address the consequences of system failure for the user

Many smart systems and environments are designed to give vital support to the end-users, which is even more vital in the case of people with activity limitations. What might happen in the case of system failure should be investigated and possible alternative solutions should be explored.

Annex 2 Basic structuring of html version

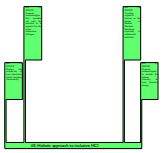
Overall roadmap

-

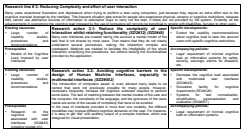


- Next level: click on any of the individual research lines:

This leads to the graphical representation



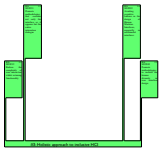
which could then lead on to the table with options to go back and forth between the two representations.

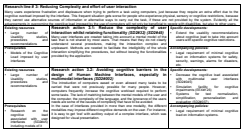


Each of the representations gives the option of clicking on a research action to access the detailed clarifications, for example SD2#32: “Support research that looks …”.

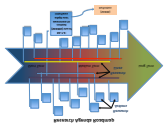
Once at this level of research action clarifications, there is an option to go back to the research line or any other research line in which the particular research action is included (option A). There is also the option of going back straight to the overall roadmap (option B) to see where this particular research action is located in the overall roadmap. If further information is required regarding the Research Actions, this can be retrieved by going down to the second level of the pyramid (Option C). According to the source of the research Action, the website visitor will be directed to the relevant background clarifications (D2.1, D2.2 or D2.3). If further background information is required, this can be retrieved by going down to the bottom level of the pyramid. According to the source of the research Action, the website vistor will be directed to the relevant background material (D1.1, D3.1 or D4.1).

Option A:





Option B: (extracted



Option C: Directed to the reports from one of the SDDP’s from D2.1, D2.2 or D2.3).

Annex 3 Manual of how to use and extract information from the roadmaps and reports

The following information serves as a manual to help the reader extract, use and interpret the information contained in the roadmaps and reports.

The first sub-section gives a guide of how to retrieve the information regarding any particular research action. The second sub-section describes how to extract the connections for any given research line, giving research line #5 as an example. The third sub-section shows the connection tables of supporting actions and sub roadmaps, following the same process, for each of the fourteen research lines.

1. How to retrieve information regarding a particular Research Action

The most important information regarding any given research action is contained in this overall report. However, more detailed information can be found in several of the other project deliverables with further information also located on other Websites (the project Website and the CARDIAC SDDP Wikispaces).

This section gives practical information of how to retrieve all these different pieces of information taking one research action as an example. The process can then be replicated for any of the other research actions.

Let us for example take research action 5.2 (RA 5.2) 'Affective computing to assist accessibility interfaces and interaction'.

The list of research actions in section 3 of this report indicates that the source of the idea behind RA5.2 came from idea number 35 of SDDP2 (SD2#35).

A more detailed description of RA5.2, along with the existing resources, prerequisites, specific developments and accompanying policies, can be found in Table 6 in section 4 of this report (page 34). The location of RA5.2 within research line #5 is graphically illustrated in Figure 13 of this report (page 34). Its location within the overall Research Agenda Roadmap can be seen on page 86, Figure 23 under section 5 of this report.

The original description of the original idea behind RA 5.2 (SD2#35) can be found in Annex 1 of deliverable D2.2 (pages 50-51). An oral description from the author of the idea can be found on the SDDP2 CARDIAC Wikispace at:

http://userinteraction-sdd-cardiac.wikispaces.com
under the heading of 'Videos of participants taken in San Sebastian' for which SD2#35 is the video number 2.

The wikispace links for the first and third SDDPs are respectively:
http://accessible-assistive-sdd-cardiac.wikispaces.com

http://network-based-applications-sdd-cardiac.wikispaces.com

The location of SD2#35 within the SDDP2 influence tree or map can be seen in Figure 7 of this report (also on page 16 of D2.2). This influence tree shows two boxes that have arrows leading into the box containing the idea SD2#35 and the ideas contained in these two boxes will therefore have a supportive influence on SD2#35. The first box contains idea SD2#21 which corresponds to research action RA 3.1 (see research action list in section 3) and the second box contains SD2#29 which corresponds to RA 4.1. The influence tree informs us that these two research actions will support and influence RA 5.2 and it could therefore make sense to support them before or at least in parallel to RA 5.2. In this particular case, there are only direct links to RA 5.2, but in other cases, the trail may carry on for two or three steps, right down to the root of the tree. All the connected research actions to be introduced into the table are identified in this way. In the cases where the original idea is located in either of the top two levels of an influence tree, more detailed information can be found in the corresponding deliverables from WP2 (D2.1, D2.2 and D2.3), where in particular, a table and sub-influence map is given showing the connections. So for example for RA 5.7 (SD3#23) the table and sub-influence map can be found on page 29 of D2.3.

2. How to retrieve the connections for any given research line

The process described above in sub-section 1 of this annex can be carried out for all the research actions contained within a given research line. A table can then be generated that shows all the research actions that have an influence and are connected to any given research line. If any other research actions are mentioned as prerequisites, specific developments or accompanying policies (as shown in the tables in section 4 of this report) these research actions are also included in the connection table of a particular research line. The tables and ensuing sub-roadmaps for each of the 14 research lines have been generated and are shown in *Table 20* and

Figure 41 onwards in sub-section 3 of this annex.

The detailed process can be described in the following 5 steps:

1. Identify the sources of the ideas behind each of the individual research actions of the given research line, which can be found in section 3 of this report. For example, for RA 5.2, the idea came from idea number 35 of SDDP2 (SD2#35).
2. Identify for each of the research actions, the ideas that influence, directly or indirectly the research action in the corresponding influence trees shown in Figure 6 – Figure 8 of this report (see sub-section 1 of this annex for an example).
3. Check in the corresponding table in section 4 of this report whether there are any other prerequisites (left column) or specific developments and accompanying policies (right hand column) that should be included because they have a direct or indirect supportive influence.
4. Generate a table containing all the connected research actions identified in steps 2 and 3.
5. Generate a filtered roadmap for the research line that contains all the connected research actions contained in the table generated under step 4.

The Research Agenda Roadmap can be filtered using a variety of different constraints that might be relevant to different stakeholders.

If, for example, the constraint was to select the research line with the joint highest potential impact and probability of requiring public funding, then, according to the results of the questionnaire shown in Table 16 (see 4th column) in section 8 of this report, it would make sense to select research line #5 "Innovative user interfaces" for support.

The related research actions that will support this research line are shown in *Table 24* and

Figure 45, which are reproduced here for convenience in Table 18 and Figure 39.

Table 18: Research actions connected to research line 5

Research line #5	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies		1.2		1.4						
#2 Privacy, safety and trust										
#3 Holistic approach to HCI	3.1	3.2	3.3	3.4						
#4 User modelling and adaptive user interfaces	4.1	4.2	4.3	4.4						
#5 Innovative user interfaces	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	5.10
#6 Access to advanced ubiquitous computing env.				6.4	6.5	6.6				
#7 Interoperability and standardisation		7.2	7.3							
#8 End-user participation & user needs analysis		8.2								
#9 Advanced design & development meth.& tools	9.1			9.4	9.5					
#10 Test and evaluation methodologies & tools	10.1		10.3	10.4						
#11 Collaborative research knowledge sharing	11.1									
#12 Social networking and applications				12.4						
#13 Social context and impact										
#14 The market, service delivery & public procure.						14.6	14.7			

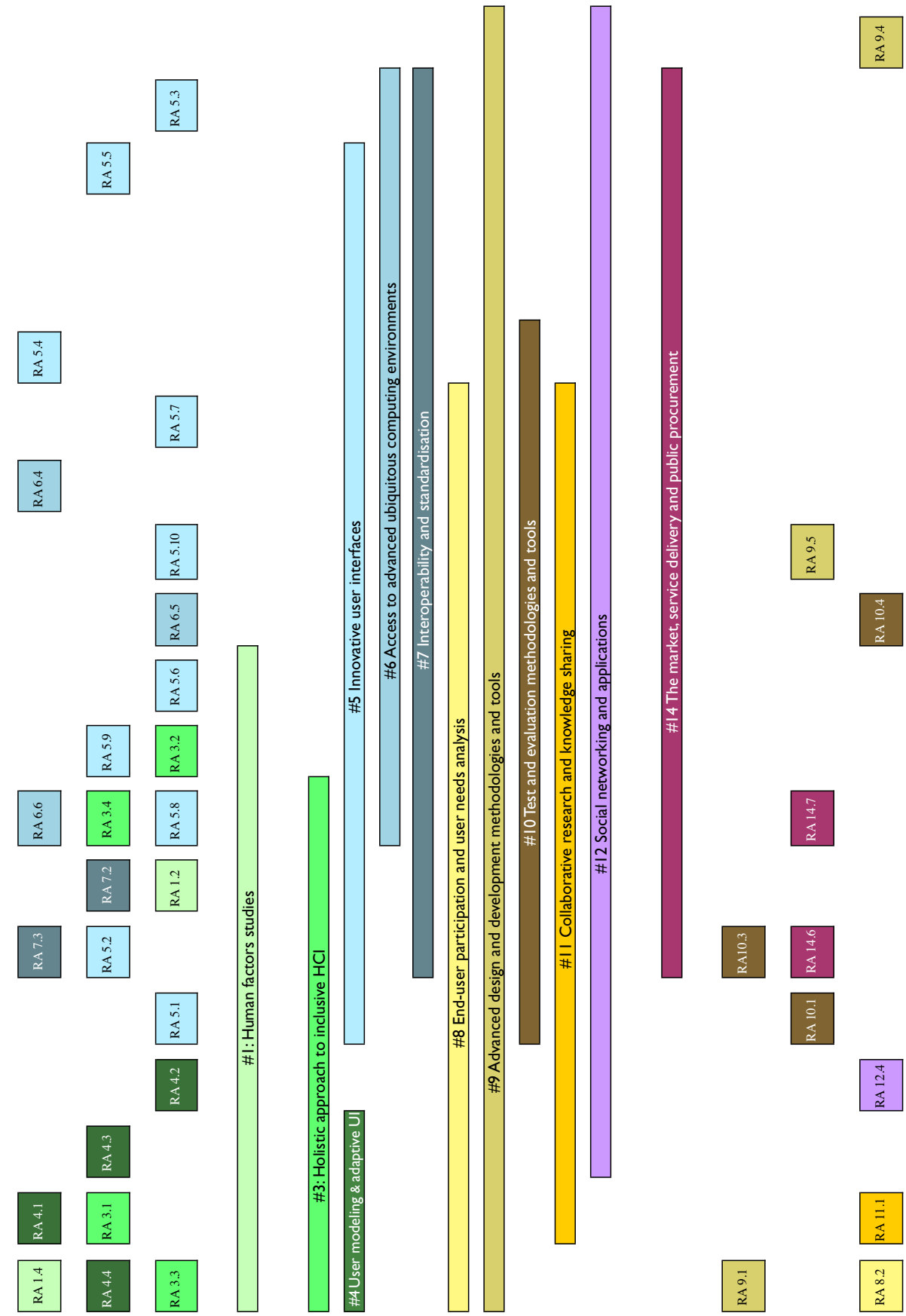


Figure 39: Complementary Research Agenda Roadmap for RL#5 and connected research actions

The results displayed in Table 18 show that 11 eleven out the remaining 13 research lines are connected to research line 5 (only research lines 2 and 13 have no connections and have thus been omitted from the roadmap). However, more importantly, some of the research lines have strong connections to research line 5 (RL#3, RL#4, RL#6 and RL#10) with research lines 3 and 4 in particular having all their research actions connected to research line 5, meaning that these two research lines will exert a strong influence on RL#5. The implication of these strong connections is that it would make sense to also support research lines 3 and 4, along with the other research actions exerting an influence on RL#5.

In particular, this would mean considering initially also giving support to the following 11 research actions, which are on the left of the sub-roadmap:

- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 3.1: Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 4.2: Use of context awareness to adapt user interfaces
- RA 4.3: Further static and adaptive user interaction profiles
- RA 4.4: Use reasoning techniques for personalisation
- RA 8.2: Involvement of end users throughout the design and development process
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 12.4: Research on how people can understand and use the full potential of AmI.

The other 15 research actions in the sub-roadmap (apart from those in RL#5) include:

- RA 1.2: Research on who could be excluded from using novel user interfaces
  RA 3.2: Promote methodologies to include the human diversity in user interface design
- RA 3.4: Reduce the complexity of user interaction whilst retaining functionality
- RA 6.4: Adaptable and affordable assistive technologies seamlessly integrating into intelligent environments
- RA 6.5: Adaptation of the environment to the needs of several persons at the same time
- RA 6.6: New materials, technologies and methods for seamless natural human environment interaction
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 7.3: Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
- RA 9.4: Tools for decision making in the user-centred design process
- RA 9.5: Development of training modules about needs of people with disabilities for developers
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 10.4: Research on automatic evaluation of end-users needs and preferences while interacting with ICT
- RA 14.6: Analysis of models and processes of Service Delivery and procurement
- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services

This particular example of research line 5 leads to a sub-roadmap, which is still quite complex, containing about half the research actions from the overall roadmap. This is not the case for all the research lines. For example, following the same process for research line 3 (which was ranked top in terms of impact and second in terms of joint impact and probability of requiring public funding) yields the results shown in *Table 19* and

Figure 40.

Table 19: Research actions connected to research line 3

Research line #3	RA	RA	RA	RA	RA	RA
#1 Human factor studies		1.2				
#2 Privacy, safety and trust						
#3 Holistic approach to HCI	3.1	3.2	3.3	3.4		
#4 User modelling and adaptive user interfaces	4.1	4.2	4.3	4.4		
#5 Innovative user interfaces	5.1	5.2				
#6 Access to advanced ubiquitous computing env.						
#7 Interoperability and standardisation		7.2	7.3			
#8 End-user participation & user needs analysis						
#9 Advanced design & development meth.& tools						
#10 Test and evaluation methodologies & tools						
#11 Collaborative research knowledge sharing	11.1					
#12 Social networking and applications						
#13 Social context and impact						
#14 The market, service delivery & public procure.						

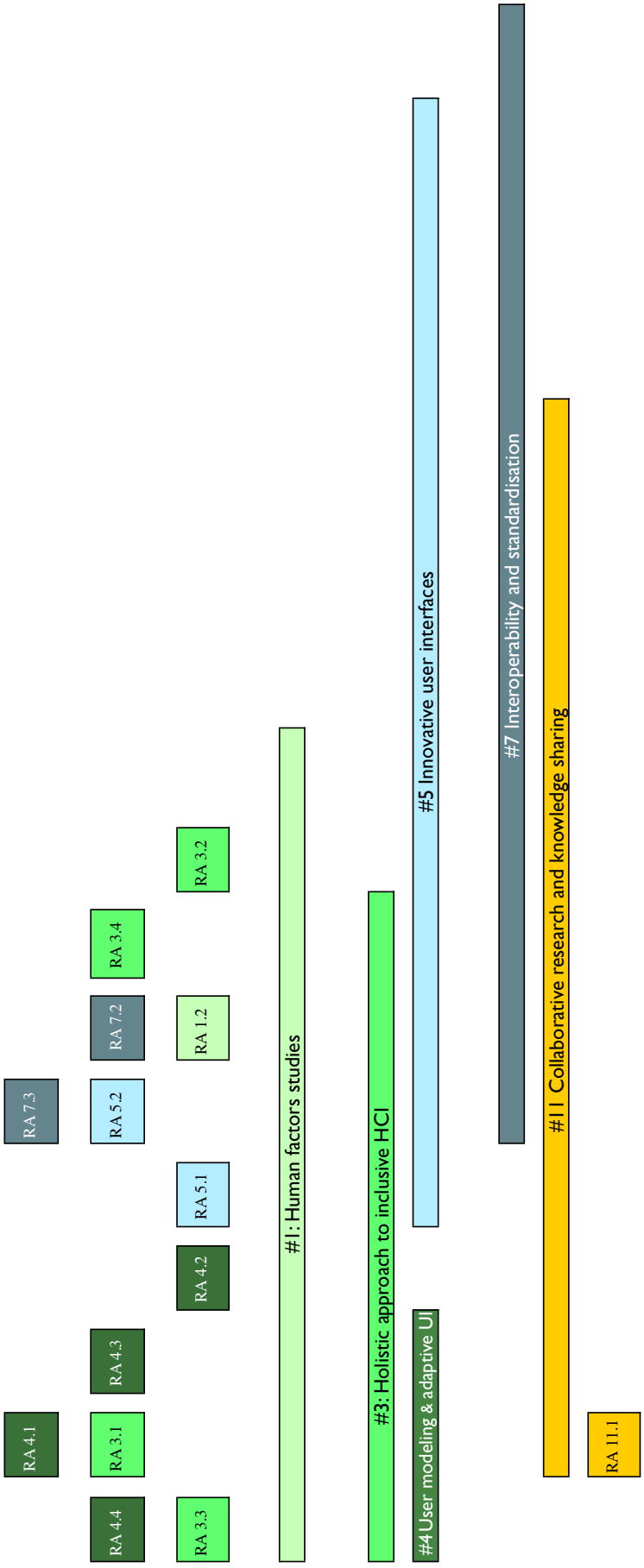


Figure 40: Complementary Research Agenda Roadmap for RL#3 and connected research actions.

As can be seen, the resulting extraction for research line 3 is a less complex sub-roadmap that includes only 10 research actions from just five of the other research lines (apart from the four research actions in research line 3). Once again all the research actions from research line #4 are connected to this particular research line and two of the research actions from research line 5 are also connected. These 14 research actions could also serve as a starting point in preparation for research line 5. If then, research line 3 were to be selected as a priority, the practical recommendation would be to support the following 14 research actions:

- RA 1.2: Research on who could be excluded from using novel user interfaces
- RA 3.1: Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue
- RA 3.2: Promote methodologies to include the human diversity in user interface design
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 3.4: Avoid cognitive barriers in the design of Human Machine Interfaces, especially in multimodal interfaces
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 4.2: Use of context awareness to adapt user interfaces
- RA 4.3: Further static and adaptive user interaction profiles
- RA 4.4: Use reasoning techniques for personalisation
- RA 5.1: Avoid cognitive barriers in the design of Human Machine Interfaces, especially in multimodal interfaces
- RA 5.2: Affective computing to assist accessibility interfaces and interaction
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 7.3: Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT

3. Connection tables and sub-roadmaps of the 14 research lines

The process described in sub-section 2 of this annex has been applied to all fourteen research lines and has yielded the following tables and sub-roadmaps showing the connected research actions that support each of the fourteen research lines:

Table 20: Research actions connected to research line 1

Research line #1	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies	1.1	1.2	1.3	1.4	1.5	1.6	
#2 Privacy, safety and trust		2.2					
#3 Holistic approach to HCI	3.1						
#4 User modelling and adaptive user interfaces	4.1						
#5 Innovative user interfaces							
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation							
#8 End-user participation & user needs analysis	8.1						
#9 Advanced design & development meth.& tools							
#10 Test and evaluation methodologies & tools							
#11 Collaborative research knowledge sharing	12.1						
#12 Social networking and applications							
#13 Social context and impact		13.2					
#14 The market, service delivery & public procure.	14.1						

The thirteen research actions in the table are:

- RA 1.1: Basic research on Assistive Technology abandonment/adoption
- RA 1.2: Research on who could be excluded from using novel user interfaces
- RA 1.3: Implications for people with disabilities of the use of biometric systems for identification and security
- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 1.5: Identify impact of cloud platforms
- RA 1.6: Implications of misuse of technology
- RA 2.2: Research on who could be excluded from using novel user interfaces
- RA 3.1: Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 12.1: Research on the use of social media to reduce isolation
- RA 13.2: Research on the ethical and legal requirements and consequences
- RA 14.1: Analysis of market potential of accessible ICT

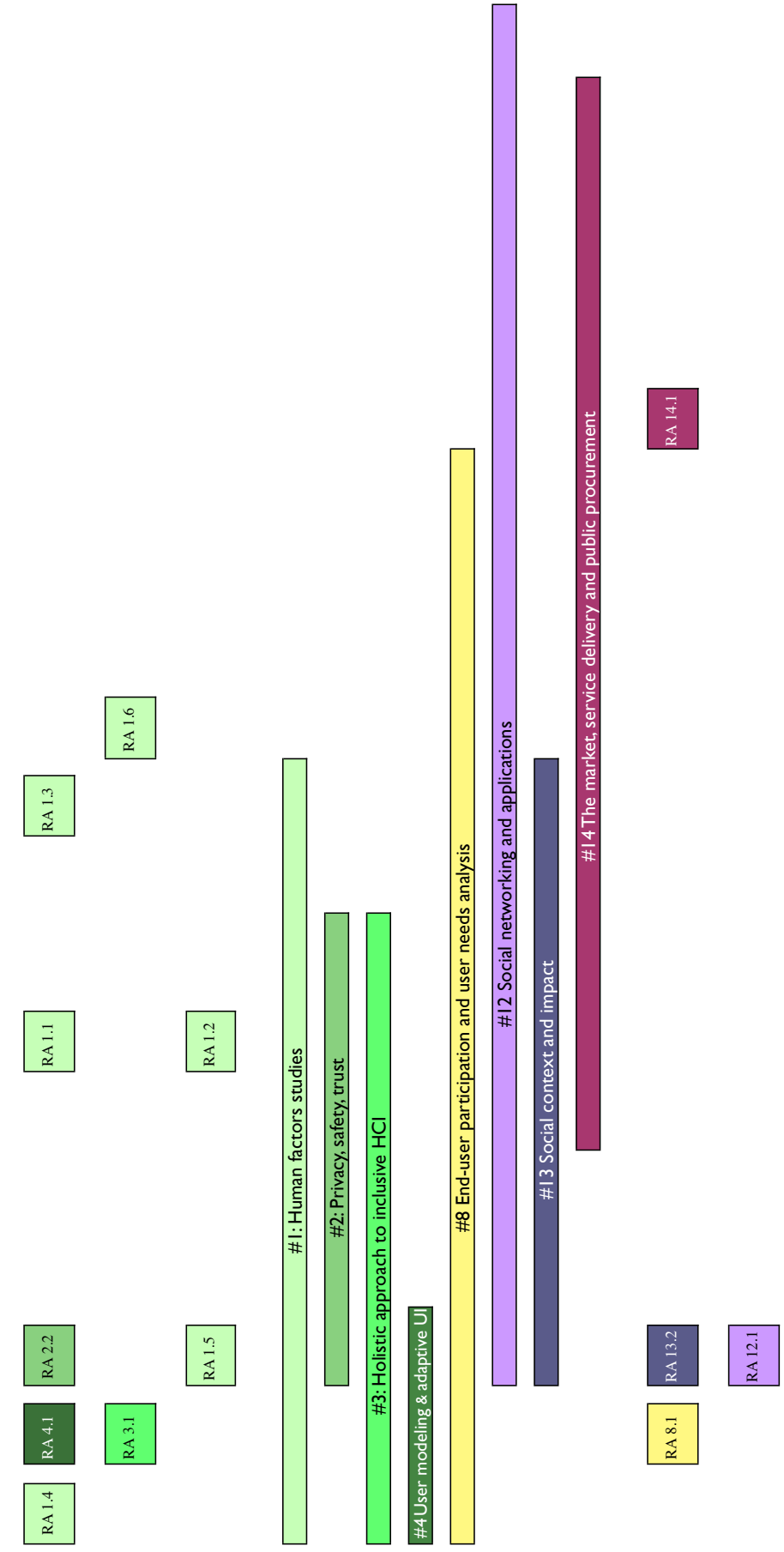


Figure 41: Complementary Research Agenda Roadmap for RL#1 and connected research actions

Table 21: Research actions connected to research line 2

Research line #2	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies					1.5		
#2 Privacy, safety and trust	2.1	2.2					
#3 Holistic approach to HCI				3.4			
#4 User modelling and adaptive user interfaces							
#5 Innovative user interfaces							
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation							
#8 End-user participation & user needs analysis							
#9 Advanced design & development meth.& tools							
#10 Test and evaluation methodologies & tools							
#11 Collaborative research knowledge sharing							
#12 Social networking and applications	12.1						
#13 Social context and impact		13.2					
#14 The market, service delivery & public procure.							

The six research actions in the table are:

- RA 1.5: Identify impact of cloud platforms
- RA 2.1: Research on the reliability of e-Inclusion services
- RA 2.2: Research on who could be excluded from using novel user interfaces
- RA 3.4: Avoid cognitive barriers in the design of Human Machine Interfaces, especially in multimodal interfaces
- RA 12.1: Research on the use of social media to reduce isolation
- RA 13.2: Research on the ethical and legal requirements and consequences

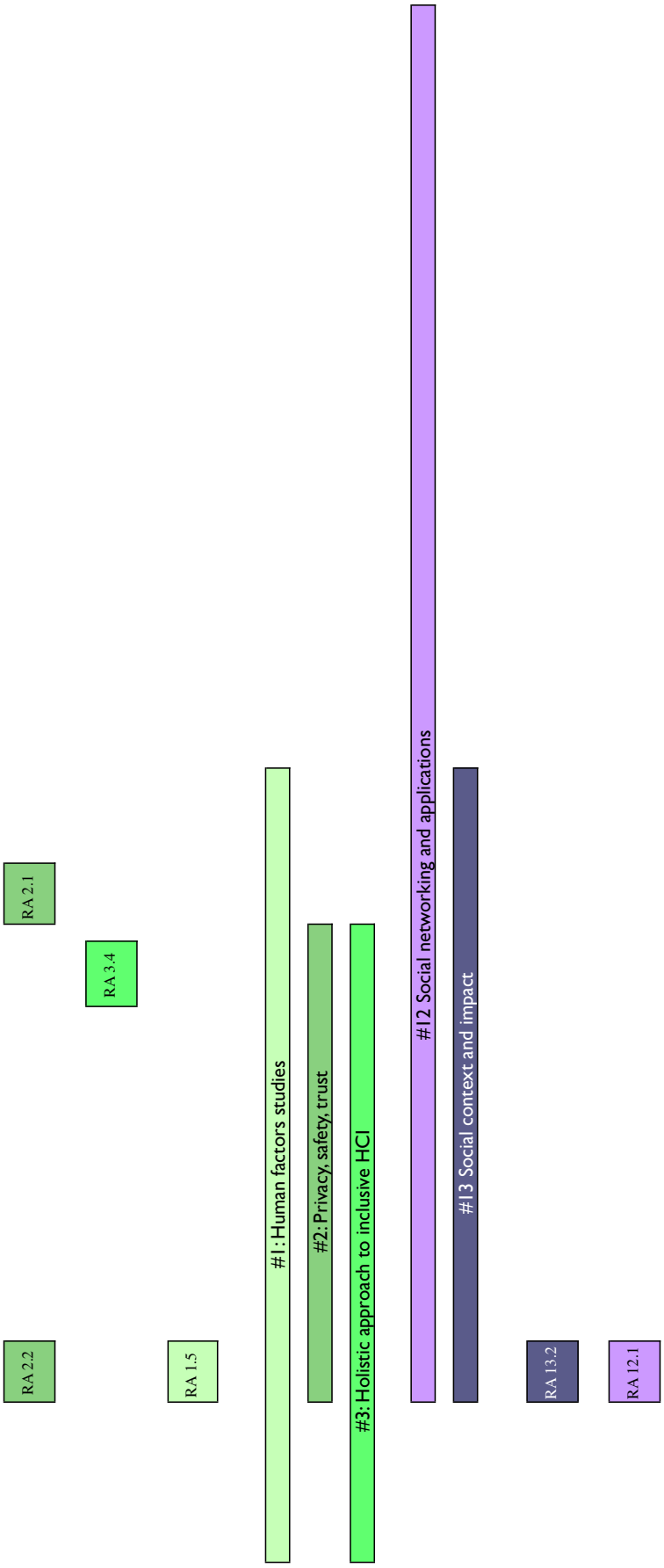


Figure 42: Complementary Research Agenda Roadmap for RL#2 and connected research actions

Table 22: Research actions connected to research line 3

Research line #3	RA	RA	RA	RA	RA	RA
#1 Human factor studies		1.2				
#2 Privacy, safety and trust						
#3 Holistic approach to HCI	3.1	3.2	3.3	3.4		
#4 User modelling and adaptive user interfaces	4.1	4.2	4.3	4.4		
#5 Innovative user interfaces	5.1	5.2				
#6 Access to advanced ubiquitous computing env.						
#7 Interoperability and standardisation		7.2	7.3			
#8 End-user participation & user needs analysis						
#9 Advanced design & development meth.& tools						
#10 Test and evaluation methodologies & tools						
#11 Collaborative research knowledge sharing	11.1					
#12 Social networking and applications						
#13 Social context and impact						
#14 The market, service delivery & public procure.						

The fourteen research actions in the table are:

- RA 1.2: Research on who could be excluded from using novel user interfaces
- RA 3.1: Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue
- RA 3.2: Promote methodologies to include the human diversity in user interface design
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 3.4: Avoid cognitive barriers in the design of Human Machine Interfaces, especially in multimodal interfaces
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 4.2: Use of context awareness to adapt user interfaces
- RA 4.3: Further static and adaptive user interaction profiles
- RA 4.4: Use reasoning techniques for personalisation
- RA 5.1: Avoid cognitive barriers in the design of Human Machine Interfaces, especially in multimodal interfaces
- RA 5.2: Affective computing to assist accessibility interfaces and interaction
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 7.3: Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT

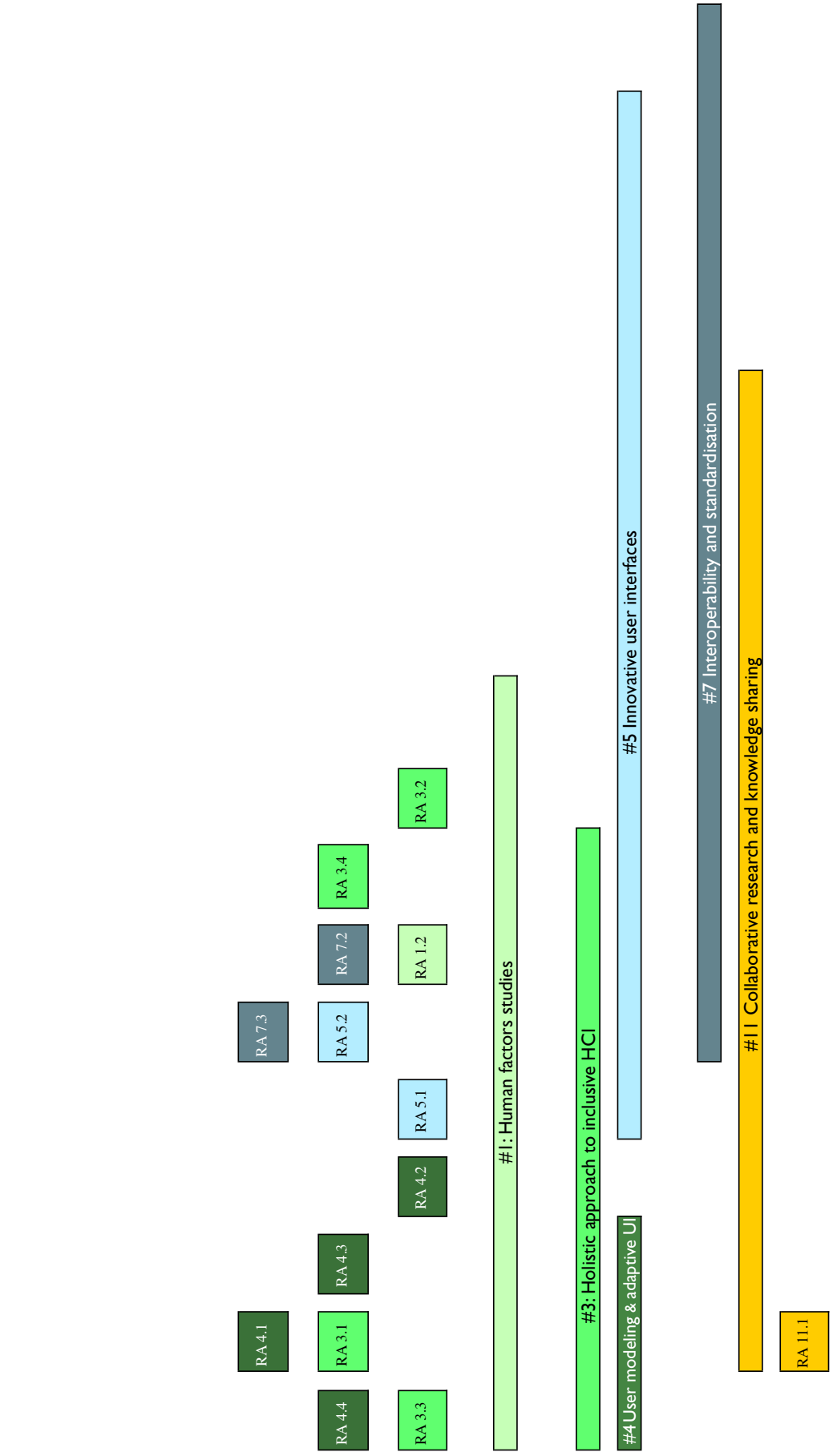


Figure 43: Complementary Research Agenda Roadmap for RL#3 and connected research actions

Table 23: Research actions connected to research line 4

Research line #4	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies							
#2 Privacy, safety and trust							
#3 Holistic approach to HCI	3.1		3.3				
#4 User modelling and adaptive user interfaces	4.1	4.2	4.3	4.4			
#5 Innovative user interfaces							
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation							
#8 End-user participation & user needs analysis							
#9 Advanced design & development meth.& tools							
#10 Test and evaluation methodologies & tools							
#11 Collaborative research knowledge sharing							
#12 Social networking and applications							
#13 Social context and impact							
#14 The market, service delivery & public procure.							

The six research actions in the table are:

- RA 3.1: Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 4.2: Use of context awareness to adapt user interfaces
- RA 4.3: Further static and adaptive user interaction profiles
- RA 4.4: Use reasoning techniques for personalisatio

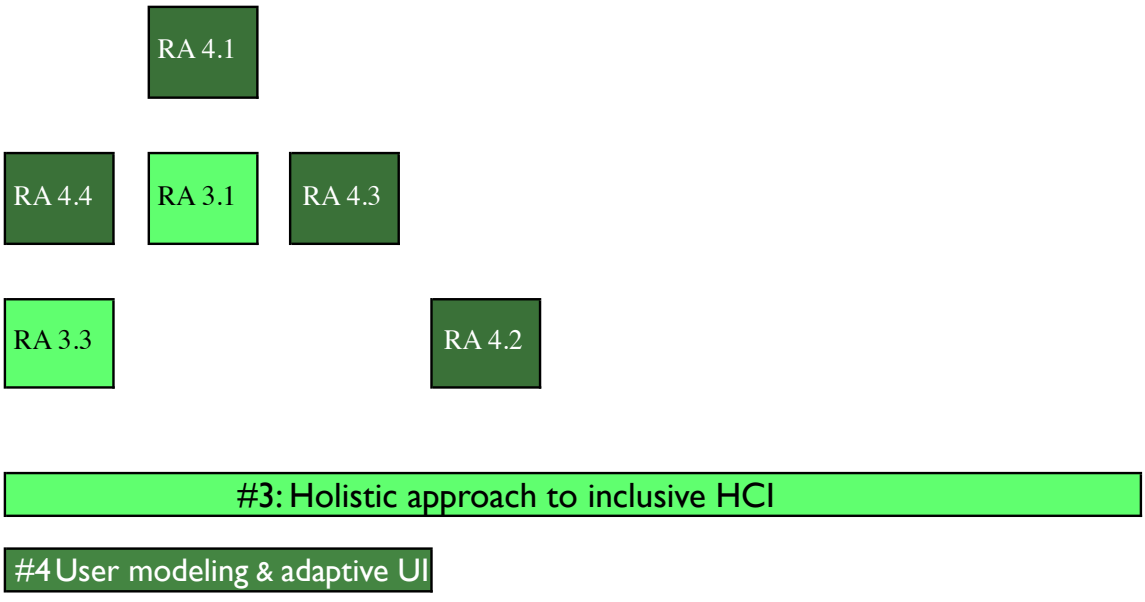


Figure 44: Complementary Research Agenda Roadmap for RL#4 and connected research actions

Table 24: Research actions connected to research line 5

Research line #5	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies		1.2		1.4						
#2 Privacy, safety and trust										
#3 Holistic approach to HCI	3.1	3.2	3.3	3.4						
#4 User modelling and adaptive user interfaces	4.1	4.2	4.3	4.4						
#5 Innovative user interfaces	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	5.10
#6 Access to advanced ubiquitous computing env.				6.4	6.5	6.6				
#7 Interoperability and standardisation		7.2	7.3							
#8 End-user participation & user needs analysis		8.2								
#9 Advanced design & development meth.& tools	9.1			9.4	9.5					
#10 Test and evaluation methodologies & tools	10.1		10.3	10.4						
#11 Collaborative research knowledge sharing	11.1									
#12 Social networking and applications				12.4						
#13 Social context and impact										
#14 The market, service delivery & public procure.						14.6	14.7			

The thirty-six research actions in the table are:

- RA 1.2: Research on who could be excluded from using novel user interfaces
- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 3.1: Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue
- RA 3.2: Promote methodologies to include the human diversity in user interface design
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 3.4: Reduce the complexity of user interaction whilst retaining functionality
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 4.2: Use of context awareness to adapt user interfaces
- RA 4.3: Further static and adaptive user interaction profiles
- RA 4.4: Use reasoning techniques for personalisation
- RA 5.1: Innovative interaction devices for accessibility: Advanced Assistive technology
- RA 5.2: Affective computing to assist accessibility interfaces and interactions
- RA 5.3: Research on accessible human-robot and human-robot-environment relationships
- RA 5.4: Novel human-machine interfaces for recreational activities
- RA 5.5: Accessible telecommunications technologies for people with no or little speech
- RA 5.6: Practical adaptive user interfaces
- RA 5.7: Research on multi-modal interaction methods
- RA 5.8: Means for customization of UI and open interfaces,
- RA 5.9: Enhance and universalize Web 2.0 accessibility
- RA 5.10: Extension of Web accessibility knowledge to general HCI
- RA 6.4: Adaptable and affordable assistive technologies seamlessly integrating into intelligent environments
- RA 6.5: Adaptation of the environment to the needs of several persons at the same time
- RA 6.6: New materials, technologies and methods for seamless natural human
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 7.3: Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
- RA 8.2: Involvement of end users throughout the design and development process
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 9.4: Tools for decision making in the user-centred design process

- RA 9.5: Development of training modules about needs of people with disabilities for developers
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 10.4: Research on automatic evaluation of end-users needs and preferences while interacting with ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 12.4: Research on how people can understand and use the full potential of AmI.
- RA 14.6: Analysis of models and processes of Service Delivery and procurement
- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services

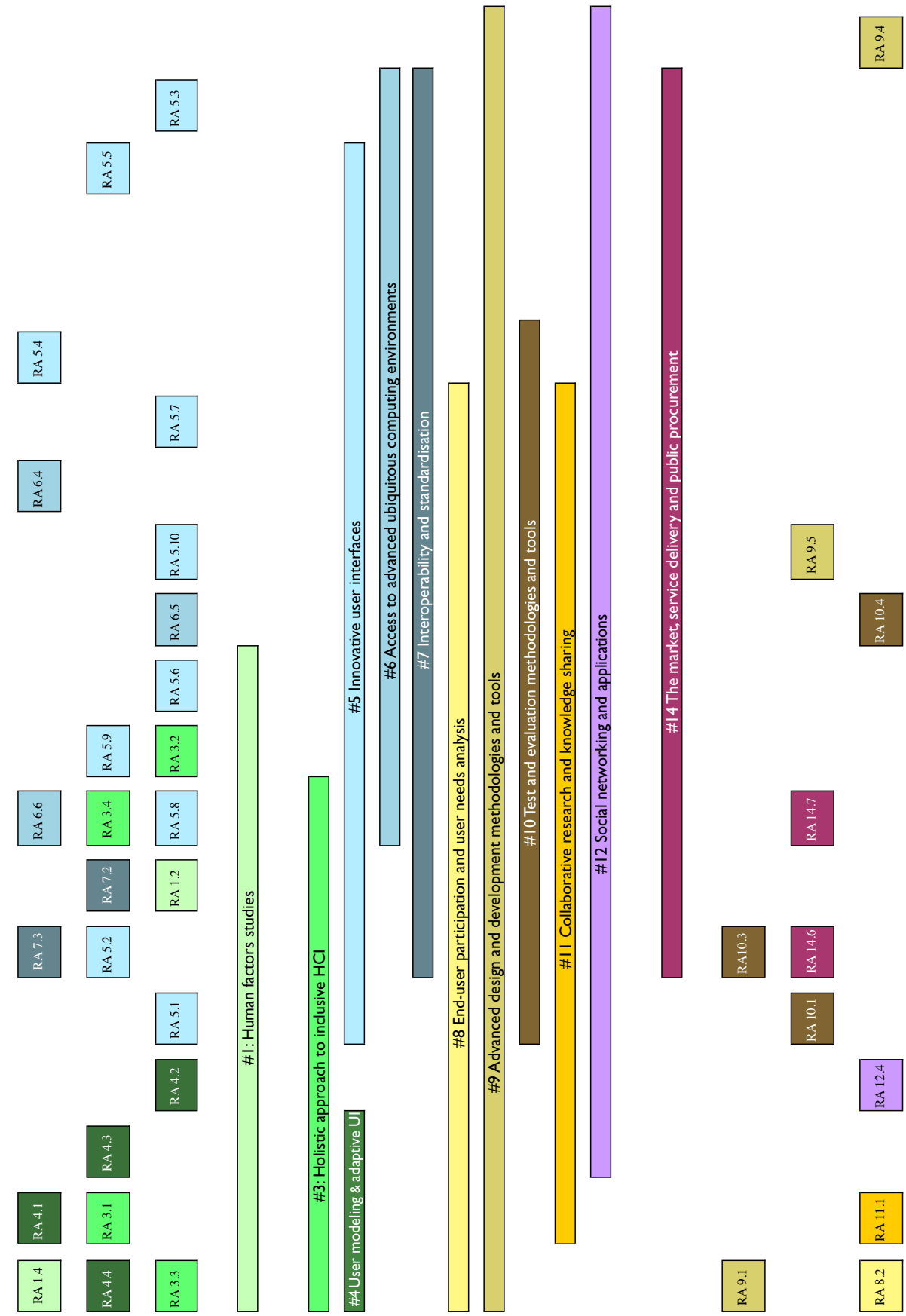


Figure 45: Complementary Research Agenda Roadmap for RL#5 and connected research actions

Table 25: Research actions connected to research line 6

Research line #6	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies	1.1	1.2	1.3	1.4	1.5		
#2 Privacy, safety and trust		2.2					
#3 Holistic approach to HCI	3.1	3.2	3.2	3.4			
#4 User modelling and adaptive user interfaces	4.1	4.2	4.3	4.4			
#5 Innovative user interfaces	5.1	5.2		5.4		5.6	5.7
#6 Access to advanced ubiquitous computing env.	6.1	6.2	6.2	6.4	6.5	6.6	
#7 Interoperability and standardisation		7.2	7.3			7.6	
#8 End-user participation & user needs analysis	8.1		8.3				
#9 Advanced design & development meth.& tools			9.3		9.5		
#10 Test and evaluation methodologies & tools	10.1	10.2		10.4			
#11 Collaborative research knowledge sharing	11.1			11.4			
#12 Social networking and applications	12.1			12.4			
#13 Social context and impact		13.2					
#14 The market, service delivery & public procure.					14.5		14.7

The forty-two research actions in the table are:

- RA 1.1: Basic research on Assistive Technology abandonment/adoption
- RA 1.2: Research on who could be excluded from using novel user interfaces
- RA 1.3: Implications for people with disabilities of the use of biometric systems for identification and security
- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 1.5: Identify impact of cloud platforms
- RA 2.2: Systems to enhance the safety and user trust and confidence of locally and remotely provided services
- RA 3.1: Promote methodologies that consider not only the interface as it appears but the entire interaction dialogue
- RA 3.2: Promote methodologies to include the human diversity in user interface design
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 3.4: Avoid cognitive barriers in the design of Human Machine Interfaces, especially in multimodal interfaces
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 4.2: Use of context awareness to adapt user interfaces
- RA 4.3: Further static and adaptive user interaction profiles
- RA 4.4: Use reasoning techniques for personalisation
- RA 5.1: Innovative interaction devices for accessibility: Advanced Assistive technology
- RA 5.2: Affective computing to assist accessibility interfaces and interactions
- RA 5.4: Novel human-machine interfaces for recreational activities
- RA 5.6: Practical adaptive user interfaces
- RA 5.7: Research on multi-modal interaction methods
- RA 6.1: Mobile technologies as access interfaces for public and private ubiquitous environments
- RA 6.2: Inclusive user interaction in ambient intelligence environments
- RA 6.3: Integration of web 2.0 with internet of things (IoT)
- RA 6.4: Adaptable and affordable assistive technologies seamlessly integrating into intelligent environments
- RA 6.5: Adaptation of the environment to the needs of several persons at the same time

- RA 6.6: New materials, technologies and methods for seamless natural human
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 7.3: Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
- RA 7.6: Open APIs for the delivery of the interface to many more varied platforms
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 8.3: Make the world accessible yourself
- RA 9.3: Design and authoring tools supporting and automating e-inclusion
- RA 9.5: Development of training modules about needs of people with disabilities for developers
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.2: Research on formal methods to validate e-Inclusion services
- RA 10.4: Research on automatic evaluation of end-users needs and preferences while interacting with ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 11.4: Research on how to structure in an appropriate way all information for e-Inclusion available on the network
- RA 12.1: Research on the use of social media to reduce isolation
- RA 12.4: Research on how people can understand and use the full potential of AmI.
- RA 14.5: Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view
- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services

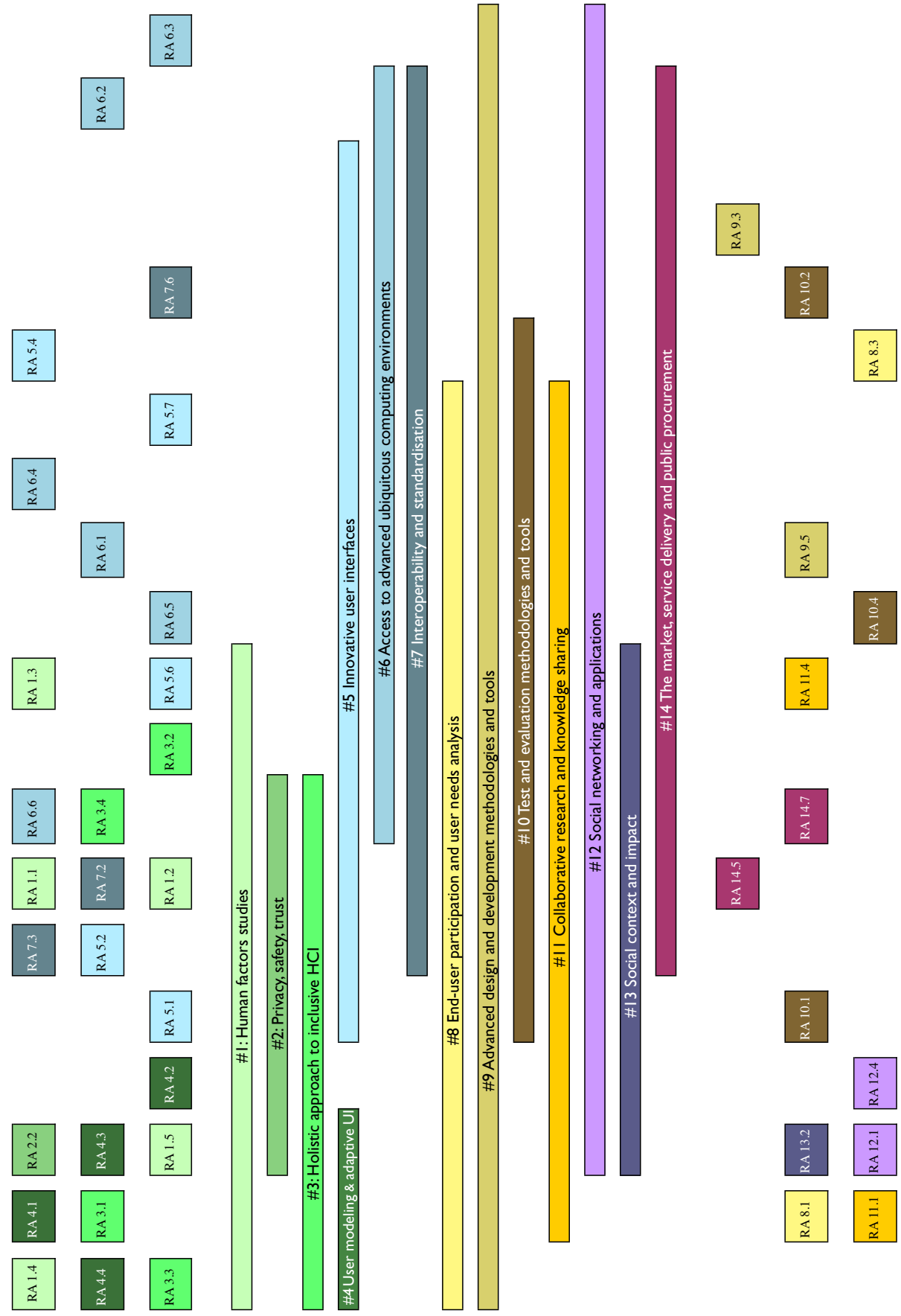


Figure 46: Complementary Research Agenda Roadmap for RL#6 and connected research actions

Table 26: Research actions connected to research line 7

Research line #7	RA	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies	1.1	1.2		1.4	1.5			
#2 Privacy, safety and trust		2.2						
#3 Holistic approach to HCI		3.2	3.3					
#4 User modelling and adaptive user interfaces	4.1		4.3	4.4				
#5 Innovative user interfaces								5.8
#6 Access to advanced ubiquitous computing env.								
#7 Interoperability and standardisation	7.1	7.2	7.3	7.4	7.5	7.6		
#8 End-user participation & user needs analysis	8.1	8.2						
#9 Advanced design & development meth.& tools	9.1			9.4				
#10 Test and evaluation methodologies & tools	10.1		10.3					
#11 Collaborative research knowledge sharing	11.1		11.3			11.6		
#12 Social networking and applications	12.1							
#13 Social context and impact	13.1	13.2						
#14 The market, service delivery & public procure.	14.1				14.5	14.6		

The thirty-two research actions in the table are:

- RA 1.1: Basic research on Assistive Technology abandonment/adoption
- RA 1.2: Research on who could be excluded from using novel user interfaces
- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 1.5: Identify impact of cloud platforms
- RA 2.2: Systems to enhance the safety and user trust and confidence of locally and remotely provided services
- RA 3.2: Promote methodologies to include the human diversity in user interface design
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 4.3: Further static and adaptive user interaction profiles
- RA 4.4: Use reasoning techniques for personalisation
- RA 5.8: Means for customization of UI and open interfaces
- RA 7.1: Open standards for accessible ICT systems based on sound scientific data,
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 7.3: Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
- RA 7.4: Standardized and harmonized remote HCIs
- RA 7.5: Dynamic composition of complex interfaces (mash-up of services)
- RA 7.6: Open APIs for the delivery of the interface to many more varied platforms
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 8.2: Involvement of end users throughout the design and development process
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 9.4: Tools for decision making in the user-centred design process
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 11.3: Infrastructure for shared knowledge in the field of Assistive ICT and Accessible ICT
- RA 11.6: Research on reasons why knowledge / standards on accessibility are not known or applied

- RA 12.1: Research on the use of social media to reduce isolation
- RA 13.1: Knowledge of the potential and the social effects of ICT to support an inclusive life
- RA 13.2: (SD3#89, SD3#24) Research on the ethical and legal requirements and consequences
- RA 14.1: Analysis of market potential of accessible ICT
- RA 14.5: Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view
- RA 14.6: Analysis of models and processes of Service Delivery and procurement

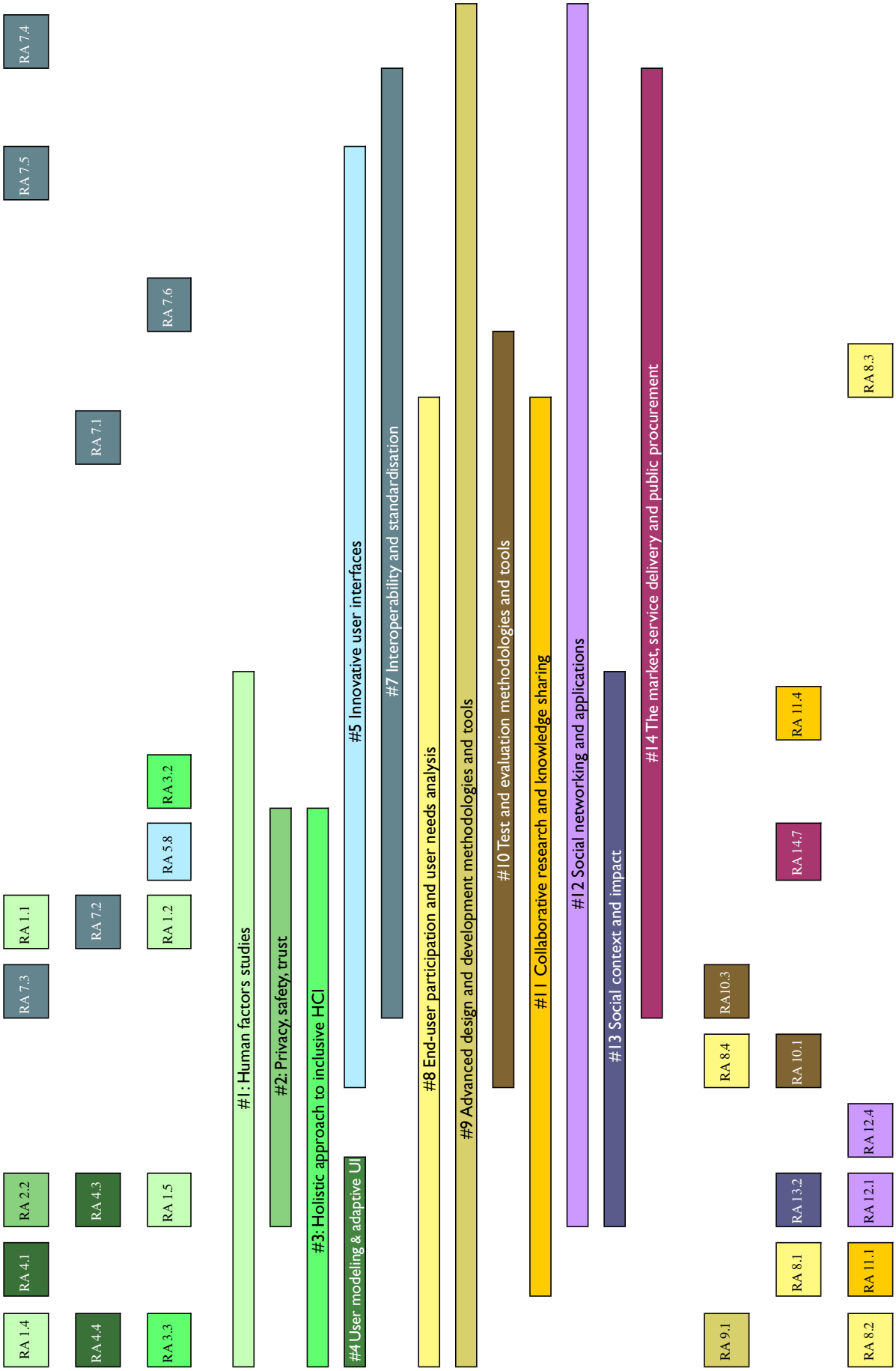


Figure 47: Complementary Research Agenda Roadmap for RL#7 and connected research actions

Table 27: Research actions connected to research line 8

Research line #8	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies				1.4	1.5		
#2 Privacy, safety and trust							
#3 Holistic approach to HCI							
#4 User modelling and adaptive user interfaces							
#5 Innovative user interfaces						5.6	
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation							
#8 End-user participation & user needs analysis	8.1	8.2	8.3	8.4			
#9 Advanced design & development meth.& tools	9.1						
#10 Test and evaluation methodologies & tools	10.1		10.3				
#11 Collaborative research knowledge sharing	11.1			11.4			
#12 Social networking and applications	12.1			12.4			
#13 Social context and impact		13.2					
#14 The market, service delivery & public procure.							14.7

The sixteen research actions in the table are:

- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 1.5: Identify impact of cloud platforms
- RA 5.6: Practical adaptive user interfaces
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 8.2: Involvement of end users throughout the design and development process
- RA 8.3: Make the world accessible yourself
- RA 8.4: User testing in real or realistic environments
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 11.4: Research on how to structure in an appropriate way all information for e-Inclusion available on the network
- RA 12.1: Research on the use of social media to reduce isolation
- RA 12.4: Research on how people can understand and use the full potential of AmI.
- RA 13.2: (SD3#89, SD3#24) Research on the ethical and legal requirements and consequences
- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services.

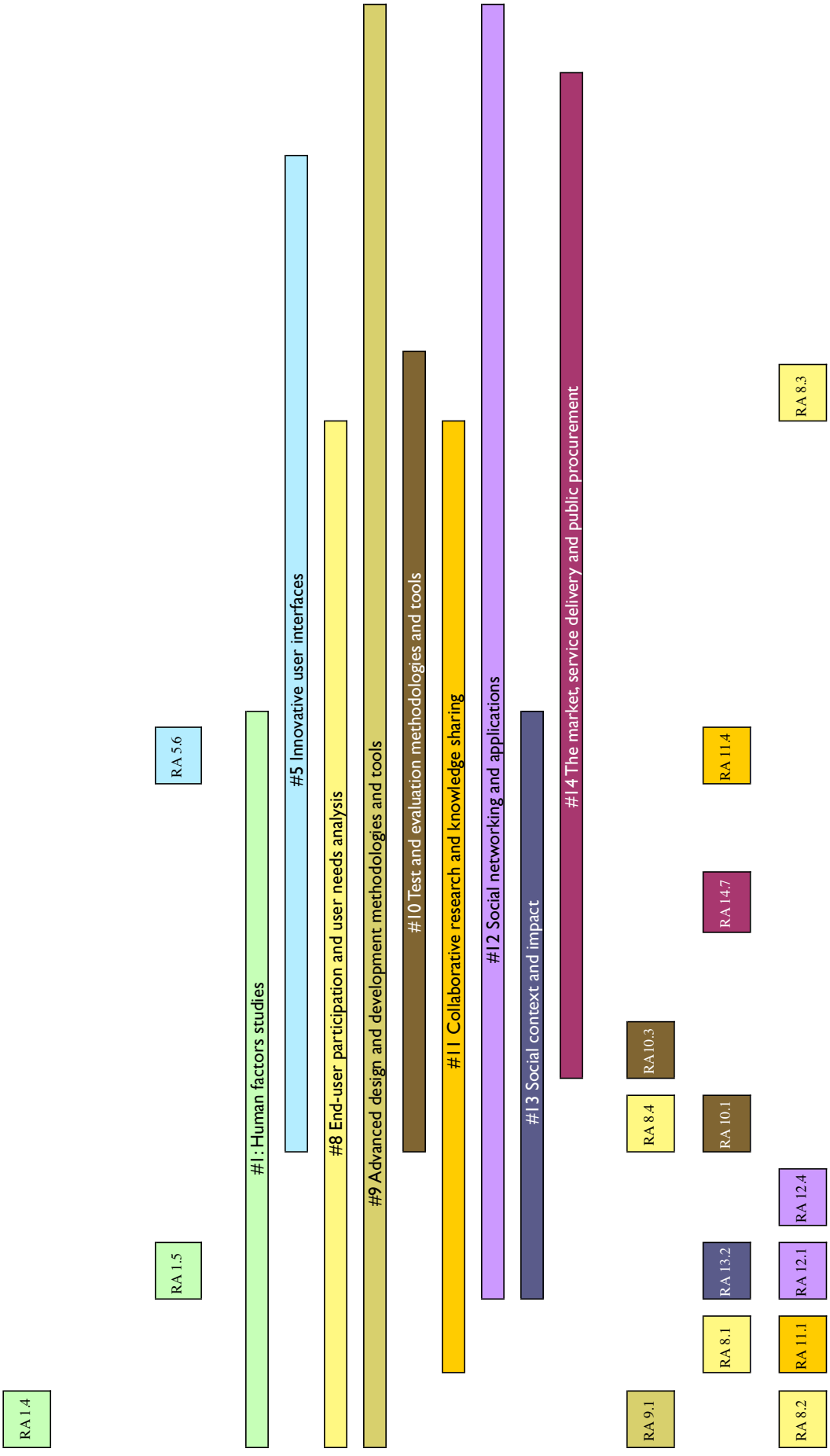

RA 1.4
RA 1.5
RA 5.6
#1: Human factors studies
#5 Innovative user interfaces
#8 End-user participation and user needs analysis
#9 Advanced design and development methodologies and tools
#10 Test and evaluation methodologies and tools
#11 Collaborative research and knowledge sharing
#12 Social networking and applications
#13 Social context and impact
#14 The market, service delivery and public procurement
RA 9.1
RA 8.4
RA10.3
RA 8.1
RA 13.2
RA 10.1
RA 14.7
RA 11.4
RA 8.2
RA 11.1
RA 12.1
RA 12.4
RA 8.3

Figure 48: Complementary Research Agenda Roadmap for RL#8 and connected research actions

Table 28: Research actions connected to research line 9

Research line #9	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies	1.1			1.4			
#2 Privacy, safety and trust							
#3 Holistic approach to HCI			3.3				
#4 User modelling and adaptive user interfaces	4.1			4.4			
#5 Innovative user interfaces							
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation							
#8 End-user participation & user needs analysis		8.2					
#9 Advanced design & development meth.& tools	9.1	9.2	9.3	9.4	9.5		
#10 Test and evaluation methodologies & tools	10.1		10.3				
#11 Collaborative research knowledge sharing	11.1			11.4			
#12 Social networking and applications				12.4			
#13 Social context and impact							
#14 The market, service delivery & public procure.					14.5		14.7

The eighteen research actions in the table are:

- RA 1.1: Basic research on Assistive Technology abandonment/adoption
- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 4.1: Methodologies to safely collect and manage the information about the user when using the ICT system
- RA 4.4: Use reasoning techniques for personalisation
- RA 8.1: Involvement of end users throughout the design and development process
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 9.2: (SD2#10) Tools to facilitate the creation of digital accessible materials to non-accessibility experts
- RA 9.3: Design and authoring tools supporting and automating e-inclusion
  RA 9.4: Tools for decision making in the user-centred design process
- RA 9.5: Development of training modules about needs of people with disabilities for developers
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 11.4: Research on how to structure in an appropriate way all information for e-Inclusion available on the network
- RA 12.4: Research on how people can understand and use the full potential of AmI.
- RA 14.5: Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view
- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services

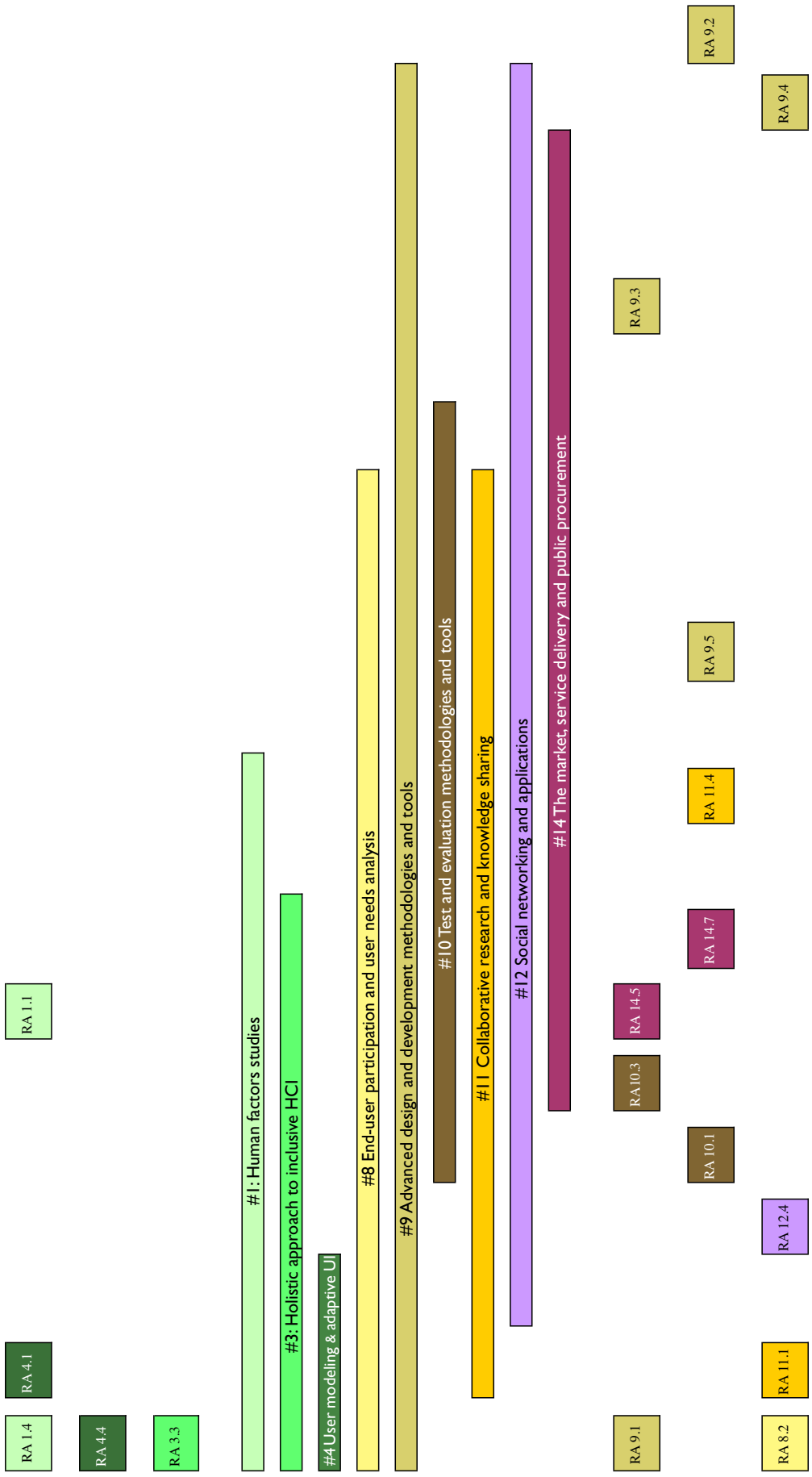


Figure 49: Complementary Research Agenda Roadmap for RL#9 and connected research actions

Table 29: Research actions connected to research line 10

Research line #10	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies	1.1	1.2		1.4			
#2 Privacy, safety and trust							
#3 Holistic approach to HCI			3.3				
#4 User modelling and adaptive user interfaces				4.4			
#5 Innovative user interfaces							
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation							
#8 End-user participation & user needs analysis	8.1			8.4			
#9 Advanced design & development meth.& tools	9.1						
#10 Test and evaluation methodologies & tools	10.0	10.2	10.3	10.4			
#11 Collaborative research knowledge sharing	11.1					11.6	
#12 Social networking and applications							
#13 Social context and impact							
#14 The market, service delivery & public procure.					14.5		

The fifteen research actions in the table are:

- RA 1.1: Basic research on Assistive Technology abandonment/adoption
- RA 1.2: Research on who could be excluded from using novel user interfaces
- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 4.4: Use reasoning techniques for personalisation
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 8.4: User testing in real or realistic environments
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.2: Research on formal methods to validate e-Inclusion services
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 10.4: Research on automatic evaluation of end-users needs and preferences while interacting with ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 11.6: Research on reasons why knowledge / standards on accessibility are not known or applied
- RA 14.5: Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view

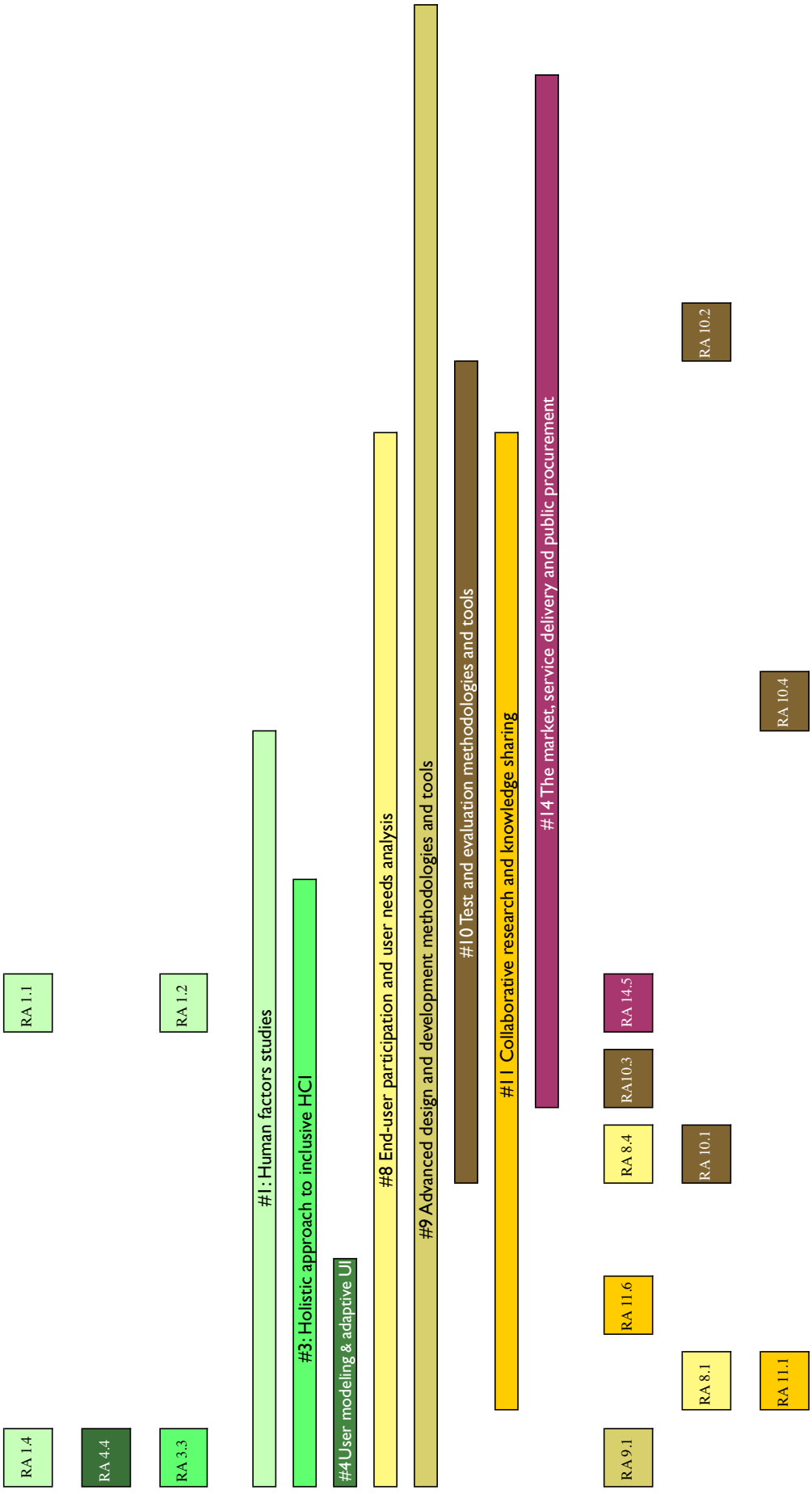


Figure 50: Complementary Research Agenda Roadmap for RL#10 and connected research actions

Table 30: Research actions connected to research line 11

Research line #11	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies	1.1			1.4	1.5		
#2 Privacy, safety and trust		2.2					
#3 Holistic approach to HCI							
#4 User modelling and adaptive user interfaces							
#5 Innovative user interfaces							
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation		7.2					
#8 End-user participation & user needs analysis	8.1	8.2					
#9 Advanced design & development meth.& tools	9.1			9.4			
#10 Test and evaluation methodologies & tools	10.1		10.3				
#11 Collaborative research knowledge sharing	11.1	11.2	11.3	11.4	11.5	11.6	
#12 Social networking and applications	12.1			12.4			
#13 Social context and impact		13.2		13.4			
#14 The market, service delivery & public procure.			14.3		14.5	14.6	14.7

The twenty-five research actions in the table are:

- RA 1.1: Basic research on Assistive Technology abandonment/adoption
- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 1.5: Identify impact of cloud platforms
- RA 2.2: Systems to enhance the safety and user trust and confidence of locally and remotely provided services
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 8.2: Involvement of end users throughout the design and development process
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 9.4: Tools for decision making in the user-centred design process
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 11.2: Process involving research, development and technology transfer in Assistive ICT and Accessible ICT
- RA 11.3: Infrastructure for shared knowledge in the field of Assistive ICT and Accessible ICT
- RA 11.4: Research on how to structure in an appropriate way all information for e-Inclusion available on the network
- RA 11.5: Research on accessible knowledge infrastructure that includes scientific knowledge
- RA 11.6: Research on reasons why knowledge / standards on accessibility are not known or applied
- RA 12.1: Research on the use of social media to reduce isolation
- RA 12.4: Research on how people can understand and use the full potential of AmI.
- RA 13.2: (SD3#89, SD3#24) Research on the ethical and legal requirements and consequences
- RA 13.4: Research on how to integrate social objectives in ICT

- RA 14.3: Business benefits and business models for eInclusion
- RA 14.5: Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view
- RA 14.6: Analysis of models and processes of Service Delivery and procurement
- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services.

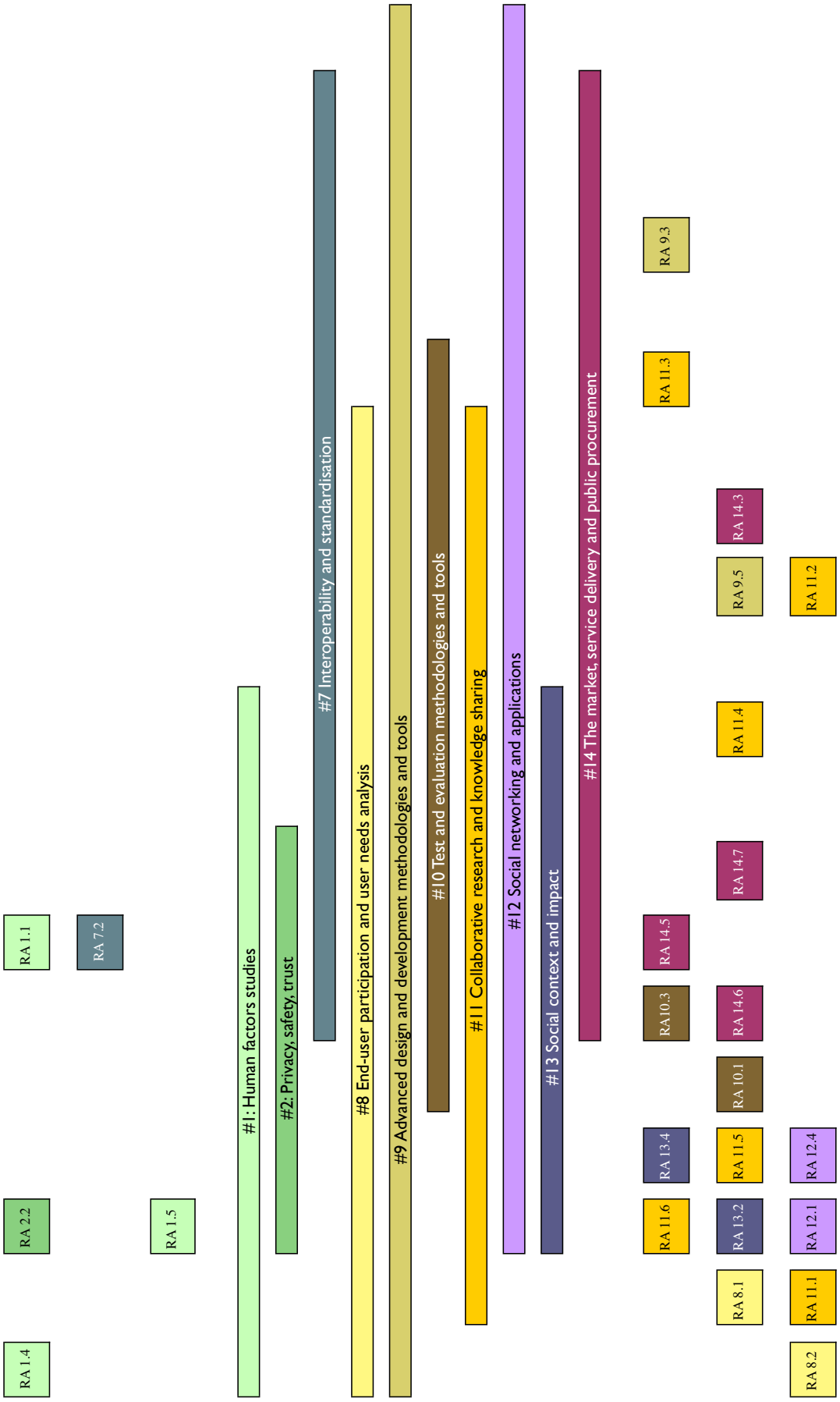


Figure 51: Complementary Research Agenda Roadmap for RL#11 and connected research actions

Table 31: Research actions connected to research line 12

Research line #12	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies				1.4	1.5		
#2 Privacy, safety and trust	2.1	2.2					
#3 Holistic approach to HCI							
#4 User modelling and adaptive user interfaces							
#5 Innovative user interfaces						5.6	
#6 Access to advanced ubiquitous computing env.					6.5		
#7 Interoperability and standardisation			7.3				
#8 End-user participation & user needs analysis	8.1						
#9 Advanced design & development meth.& tools			9.3		9.5		
#10 Test and evaluation methodologies & tools							
#11 Collaborative research knowledge sharing				11.4	11.5		
#12 Social networking and applications	12.1	12.2	12.3	12.4			
#13 Social context and impact		13.2	13.3	13.4			
#14 The market, service delivery & public procure.							14.7

The twenty research actions in the table are:

- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 1.5: Identify impact of cloud platforms
- RA 2.1: Research on the reliability of e-Inclusion services,
- RA 2.2: Systems to enhance the safety and user trust and confidence of locally and remotely provided services
- RA 5.6: Practical adaptive user interfaces
- RA 6.5: Adaptation of the environment to the needs of several persons at the same time
- RA 7.3: Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 9.3: Design and authoring tools supporting and automating e-inclusion
- RA 9.5: Development of training modules about needs of people with disabilities for developers
- RA 11.4: Research on how to structure in an appropriate way all information for e-Inclusion available on the network
- RA 11.5: Research on accessible knowledge infrastructure that includes scientific knowledge
- RA 12.1: Research on the use of social media to reduce isolation
- RA 12.2: Disaster Risk Reduction: participation of persons with disabilities
- RA 12.3: Research on social cooperation models to support people inclusion
- RA 12.4: Research on how people can understand and use the full potential of AmI.
- RA 13.2: Research on the ethical and legal requirements and consequences
- RA 13.3: Research on changing attitudes of different stakeholders towards eInclusion.
- RA 13.4: Research on how to integrate social objectives in ICT
- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services

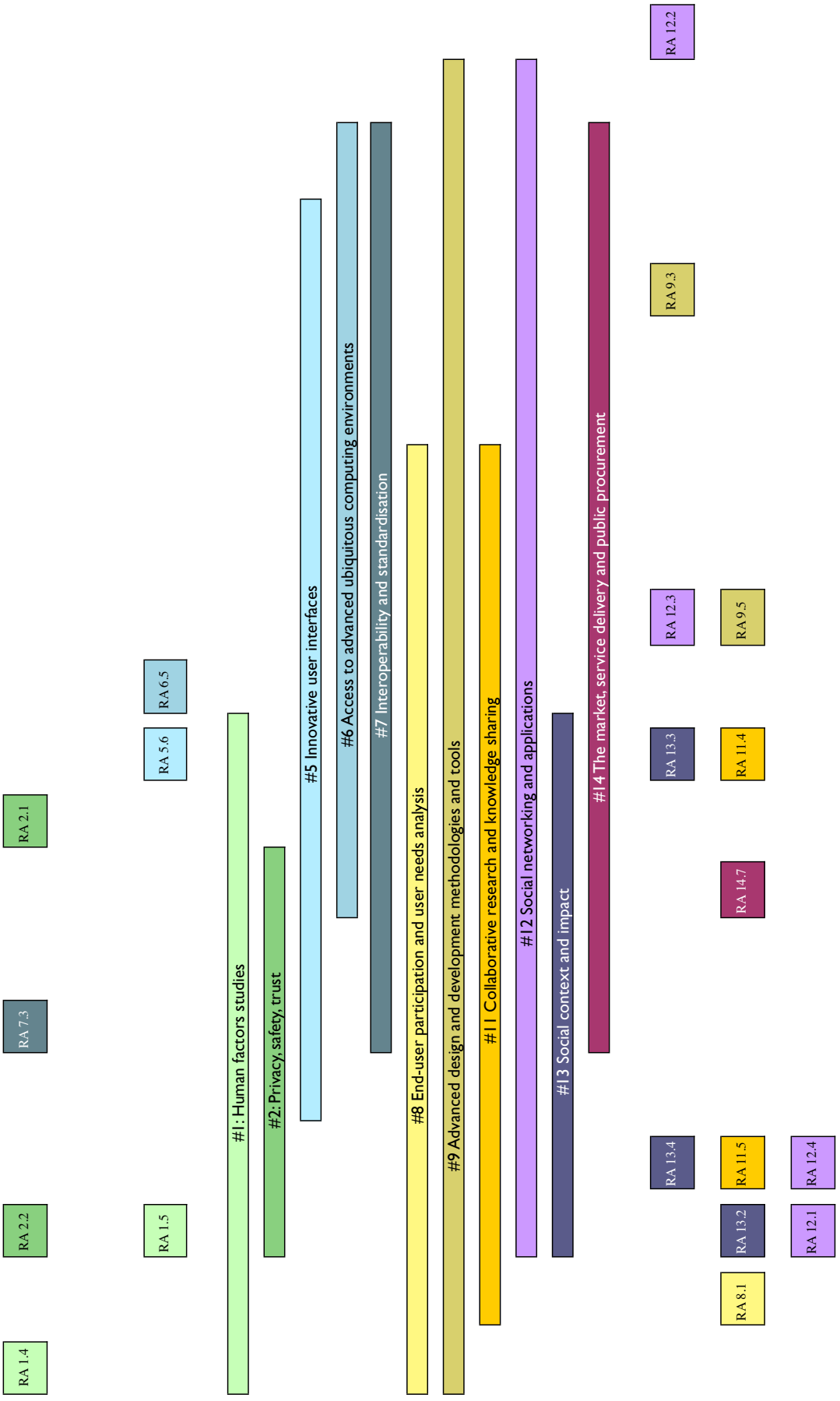


Figure 52: Complementary Research Agenda Roadmap for RL#12 and connected research actions

Table 32: Research actions connected to research line 13

Research line #13	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies				1.4	1.5		
#2 Privacy, safety and trust		2.2					
#3 Holistic approach to HCI							
#4 User modelling and adaptive user interfaces							
#5 Innovative user interfaces							5.8
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation	7.1	7.2					
#8 End-user participation & user needs analysis	8.1	8.2					
#9 Advanced design & development meth.& tools	9.1			9.4	9.5		
#10 Test and evaluation methodologies & tools	10.1		10.3				
#11 Collaborative research knowledge sharing	11.1	11.2	11.3		11.5		
#12 Social networking and applications	12.1	12.2		12.4			
#13 Social context and impact	13.1	13.2	13.3	13.4			
#14 The market, service delivery & public procure.	14.1					14.6	14.7

The twenty-seven research actions in the table are:

- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 1.5: Identify impact of cloud platforms
- RA 2.2: Systems to enhance the safety and user trust and confidence of locally and remotely provided services
- RA 5.8: Means for customization of UI and open interfaces,
- RA 7.1: Open standards for accessible ICT systems based on sound scientific data,
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 8.2: Involvement of end users throughout the design and development process
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 9.4: Tools for decision making in the user-centred design process
- RA 9.5: Development of training modules about needs of people with disabilities for developers
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 11.2: Process involving research, development and technology transfer in Assistive ICT and Accessible ICT
- RA 11.3: Infrastructure for shared knowledge in the field of Assistive ICT and Accessible ICT
- RA 11.5: Research on accessible knowledge infrastructure that includes scientific knowledge
- RA 12.1: Research on the use of social media to reduce isolation
- RA 12.2: Disaster Risk Reduction: participation of persons with disabilities
- RA 12.4: Research on how people can understand and use the full potential of AmI
- RA 13.1: Knowledge of the potential and the social effects of ICT to support an inclusive life
- RA 13.2: Research on the ethical and legal requirements and consequences
- RA 13.3: Research on changing attitudes of different stakeholders towards eInclusion.

- RA 13.4: Research on how to integrate social objectives in ICT
- RA 14.1: Analysis of market potential of accessible ICT
- RA 14.6: Analysis of models and processes of Service Delivery and procurement
- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services

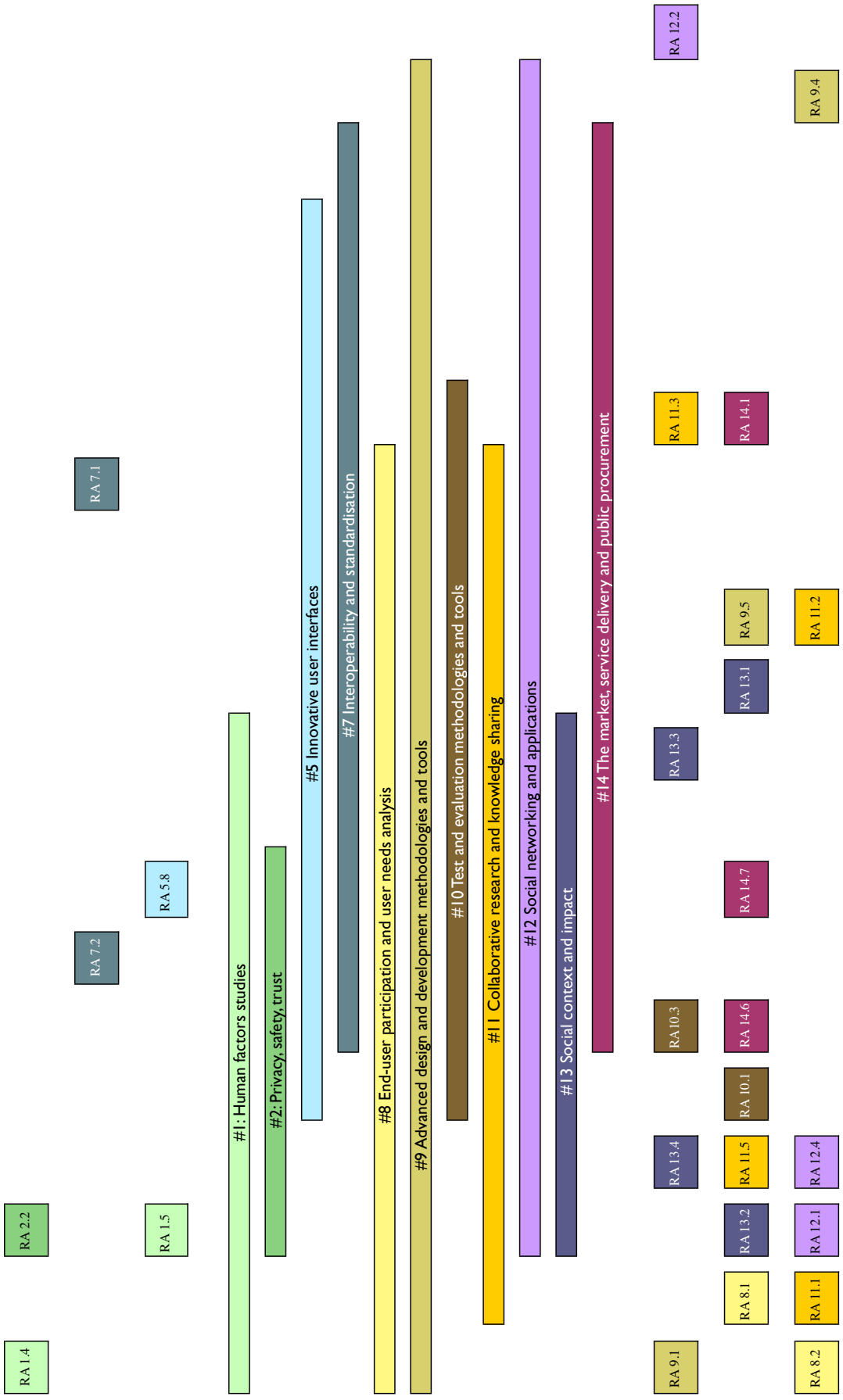


Figure 53: Complementary Research Agenda Roadmap for RL#13 and connected research actions

Table 33: Research actions connected to research line 14

Research line #14	RA	RA	RA	RA	RA	RA	RA
#1 Human factor studies	1.1			1.4			
#2 Privacy, safety and trust							
#3 Holistic approach to HCI			3.3				
#4 User modelling and adaptive user interfaces				4.4			
#5 Innovative user interfaces							
#6 Access to advanced ubiquitous computing env.							
#7 Interoperability and standardisation		7.2	7.3				
#8 End-user participation & user needs analysis	8.1	8.2					
#9 Advanced design & development meth.& tools	9.1			9.4			
#10 Test and evaluation methodologies & tools	10.1		10.3				
#11 Collaborative research knowledge sharing	11.1	11.2	11.3	11.4			
#12 Social networking and applications				12.4			
#13 Social context and impact	13.1						
#14 The market, service delivery & public procure.	14,1	14.2	14.3	14.4	14.5	14.6	14.7

The twenty-five research actions in the table are:

- RA 1.1: Basic research on Assistive Technology abandonment/adoption
- RA 1.4: Explore how users interact and cooperate with intelligent systems
- RA 3.3: Reduce the complexity of user interaction whilst retaining functionality
- RA 4.4: Use reasoning techniques for personalisation
- RA 7.2: Technical interfaces between mainstream ICT products and Assistive Technology products
- RA 7.3: Interoperability of devices, networks and services to enhance accessibility to ubiquitous computing environments
- RA 8.1: Analyse end-user needs and personal barriers with respect to ICT
- RA 8.2: Involvement of end users throughout the design and development process
- RA 9.1: Methodologies and tools for the development of accessible and assistive ICT
- RA 9.4: Tools for decision making in the user-centred design process
- RA 10.1: Methods, tools, and environments for testing ICT accessibility, including monitoring and benchmarking
- RA 10.3: Procedures, tools and environments for usability evaluation of Assistive ICT
- RA 11.1: Methodologies for collaborative research in the field of Assistive ICT and Accessible ICT
- RA 11.2: Process involving research, development and technology transfer in Assistive ICT and Accessible ICT
- RA 11.3: Infrastructure for shared knowledge in the field of Assistive ICT and Accessible ICT
- RA 11.4: Research on how to structure in an appropriate way all information for e-Inclusion available on the network
- RA 12.4: Research on how people can understand and use the full potential of AmI
- RA 13.1: Knowledge of the potential and the social effects of ICT to support an inclusive life
- RA 14.1: Analysis of market potential of accessible ICT
- RA 14.2: Analysis of market potential of assistive ICT
- RA 14.3: Business benefits and business models for eInclusion
- RA 14.4: Research on the marketing and branding for facilitating the use of eInclusion.
- RA 14.5: Analyse supply chain and usage of existing Assistive and Accessible ICT inclusive failures from the users' point of view
- RA 14.6: Analysis of models and processes of Service Delivery and procurement

- RA 14.7: How to support and train people with disabilities to effectively demand, customize and use Accessible and Assistive ICT products and services

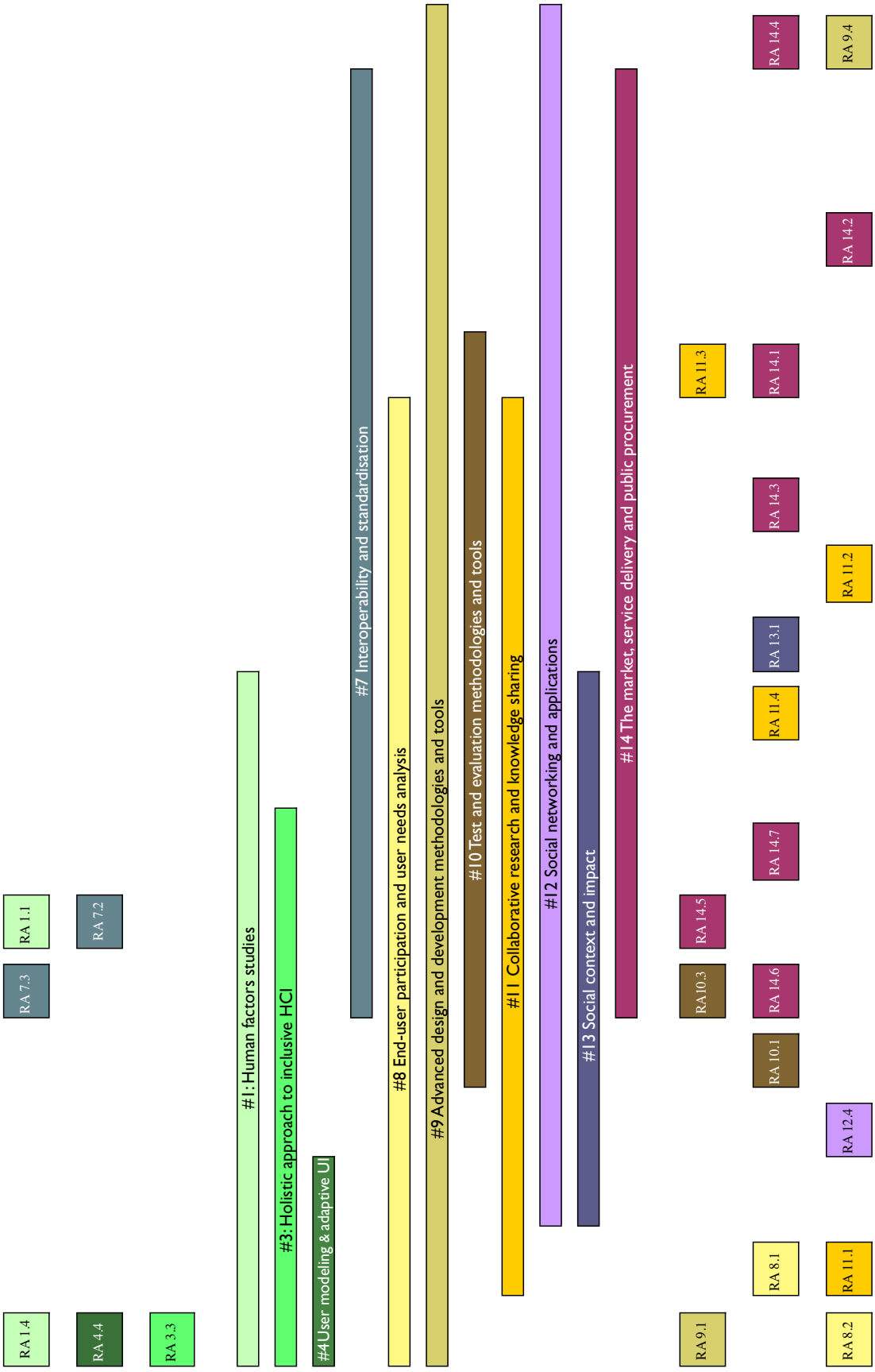


Figure 54: Complementary Research Agenda Roadmap for RL#14 and connected research actions