

Developing User-centric AAL Systems

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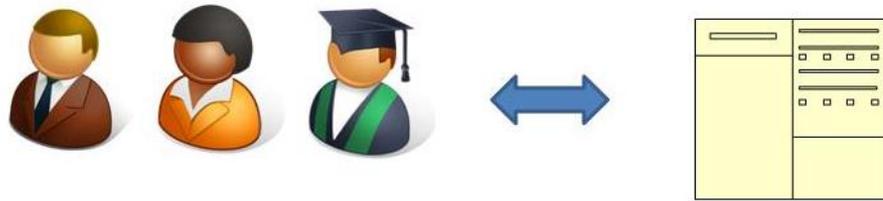


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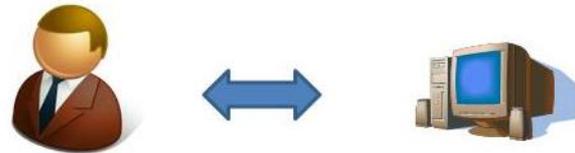
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We are immersed in another historical shift within CS...



Many users to
one (big) computer

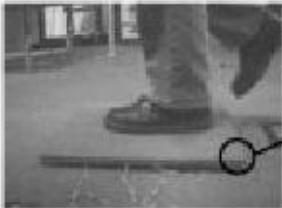
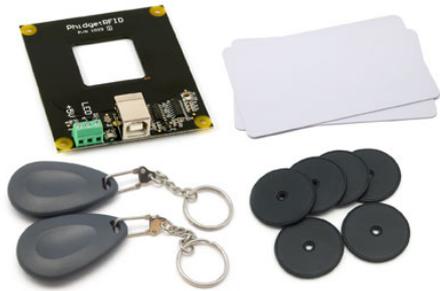


One user to One PC



One user to
many computing devices!

Availability of Sensors



Sensors at the core of applications in ...

- Cars and transportation network
- Manufacturing and plant automation
- Entertainment (new interactive toys and gaming)
- Domotics and smart homes
- Medicine
- New trends on wellbeing and fitness
- ...

Immersion of CS in society...

“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.”

Mark Weiser in “The Computer for the Twenty-First Century”
(Scientific American, 1991, pp. 66–75)

(July 23, 1952 – April 27, 1999)



Related Concepts

- ***Ubiquitous Computing***
- ***Pervasive Computing***
- ***Internet of Things***
- ***Ambient Intelligence***
- ***Intelligent Environments***
- ***Ambient Assisted Living***

Related Concepts (cted.)

“*Ambient Intelligence* is a digital environment that **proactively**, but **sensibly**, supports people in their daily lives”

Note: Each user has their own notion of what is “sensibly”...!

[1] J. Augusto, Ambient intelligence: The confluence of pervasive computing and artificial intelligence, in: A. Schuster (Ed.), *Intelligent Computing Everywhere*, Springer, 2007, pp. 213-234.

Ambient Assisted Living as a concept aims to extend the time people can live in a decent way in their own home by increasing their autonomy and self-confidence, the discharge of monotonously everyday activities, to monitor and care for the elderly or ill person, to enhance the security and to save resources. [2]

[2] European Commission – Ambient Assisted Living Joint Programme

Intelligent Environments Manifesto

Based on nine principles [3]:

- P1) to be intelligent to recognize a situation where it can help.*
- P2) to be sensible to recognize when it is allowed to offer help.*
- P3) to deliver help according to the needs and preferences of those which is helping.*
- P4) to achieve its goals without demanding from the user/s technical knowledge to benefit from its help.*
- P5) to preserve privacy of the user/s.*
- P6) to prioritize safety of the user/s at all times.*
- P7) to have autonomous behaviour.*
- P8) to be able to operate without forcing changes on the look and feel of the environment or on the normal routines of the environment inhabitants.*
- P9) to adhere to the principle that the user is in command and the computer obeys, and not viceversa.*

Current problems in State of the art Systems

- Accurate context-awareness
- Balancing preferences and needs
- ‘Mindreading’
- Coping with multiple occupancy
- Not enough human-centric design
- Deploying reliable systems
- Ensuring ethics and privacy

So far...



New and more specific methods and tools are needed to develop appropriate AAL systems.

Some of the work we have been doing in our Research Group...

New and more specific methods and tools are needed to develop appropriate AAL systems.

- **User-Centric Software Development Process [4]**
- Requirements for Context-Aware Systems
- Ethics embedded in the engineering of these systems

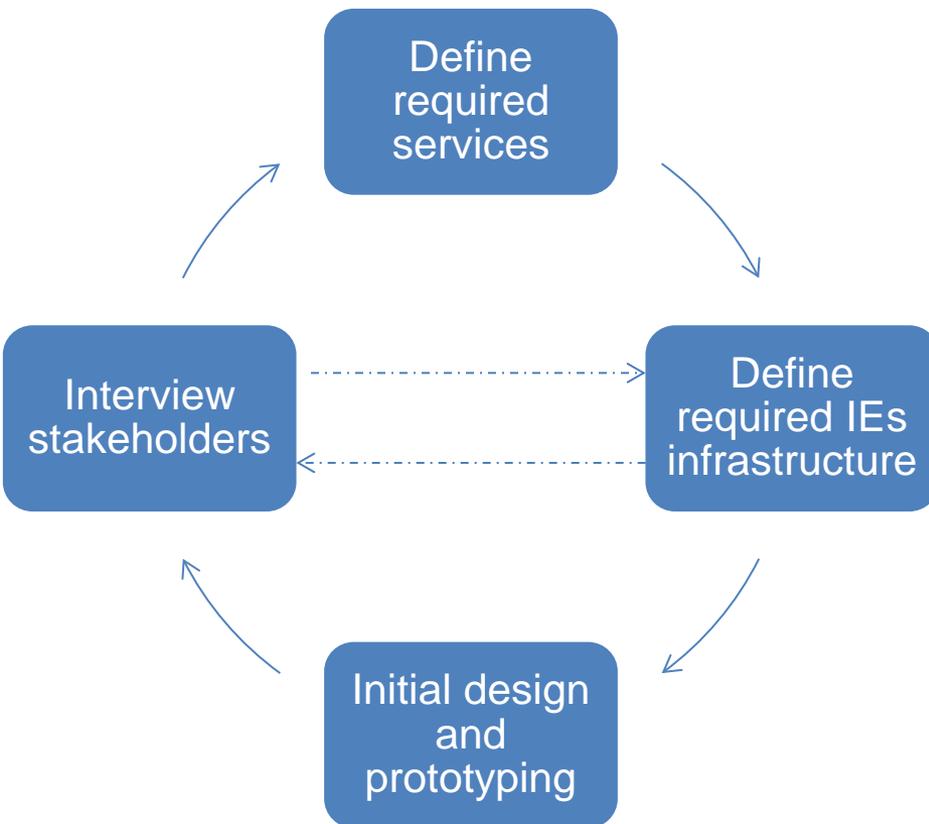
[4] A User-Centric Software Development Process. Juan Carlos Augusto. In Proceedings The 10th International Conference on Intelligent Environments (IE'14), pp. 252-255. Shanghai, 29th of June to 4th of July, 2014. IEEE Press.

- Established Software Development Processes can be roughly split into plan-driven (i.e., Waterfall) or agile (i.e., SCRUM). A common feature is that their focus is more on the deliverables and productivity...
- Our community sees AAL systems as user-centric
- The focus should then be on: *How to make final users happier with what the services they are given?*

Stakeholders should be in control

- Some projects claim to involve stakeholders, actually this does not happen in practice
- Teams often have a product and then try to create an excuse to sell it ('product push' vs 'market pull'), we increase stakeholders role and decision power.

Initial Scoping Cycle



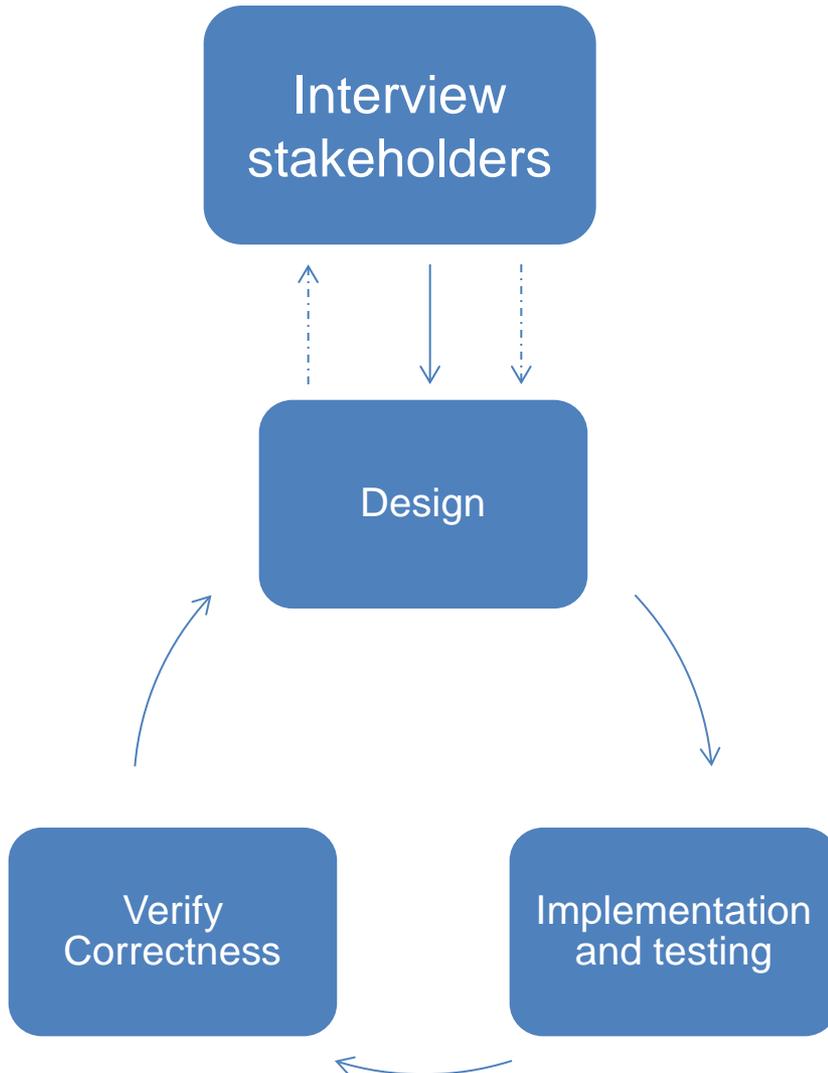
Stakeholders can continuously monitor and influence the development.

Technical teams translate the information gathered from stakeholders into services.

Technical teams propose infrastructure and check acceptability with stakeholders.

Results of this stage shown and explained to stakeholders. They can trigger another scoping iteration.

Main Development Cycle



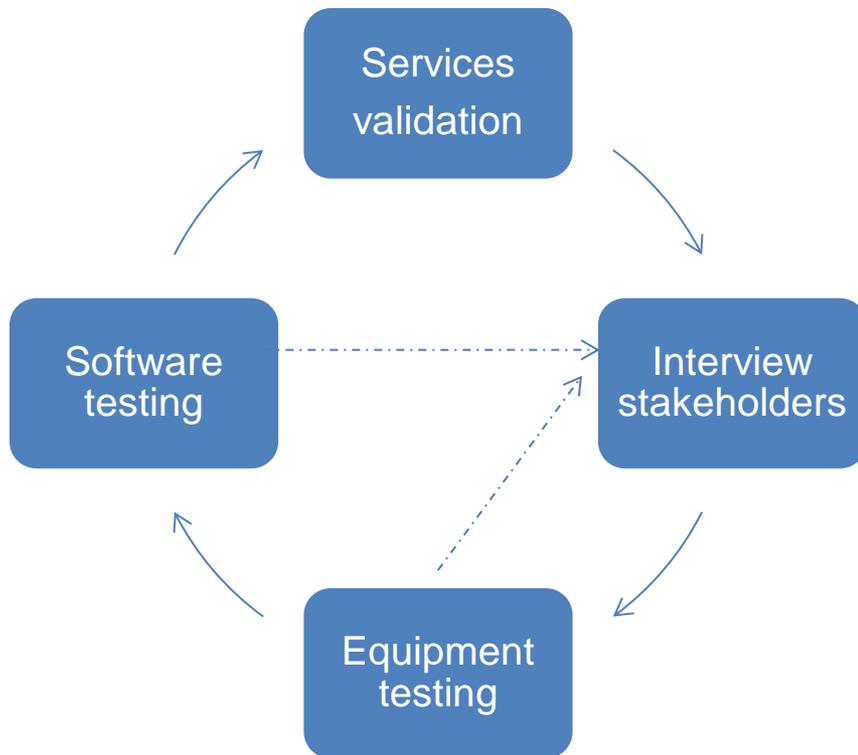
A more detailed design analysis through an iterative interaction with stakeholders.

Testing should consider all elements: software, hardware and human-computer interfaces...

Verify correctness more formally as a complement to testing.

Stakeholders should be also involved on testing and approving the final functionality of the system they will experience.

IE Installation Cycle



Users can check if the infrastructure deployed is acceptable for them (location, maintenance required, and other practical aspects of its presence).

Stakeholders experiencing the system for significant periods of time.

Stakeholders feedback goes to the development team to potentially trigger a revision.

Some of the work we have been doing in our Research Group...

New and more specific methods and tools are needed to develop appropriate AAL systems

- User-Centric Software Development Process
- **Requirements for Context-Aware Systems [5]**
- Ethics embedded in the engineering of these systems

[5] Requirements Engineering for Intelligent Environments. Carl Evans, Lindsey Brodie, Juan Carlos Augusto. In Proceedings The 10th International Conference on Intelligent Environments (IE'14), pp. 154-161. Shanghai, 29th of June to 4th of July, 2014. IEEE Press.

Requirements Engineering for Context-Awareness

- Context-awareness provide the core of IEs and it is important to have specialized processes and tools to properly identify and track requirements.
- A typical approach:
 - define features of context-awareness specific to the domain
 - create taxonomy of context-awareness (e.g., Dey et al. considers computing, user and physical contexts).
 - create services for contexts of the taxonomy above

Some Reflections

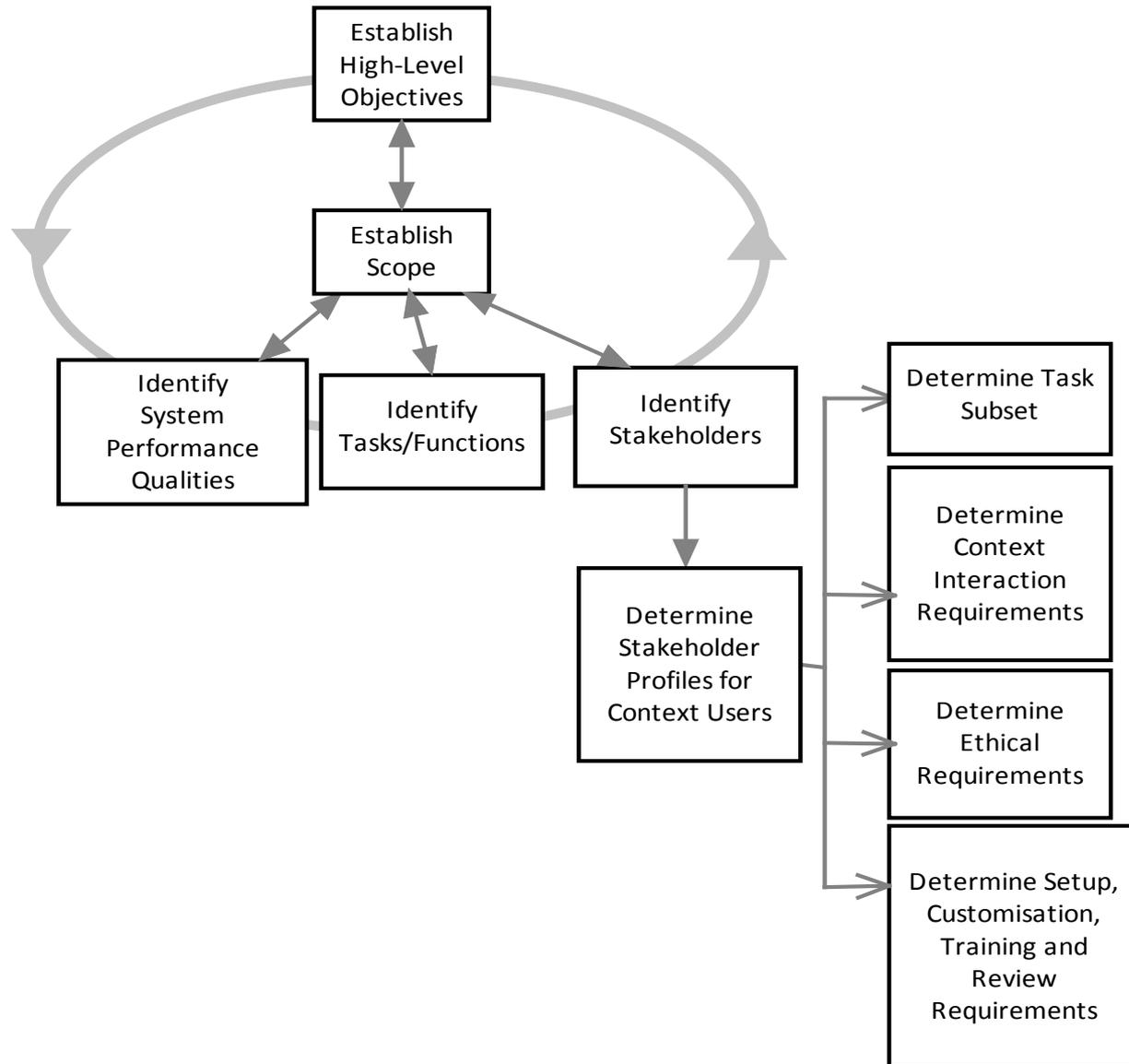
Common characteristics in all the approaches:

- Involve the end-user and adapt elicitation to them
- Explicit representation of the context and goals of the user
- Formalization of which requirements are relevant for a given context and the evolution of context-requirements

Within AAL Specifically:

- Contexts more depending on associated prioritisations.
- Demarcation between individual and other user groups.
- Ethical issues more prominent (e.g., privacy in relation to contexts)

Core Activities in R4IE (AAL)



Activity	Summary
Establish High Level Objectives	Specifically the main objectives of the project so that all parties understand the aim(s) and main goals.
Establish Scope	Establish system scope especially in terms of the boundaries of the project (i.e., what is inside the system and what is immediately external to the system).
Identify Stakeholders	All the parties with an interest in the system. Their requirements will be gathered using user interviews, observational techniques, focus group workshops and questionnaires.
Identify Tasks/Functionality	Depending on the nature of the target system, this might be initiated with the secondary and tertiary user groups. The use of scenario-based methods will be central to this activity.
Identify System Performance Qualities	Establish system performance qualities with quantified targets
Determine Stakeholder Profiles	Specifically those profiles which involve context-awareness. Sub-activities: <ul style="list-style-type: none"> a. Determine task subset and the tasks' goals b. Determine context interaction requirements c. Determine ethical requirements d. Determine setup, customisation, training, system monitoring, and review requirements
Outline operational support	Determine technical support requirements for all aspects of the operational workload: delivery/setup, customisation training, system monitoring, review and potential upgrade requirements
Harmonisation	Involves managing the overall requirements process and requirements specifications (including future review), particularly with reference to a multi-disciplinary team that may or may not be distributed across different centres.

Some of the work we have been doing in our Research Group...

New and more specific methods and tools are needed to develop appropriate AAL systems

- User-Centric Software Development Process
- Requirements for Context-Aware Systems
- **Ethics embedded in the engineering of these systems [6]**

[6] eFRIEND: an Ethical Framework for Intelligent Environment Development. Simon Jones, Sukhvinder Hara, Juan Carlos Augusto. Accepted in **Ethics and Information Technology** by Springer.
DOI: 10.1007/s10676-014-9358-1

- Started with a survey on ethical issues in Intelligent Environments literature
- Main issues:
 - Disjoint coverage of areas
 - Focus on the ‘philosophical debate’ ...
...whilst we want something practical with an impact in the final product!



Key Issues and Principles discussed in the literature

- **Privacy**—sensitive personal data [quantity & quality]
- **Data Protection**—principles and practices
- **Security**—safety, reliability
- **Transparency**—invisibility of embedded, pervasive, background systems [processes, decisions, rules]
- **Autonomy**—human agency, control, freedom to choose
- **Equality of Access**—affordability, social inclusiveness
- **Dignity**—replacing/substituting human care, social isolation, ‘medicalisation’ of the home?

Existing Frameworks

	Privacy	Data protection	Security	Transparency	Autonomy	Equality	Dignity	Non-harm	Beneficence
Brown and Adams (2007)	✓					✓			
Callaghan et al (2009, 2011)				✓	✓				
Coeckelbergh (2010)	✓								✓
Ikonen et al (2009, 2013)	✓		✓		✓	✓	✓	✓	✓
Magnusson and Hanson (2003)					✓				✓
Nixon et al (2004)	✓	✓	✓	✓	✓				
Perry et al (2009)	✓				✓		✓	✓	✓
Schulke et al (2010)					✓	✓		✓	✓
van Hoof et al (2007)		✓	✓		✓		✓		

An Alternative Framework

In our framework we aim at emphasizing:

- Non-Maleficence and Beneficence
- User-Centred
- Multiple Users
- Privacy (how much the system can know)
- Data Protection (how much can be shared with others)
- Security
- Independence/Autonomy of the user
- Transparency
- Equality, Dignity and Inclusiveness

Influencing the final product

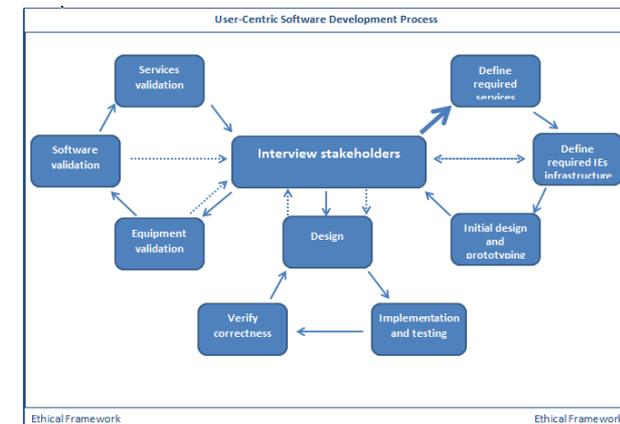
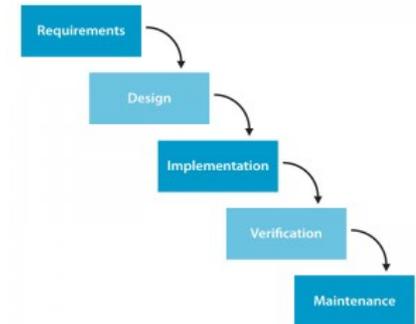
Requirements: Gather stakeholder views and feedback on ethical principles, make sure they are all represented within the requirements.

Design: Embed capacity to deal with ethical principles in conception of the system. Make sure users understand how the ethical principles are going to be realized.

Implementation: Ethical principles are implemented as services/agents within the system. Produce system code.

Verification and Validation: Embed ethical principles through tests and/or formal methods. Involve stakeholders in validating the system by checking that it provides satisfactory behaviour consistent with all key eFRIEND principles.

Maintenance: Identify how to deal with evolving stakeholder views and the ethical principles. Accommodate user ability to influence adaptation to optimize user satisfaction over time.



POSEIDON

PersOnalized Smart
Environments to increase
Inclusion of people with
Down's syNdrome

Objective ICT-2013.5.3 ICT for smart and personalised inclusion



POSEiDON

About the project

- Most people with Down's Syndrome experience low integration with society.
- A perception that they can achieve less than what they really can.
- The POSEIDON project aims at developing technology to support people with Down's Syndrome in their daily routines.

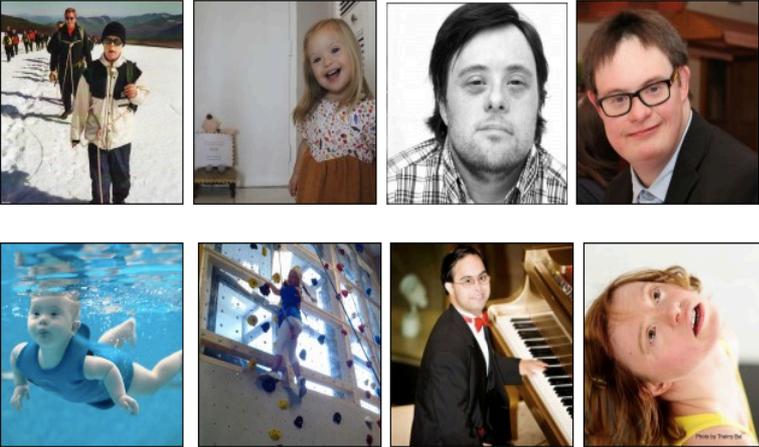


POSEiDON Home About the project Technology Work Packages Partners Publications Contact

POSEIDON – PersOnalized Smart Environments to increase Inclusion of people with DOWn's syNdrome

Many people with Down's Syndrome have abilities that they can contribute with in our society.
Here are some examples of talented people with Down's Syndrome.
In all age groups. From all over the world.

Click on the image to see more about each person and his/her achievements.

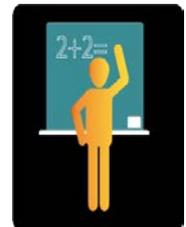


[View more success stories](#)

[View inspiring YouTube videos](#)

<http://www.poseidon-project.org>

Target areas of support



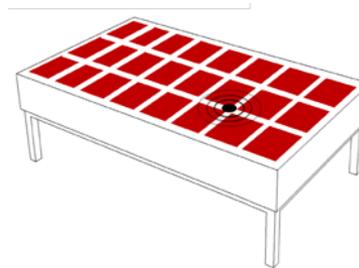
Virtual Reality



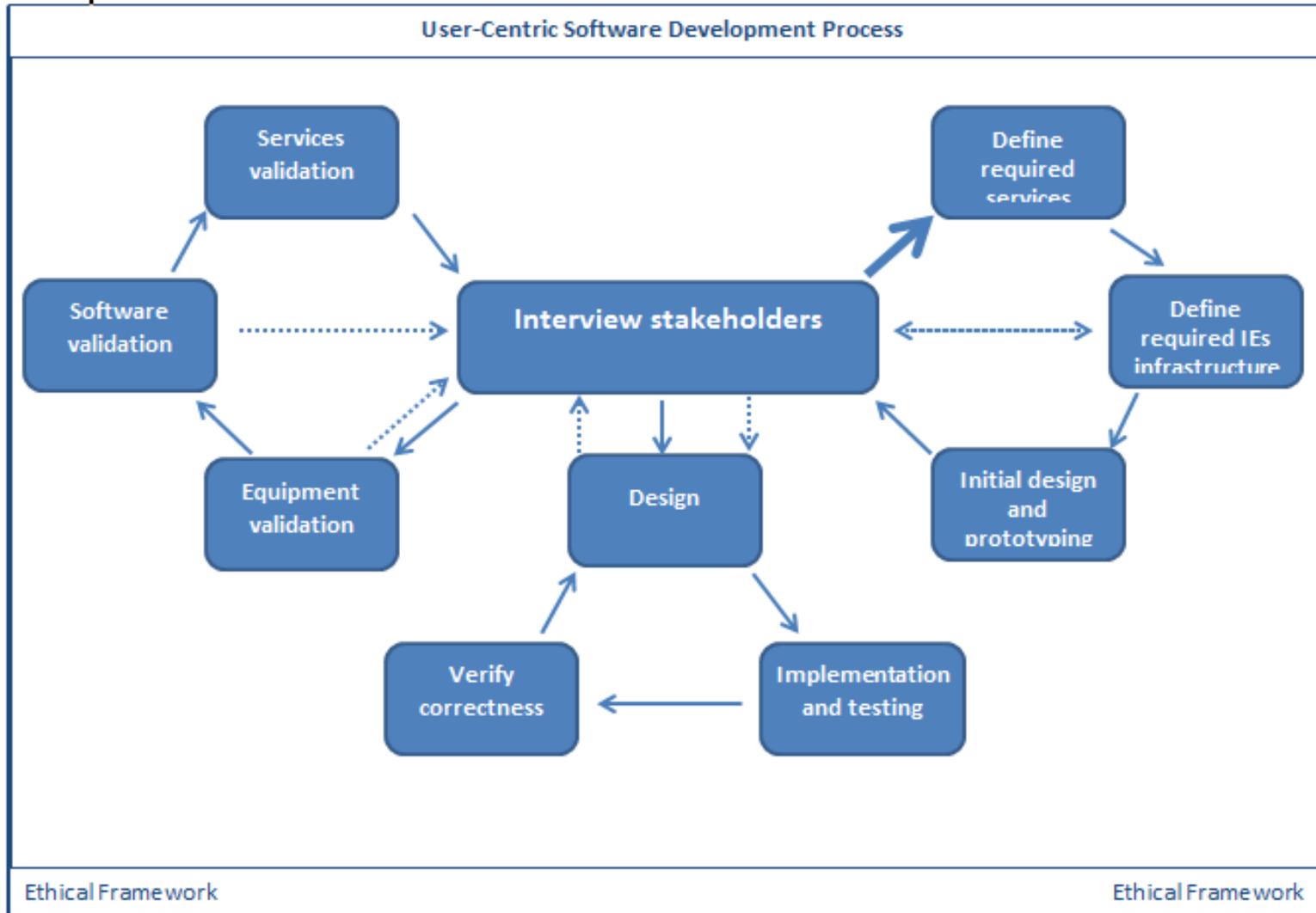
Interactive table



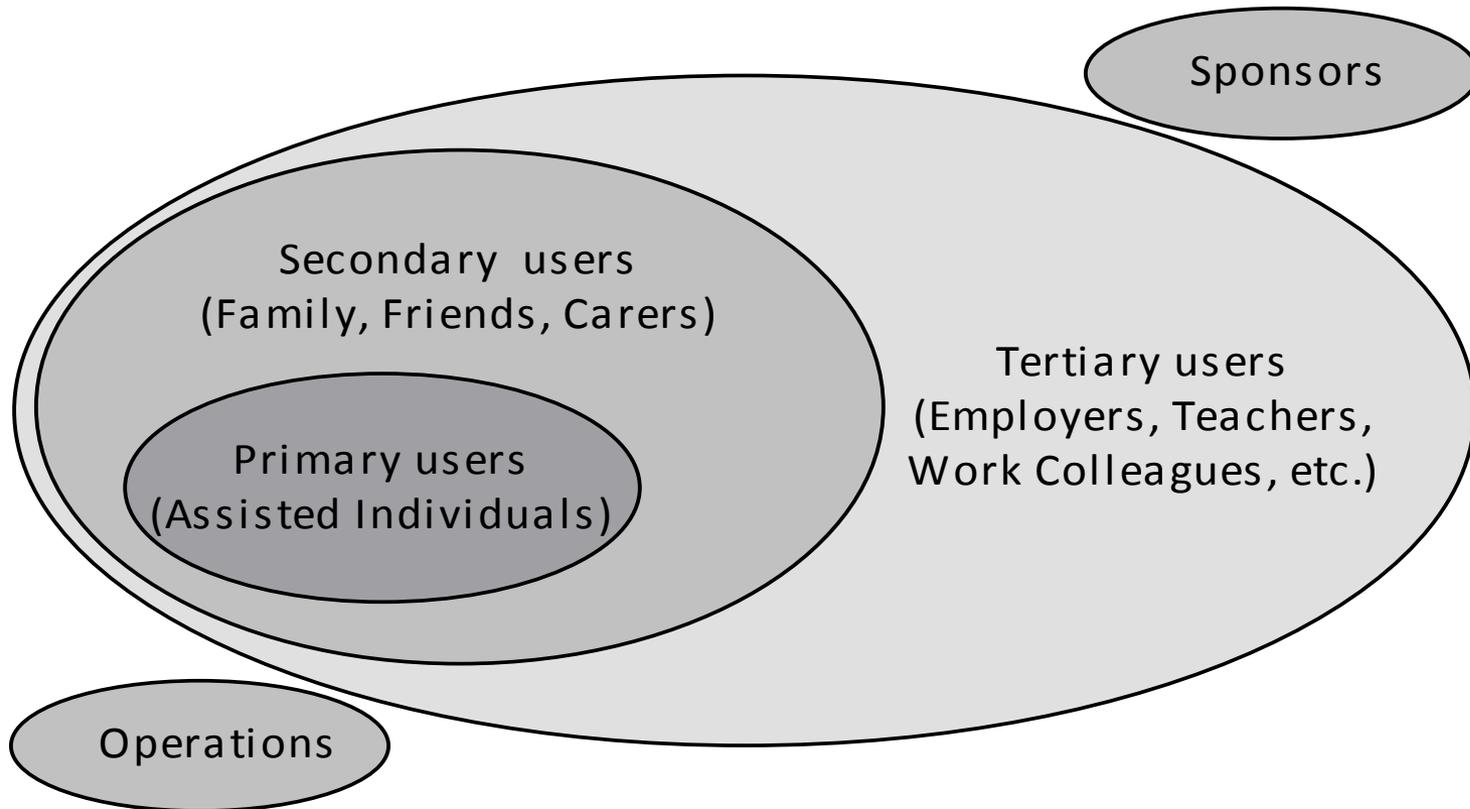
PC, Tablets, Smartphones



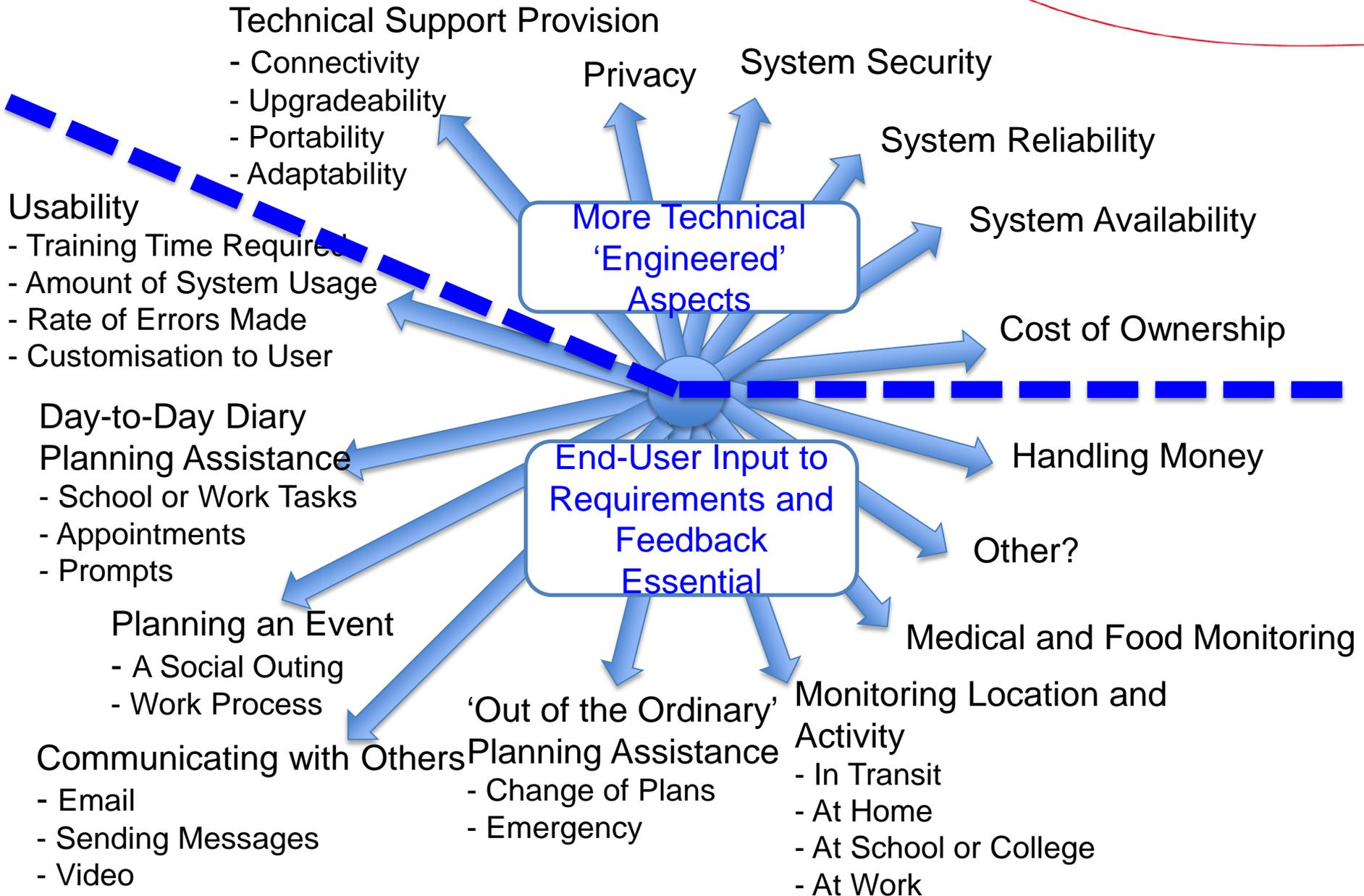
POSEiDON is being developed using U-C SDP



R4IE (AAL) for Requirements elicitation in POSEiDON



POSEIDON - System Requirements





POSEIDON

is eFRIEND compatible

Non-maleficence / Beneficence	✓
User-centricity	✓
Multi-user/stakeholder	✓
Privacy	✓
Data Protection	✓
Transparency	✓
Autonomy	✓
Safety, Security, Reliability	✓
Equality of Access, Dignity, Inclusiveness	✓

In total 47 requirements related to this features...

Conclusions

Limitations in current systems:

- Accurate context-awareness
- Balancing preferences and needs
- ‘Mindreading’
- Coping with multiple occupancy
- Not enough human-centric design
- Deploying reliable systems
- Ensuring ethics and privacy

Conclusions (cted.)

- **User-centric SDP**: good to increase user satisfaction
 - It requires higher stakeholders availability.
- **R4IE**: more focused on securing context-awareness features
 - It requires the creation of more dedicated support for requirements elicitation and tracking.
- **eFRIEND**: a framework with a practical aim which
 - It requires careful protection (!) during the full project.
- Currently...
 - testing how they cope with IEs in different domains, and
 - how to support them with intuitive tools.

